UI Navigation

Mike Nakhimovich

Dispatching State

Mike Nakhimovich

Apps have a UI

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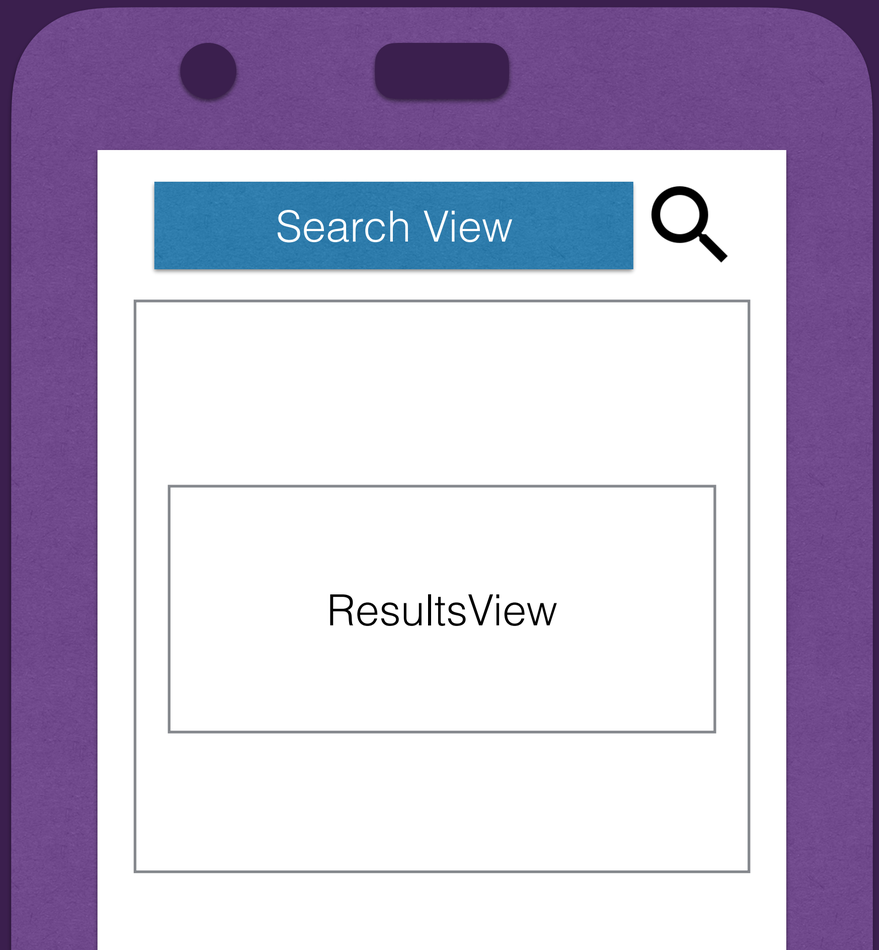
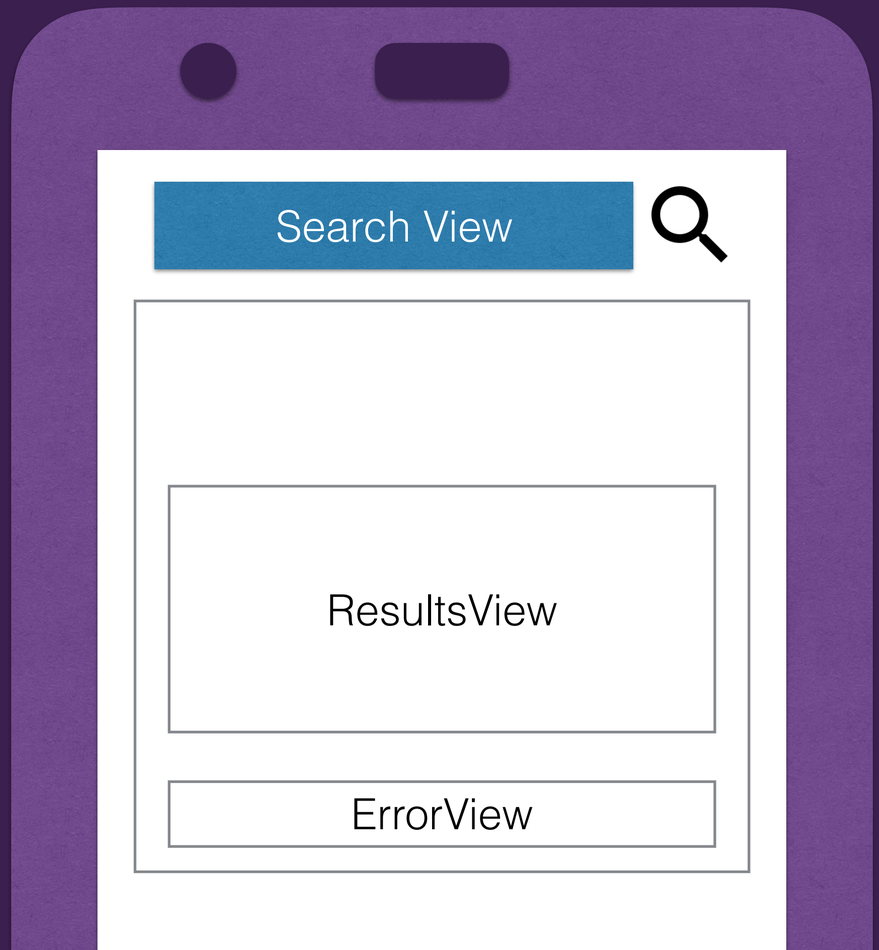


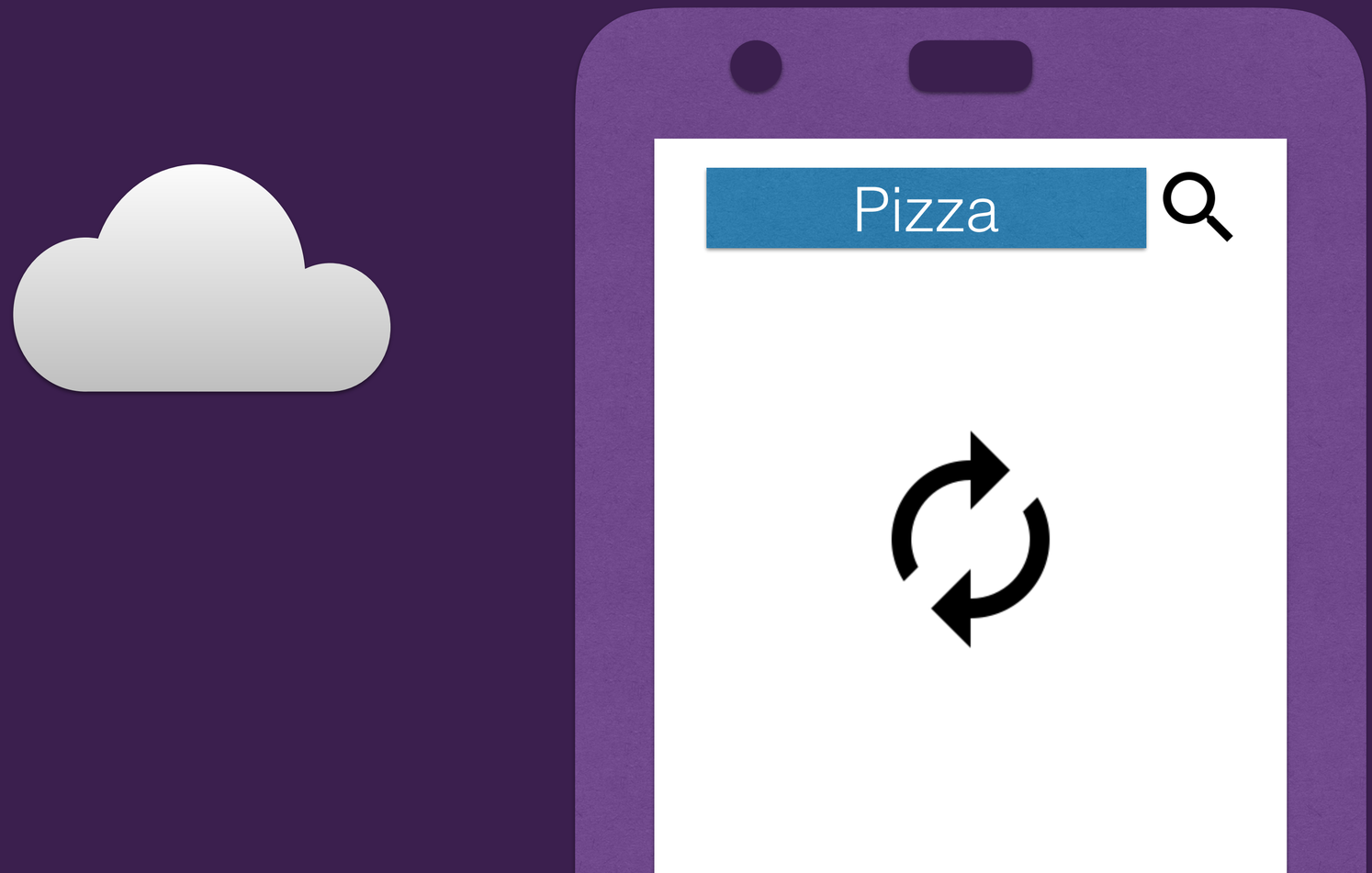
Apps have a UI



Apps have a UI

Users interact with the UI

Interactions lead to State change



Interactions lead to State change

State change need to be rendered

What is state?

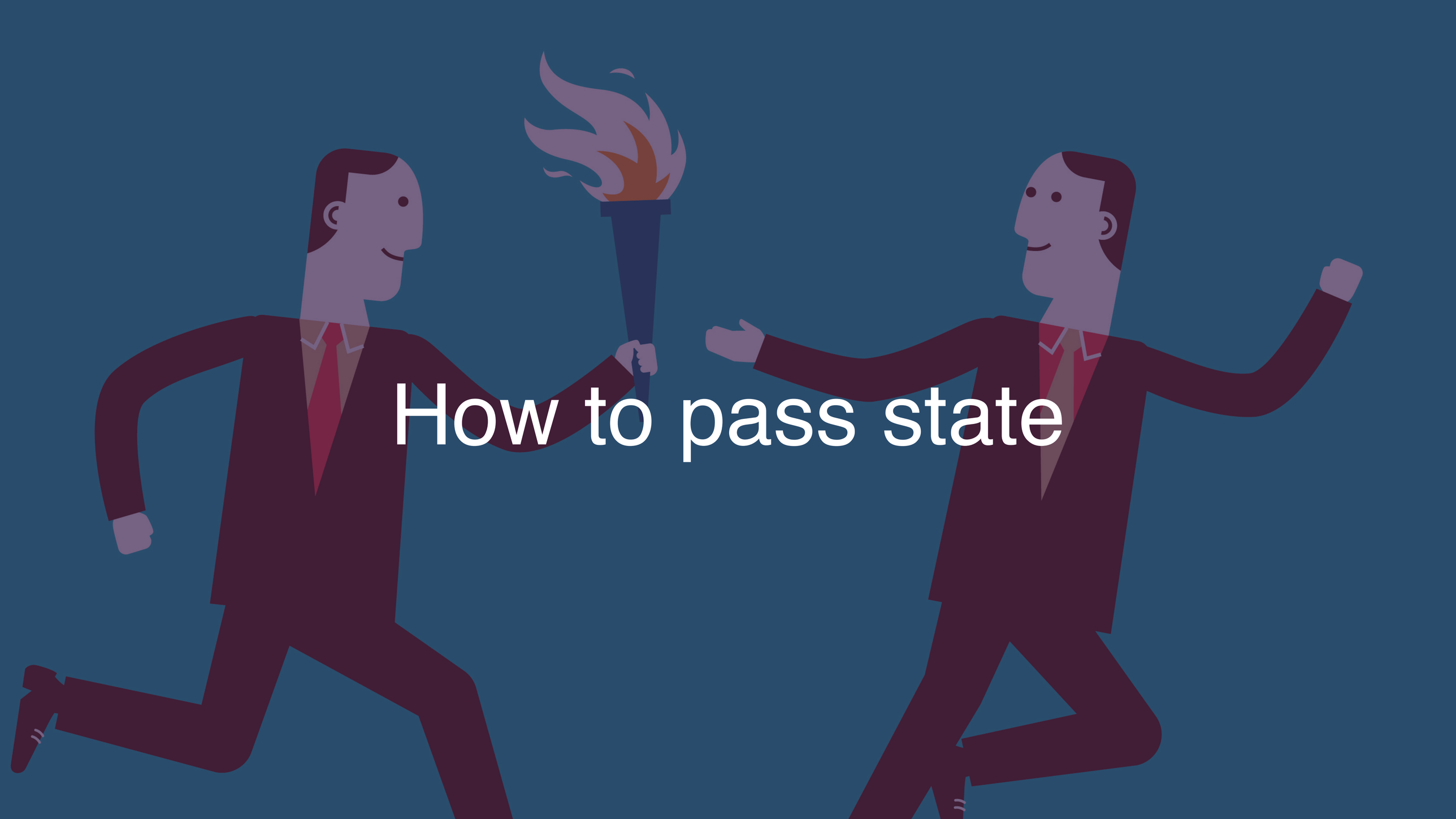
What is state?

A representation of UI
at a certain point in time

State determines how the UI renders & behaves

Android lacks patterns for working with state & views


How to create state


How to pass state

How to hold state


How do we think about state?

Example: state modeled as a single data class

```
data class ScreenState(
val searchResults:List<Results>,
val searchTerm:String,
val isLoading:Boolean)
```

Example: state modeled as a single growing data class

```
data class ScreenState(
val searchResults:List<Results>,
val searchTerm:String,
val isLoading:Boolean,
val CartItems:List<Items>,
val userId:Long
```

State modeled as a God class

```
data class ScreenState(
val searchResults:List<Results>,
val searchTerm:String,
val isLoading:Boolean,
val CartItems:List<Items>,
val userId:Long
```


Android devs love being reactive,
why not represent state as a stream?

Lately, I’ve been using a centralized dispatcher to model state as a reactive stream

What’s a dispatcher?

A dispatcher is an object that receives and sends messages about state

A dispatcher is an object that receives and sends messages about state

that the UI reacts to

Why a state dispatcher?

Why a state dispatcher?

Decouple producers of state change from its consumers


Journey to dispatcher

User types a search term

User clicks search

Loading should become visible

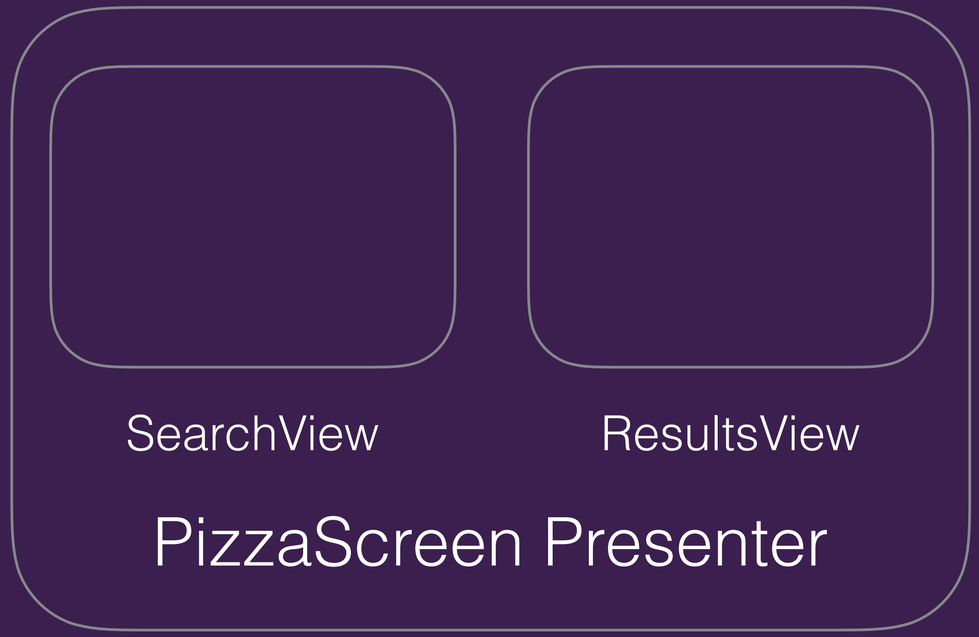
Followed by results

How do we tell views what to display?

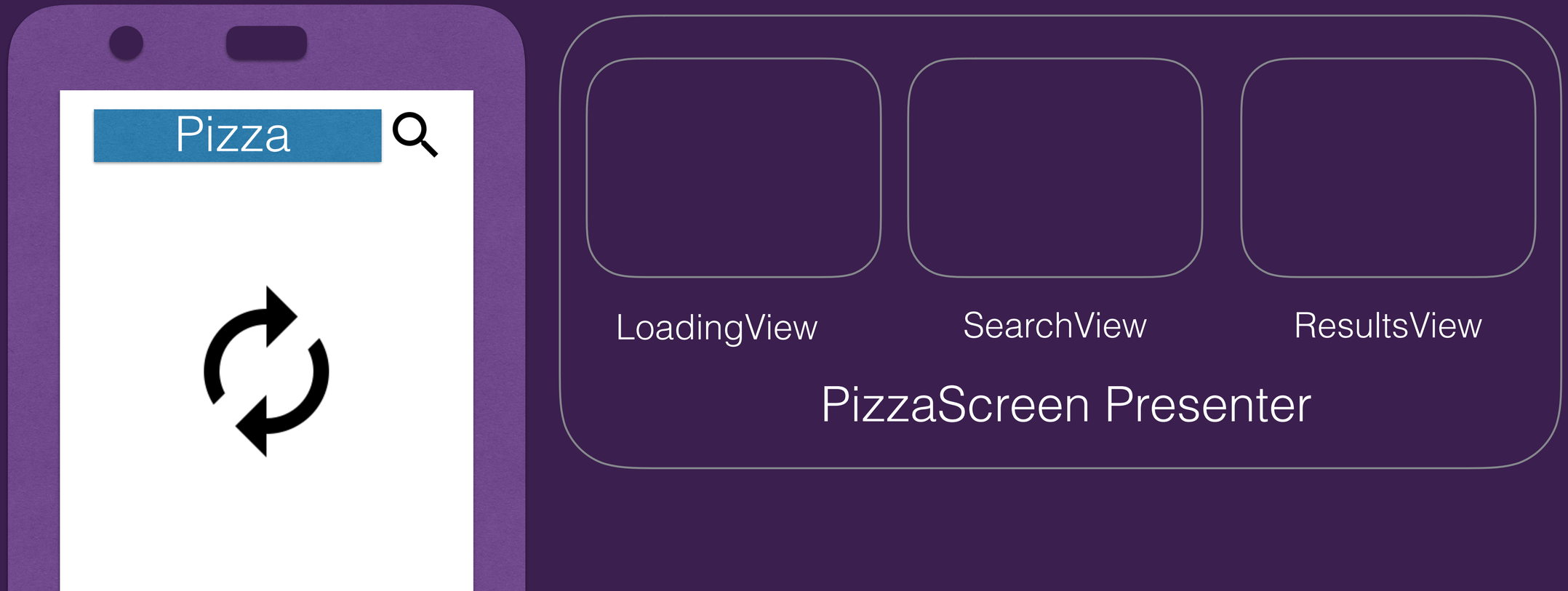
Proposal 1: Encapsulate Screen in a ScreenPresenter

How do we tell ResultsViews what to display?

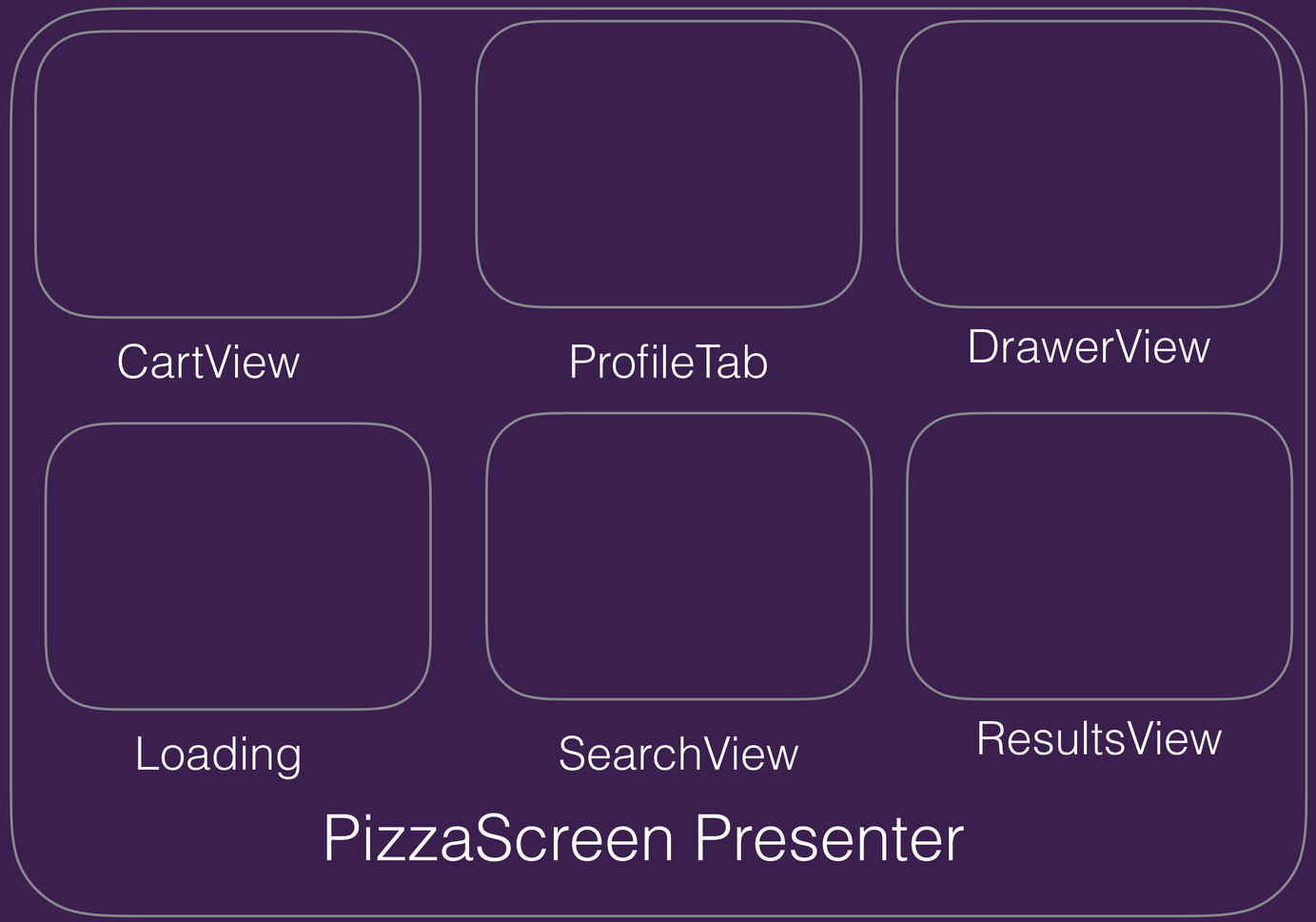
Proposal 1: Encapsulate Screen in a ScreenPresenter



But then… Product adds another view



And then… Product adds 3 more views



How do we tell ResultsView what to display?

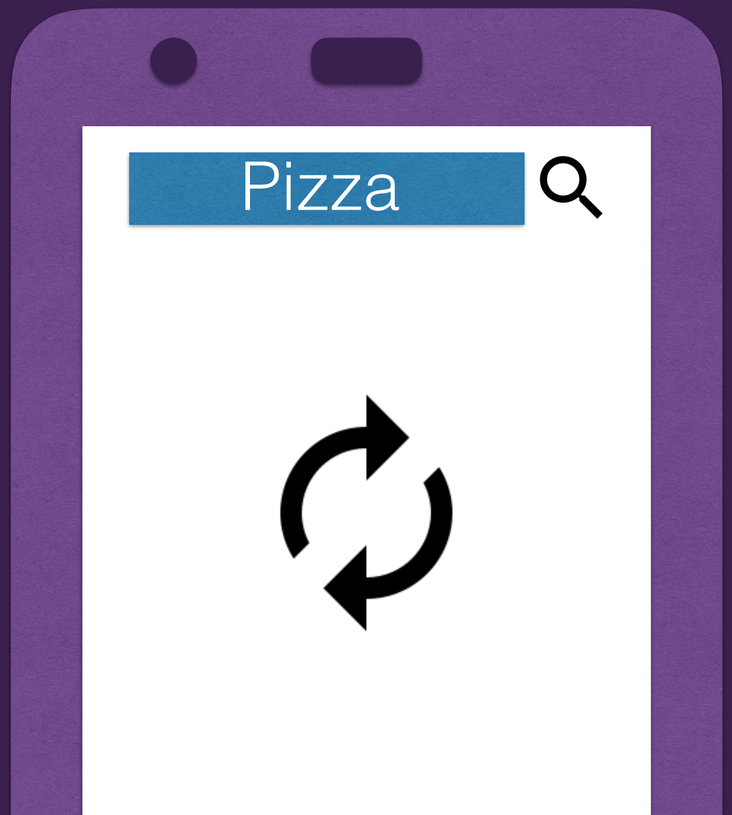
~~Proposal 1: Create a ScreenPresenter which contains both Presenters~~

Not very scalable

How do we tell ResultsView what to display?

Proposal 2: Create a Listener

Proposal 2: Create a Listener

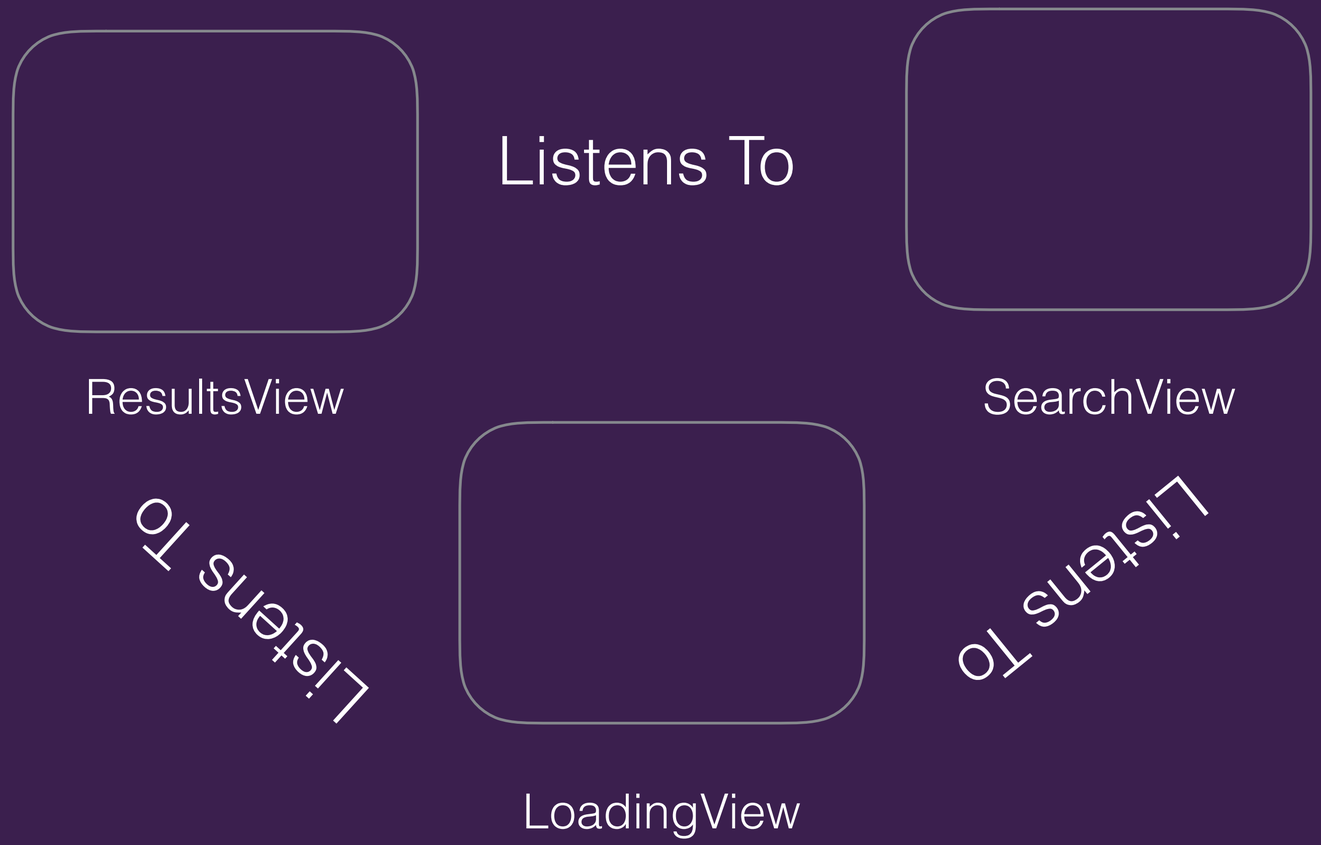


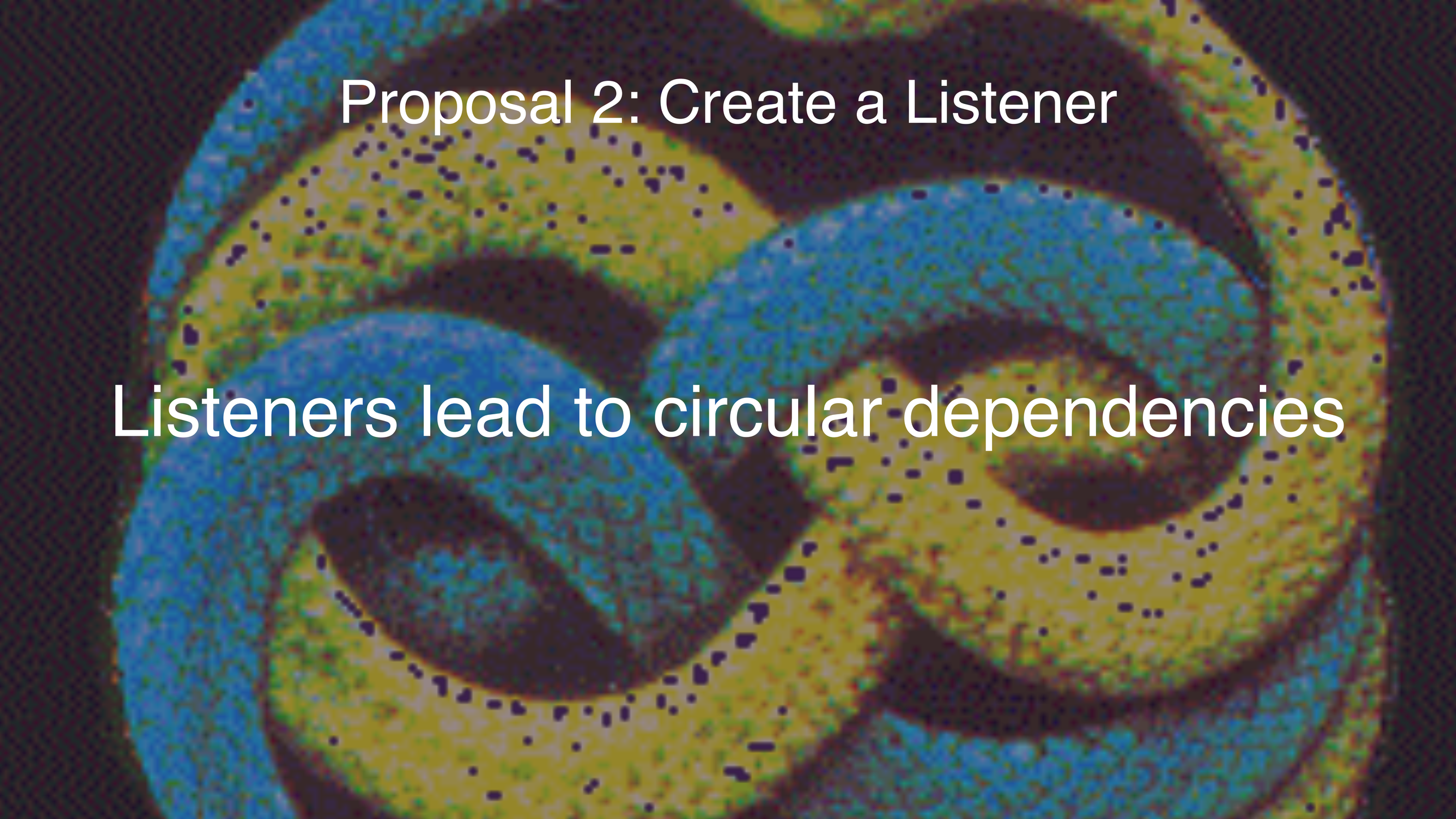
ResultsView

Listens To

SearchView

Proposal 2: Create a Listener




Proposal 2: Create a Listener
Listeners lead to circular dependencies

Last Proposal

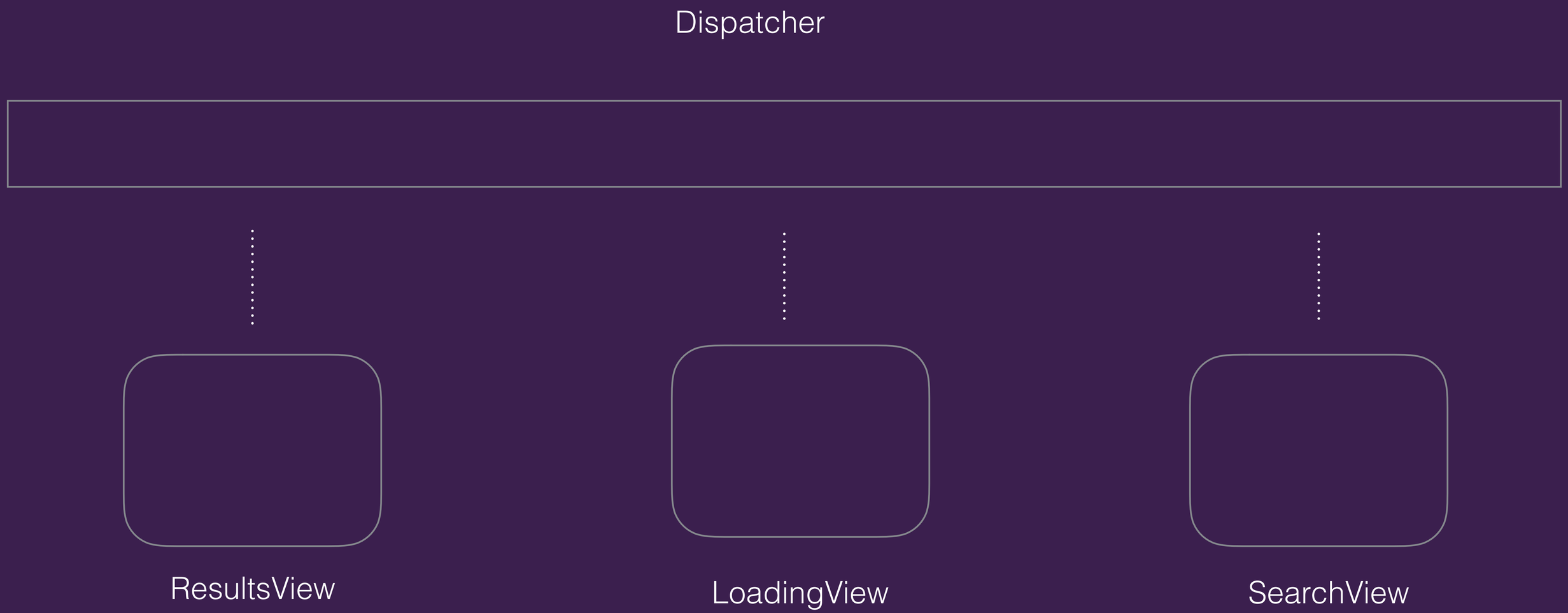
Use a centralized dispatcher
for ALL state change

Use a centralized dispatcher
for ALL state change

A Dispatcher is responsible for receiving state changes and emitting them

Why a state dispatcher?

Views become coupled to the dispatcher not each other



Reactive state

UI creates new state

Reactive state

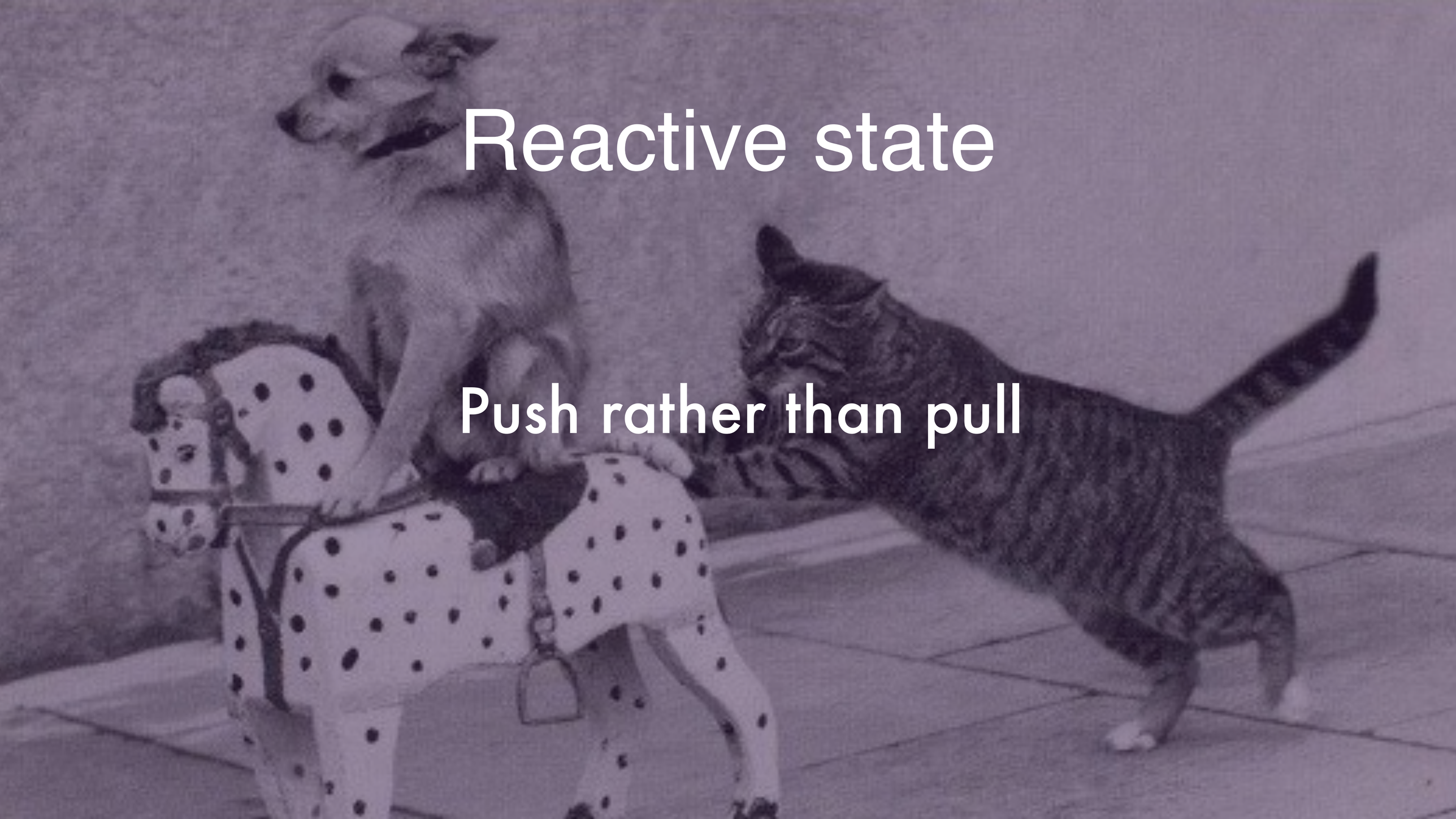
UI reacts to new state

Reactive state

With no hard references between UI elements

Reactive state

Push rather than pull



Implementing reactive state

Reactive state

Represent your state as immutable value objects

```
Sealed class State{
data class ShowingLoading():State
data class ShowingResults(val results:List<String>):State
data class ShowingError(val error:Error):State
}
```

Reactive state

Push new state through a reactive stream

```
Interface Dispatcher
    fun dispatch(state: State)
}

interface RxState {
    fun <T> ofType(clazz: Class<T>): Observable<T>
}
```

```
Sealed class State{
data class ShowingLoading():State
data class ShowingResults(val results:List<String>):State
data class ShowingError(val error:Error):State
}
```

Reactive state

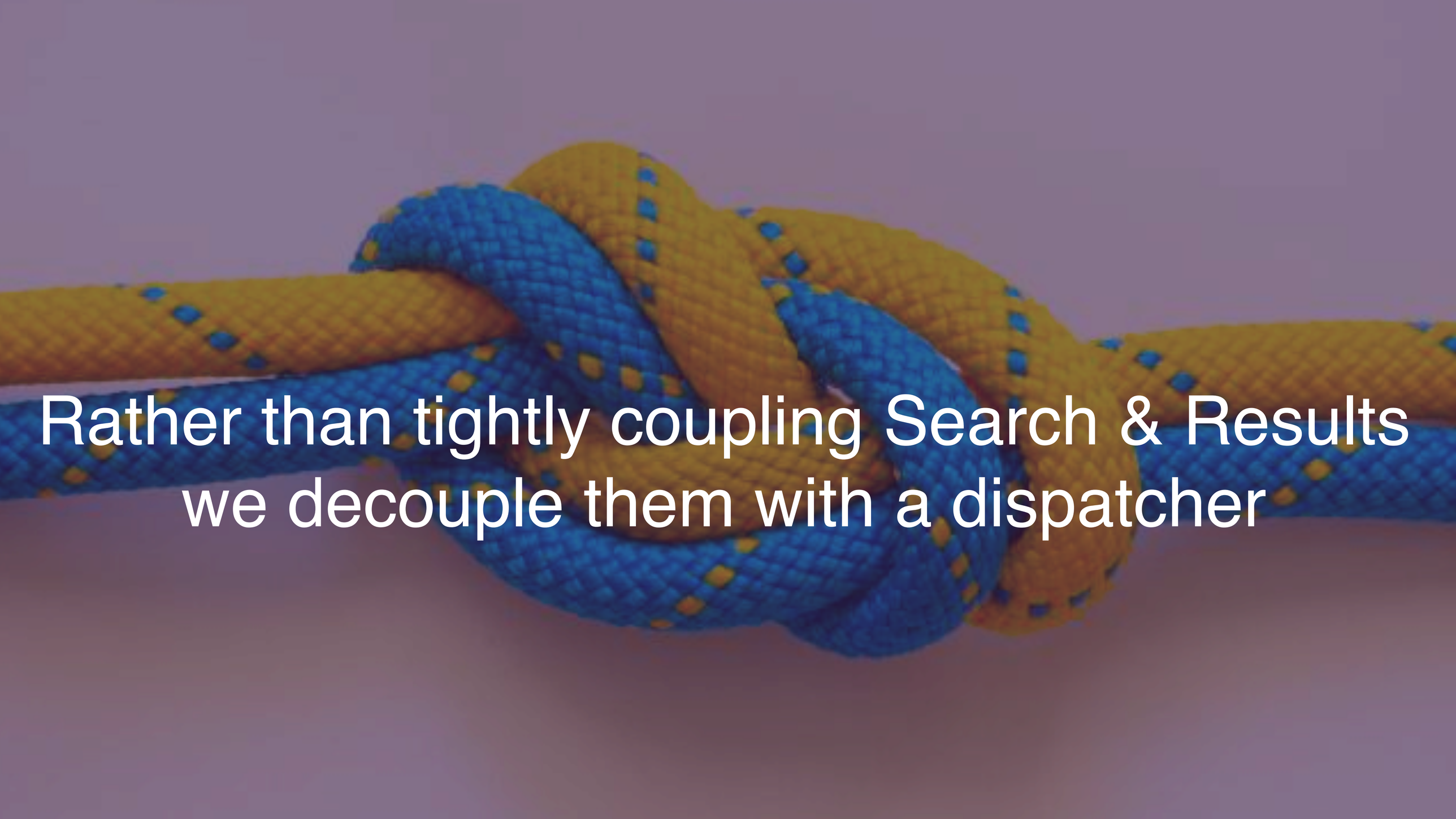
Anytime UI needs to change, dispatch a new state

```
dispatcher.dispatch(State.ShowingResults(resultData)
dispatcher.dispatch(State.ShowingLoading()
dispatcher.dispatch(State.ShowingError(errors)
```

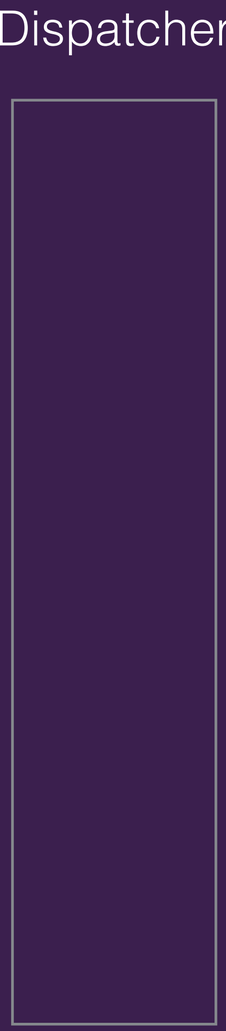
Reactive state

Anytime state changes, react to new state

```
rxState.ofType(State.Results)
        .map{it.data}
        .subscribe{  mvpView.updateUI(data) }
```

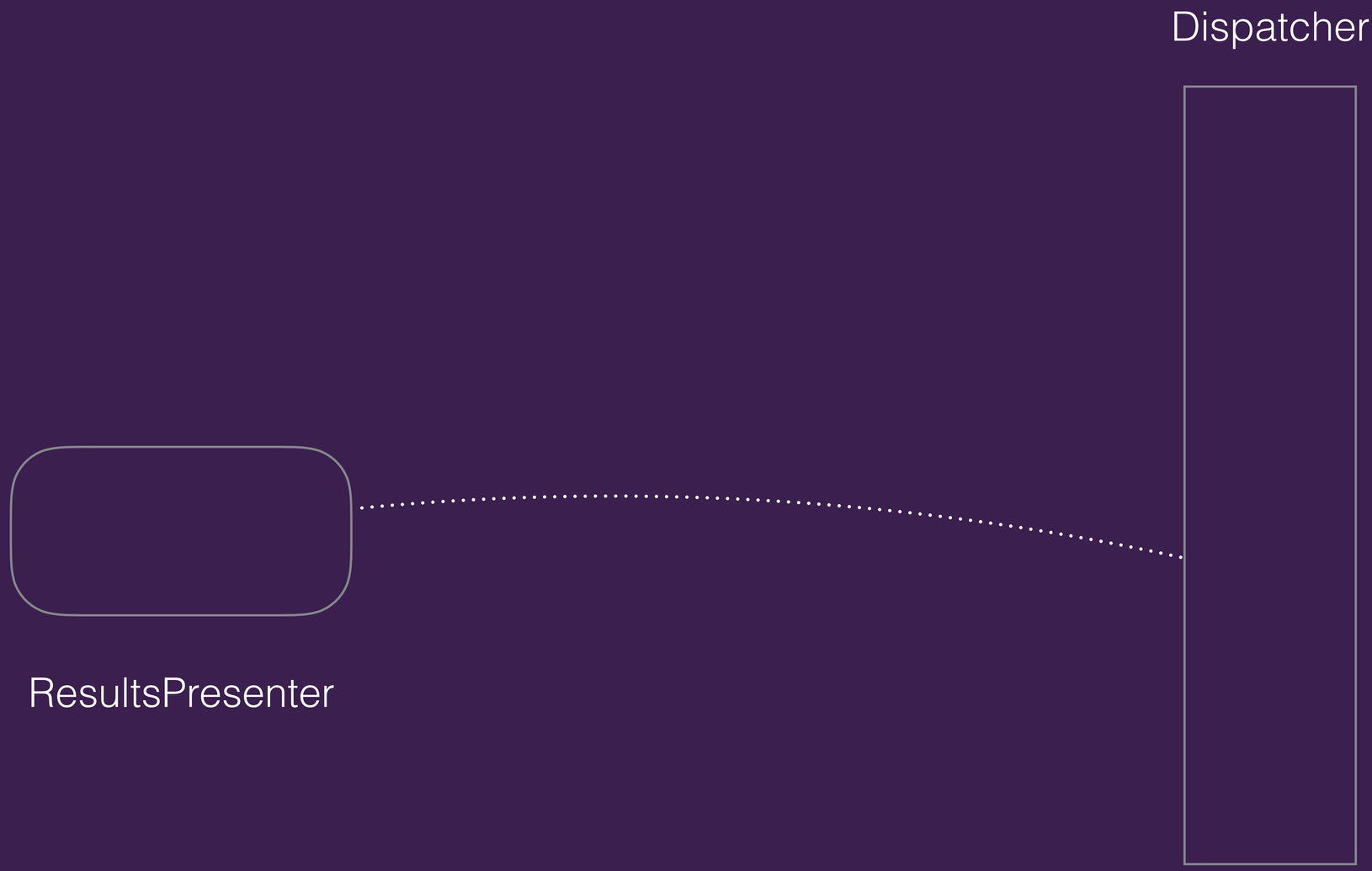

Rather than tightly coupling Search & Results
we decouple them with a dispatcher

Reactive state visualized



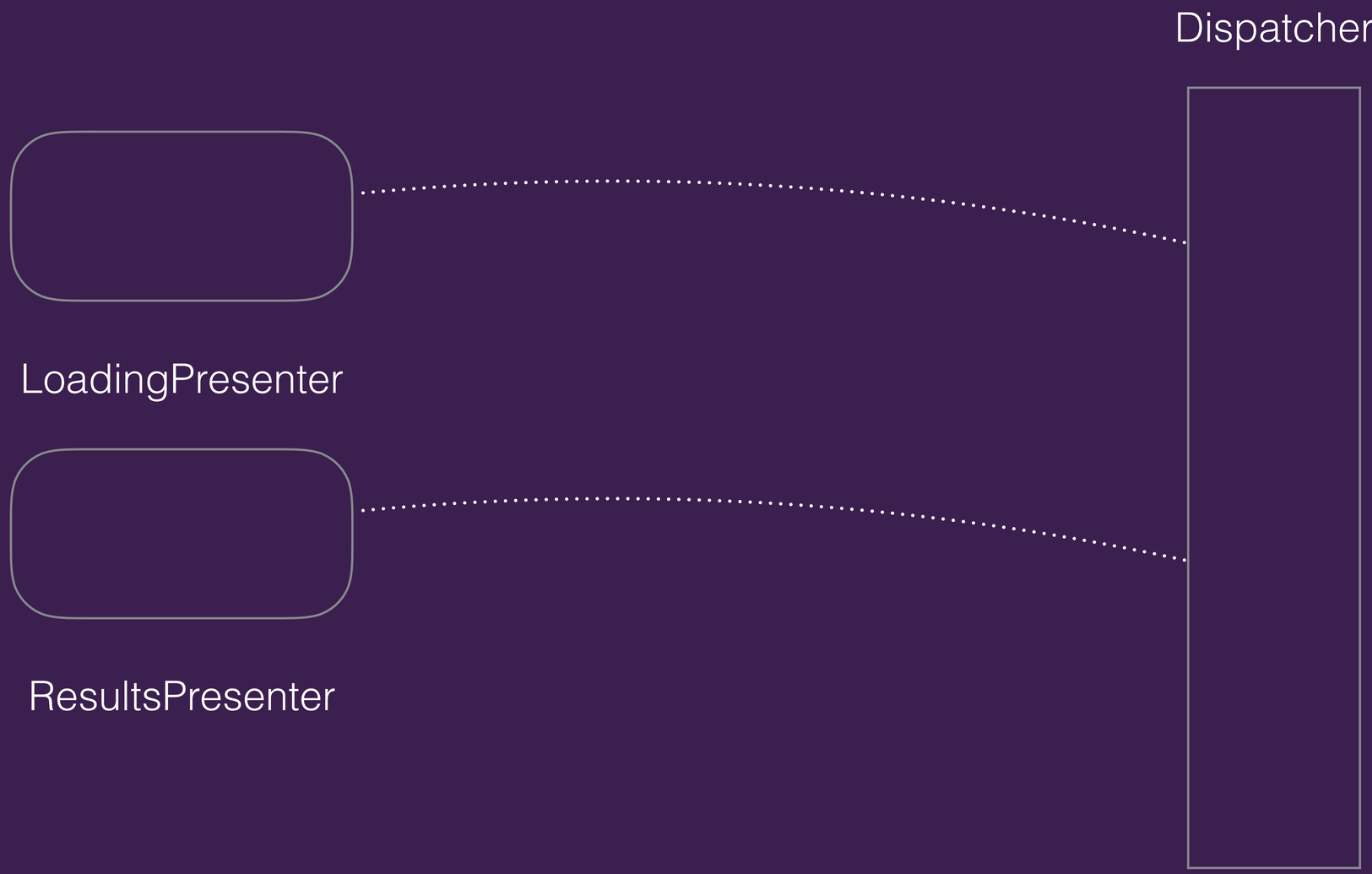
Reactive state

ResultsPresenter Subscribes to ShowResults states change

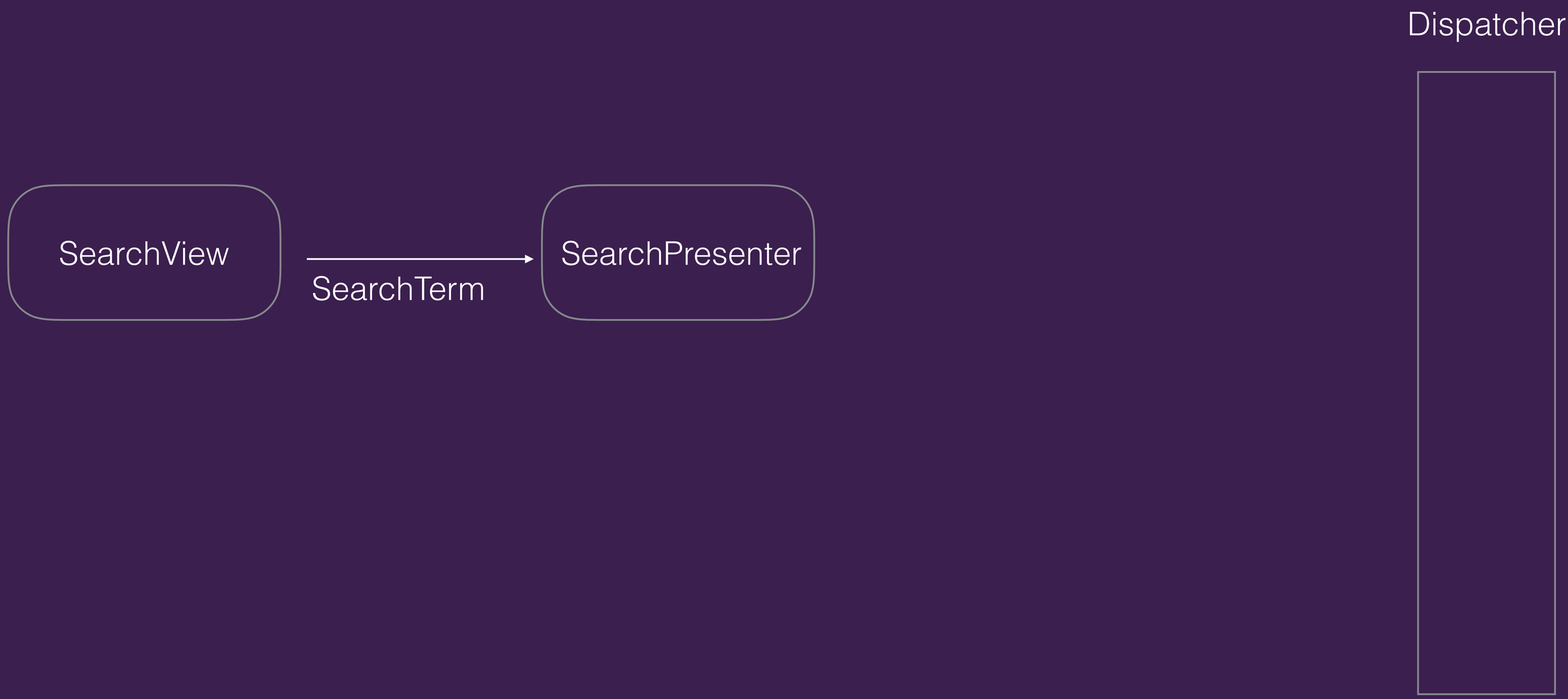


Reactive state

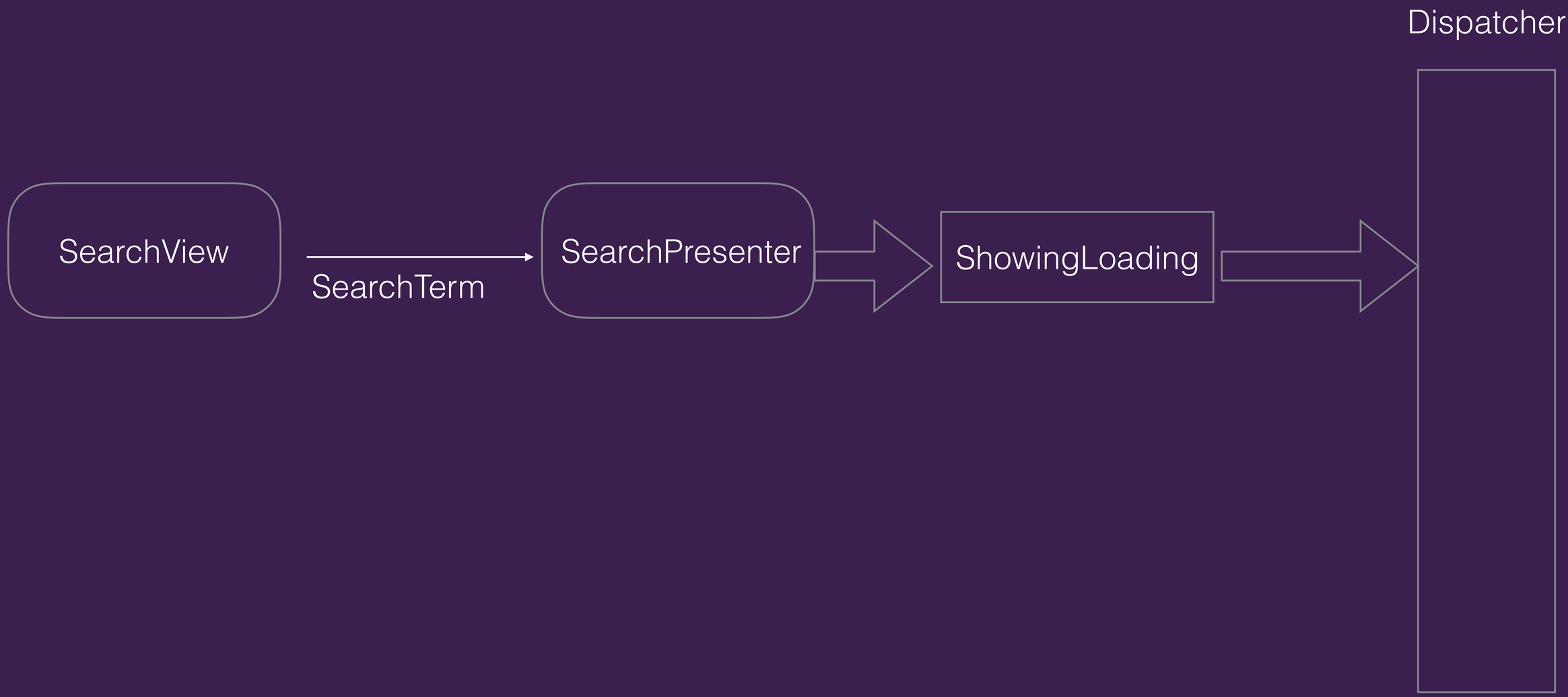
LoadingPresenter Subscribes to ShowLoading states change



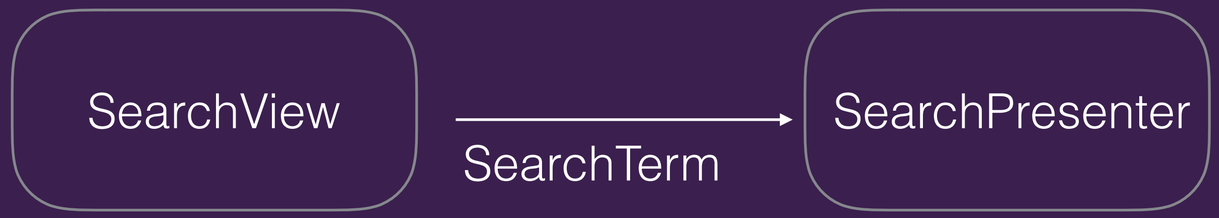
Reactive state



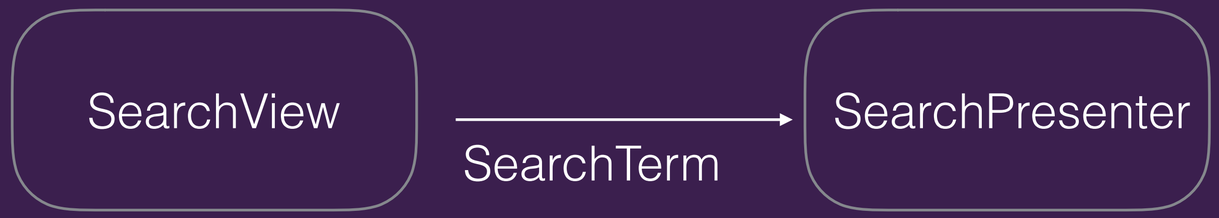
Reactive state



Reactive state



Reactive state



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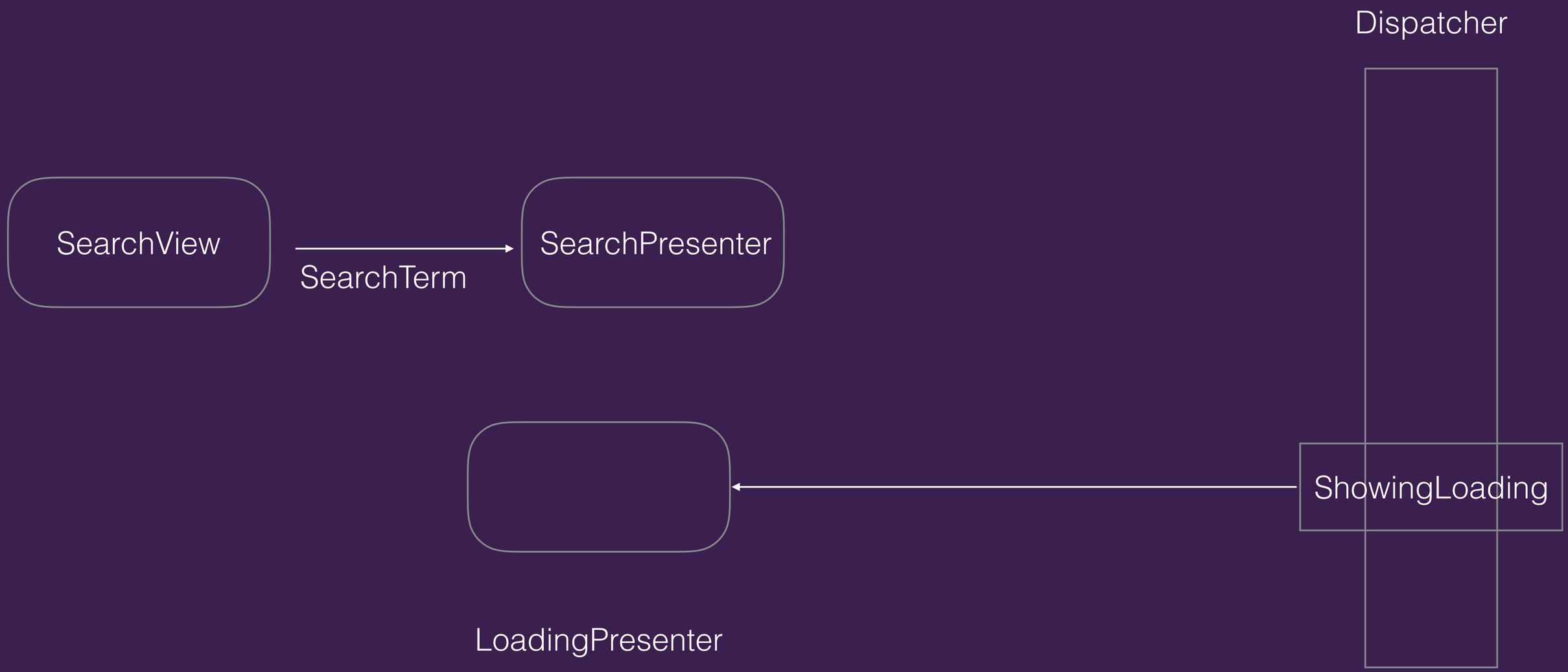

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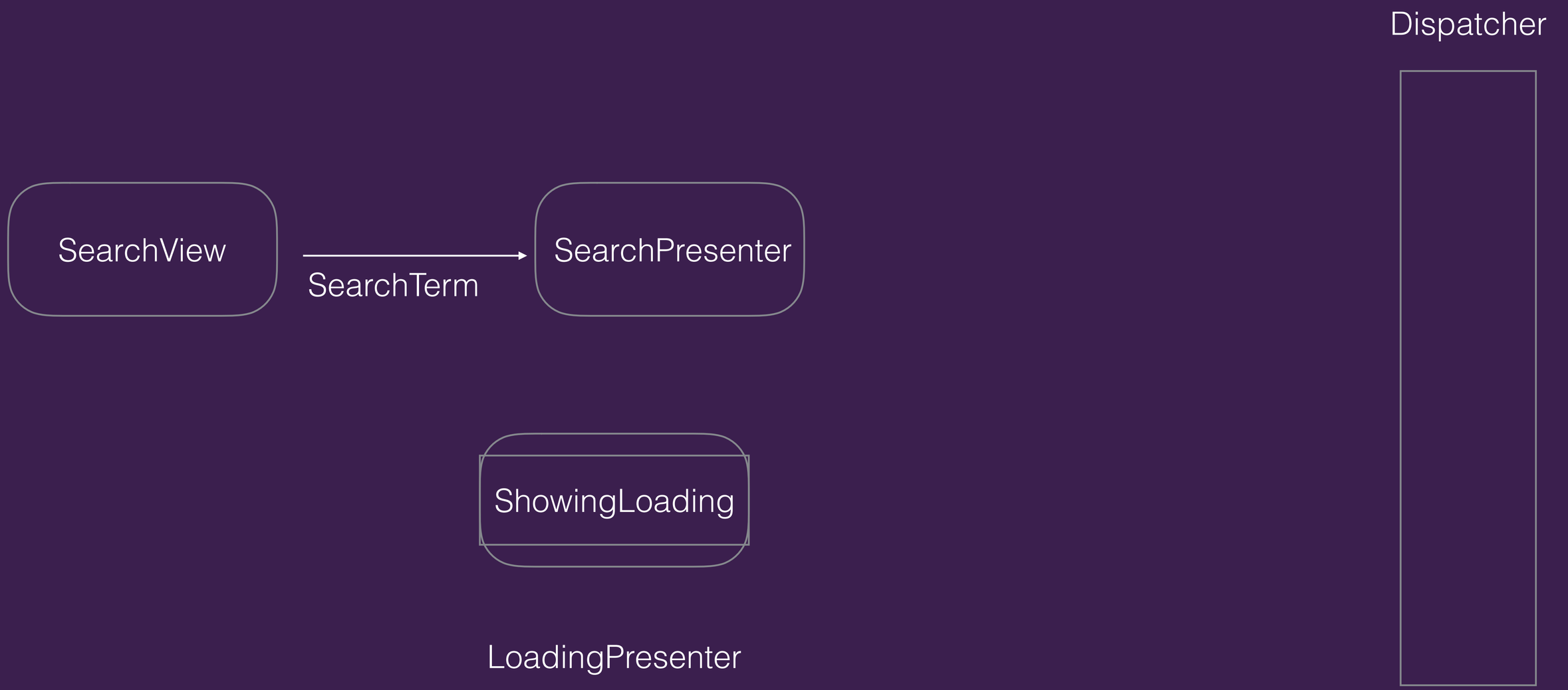
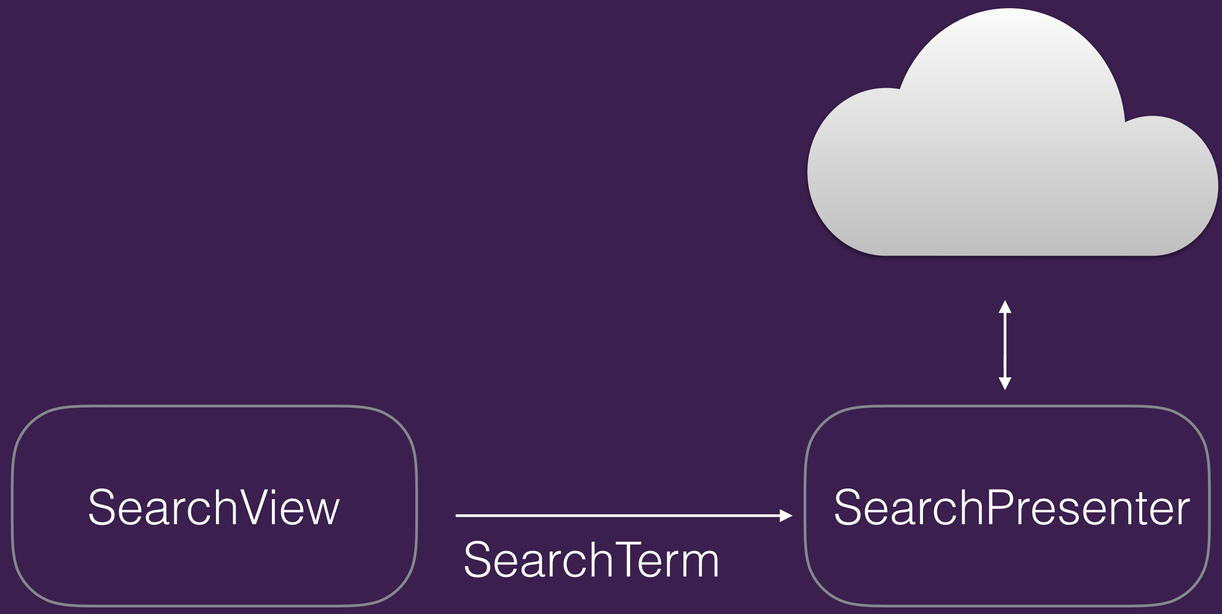
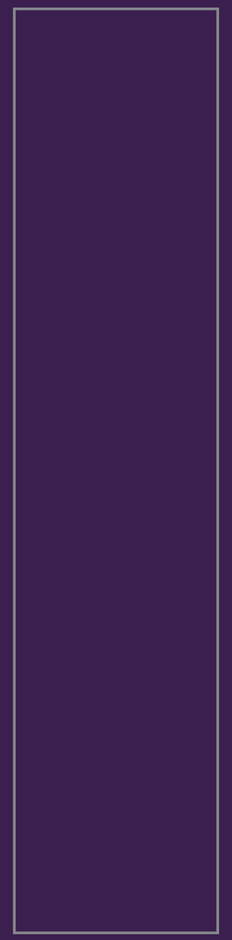


Reactive state

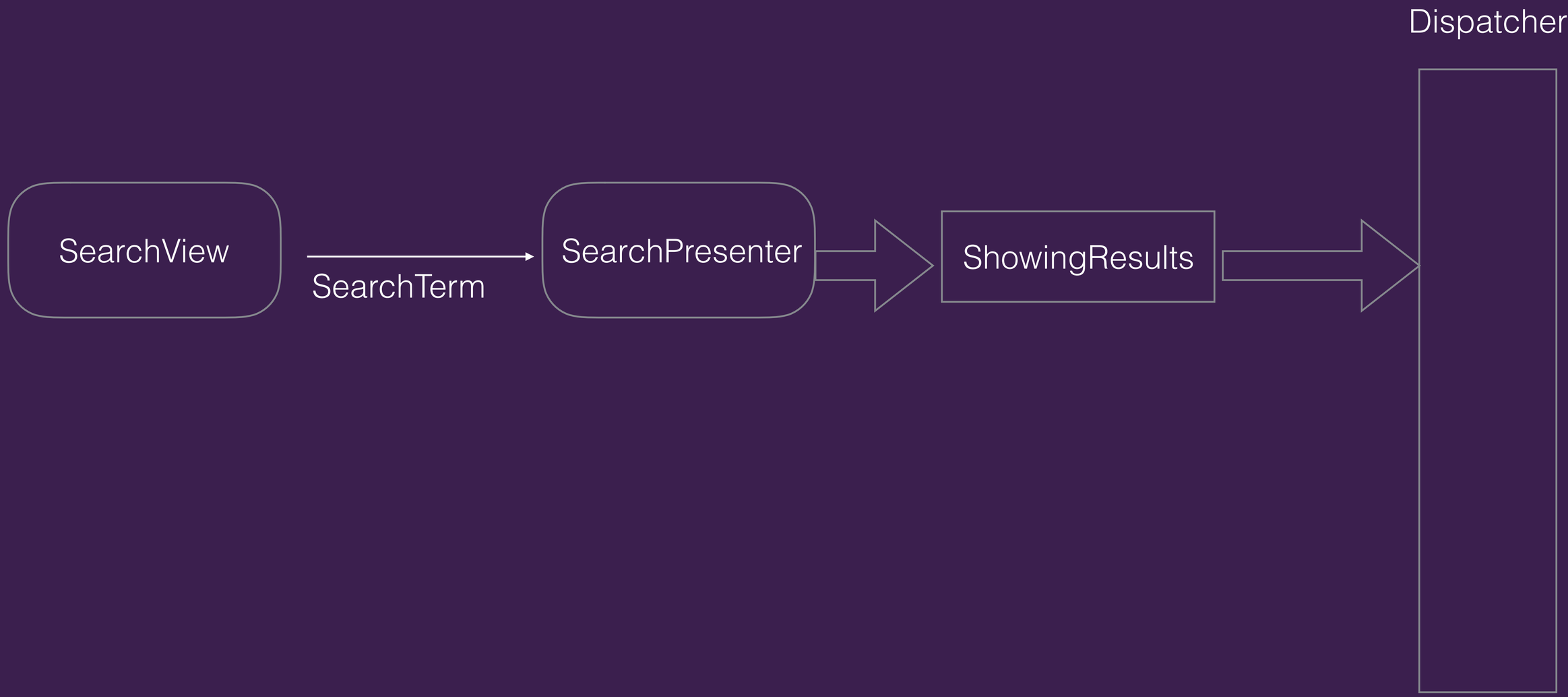


Dispatcher



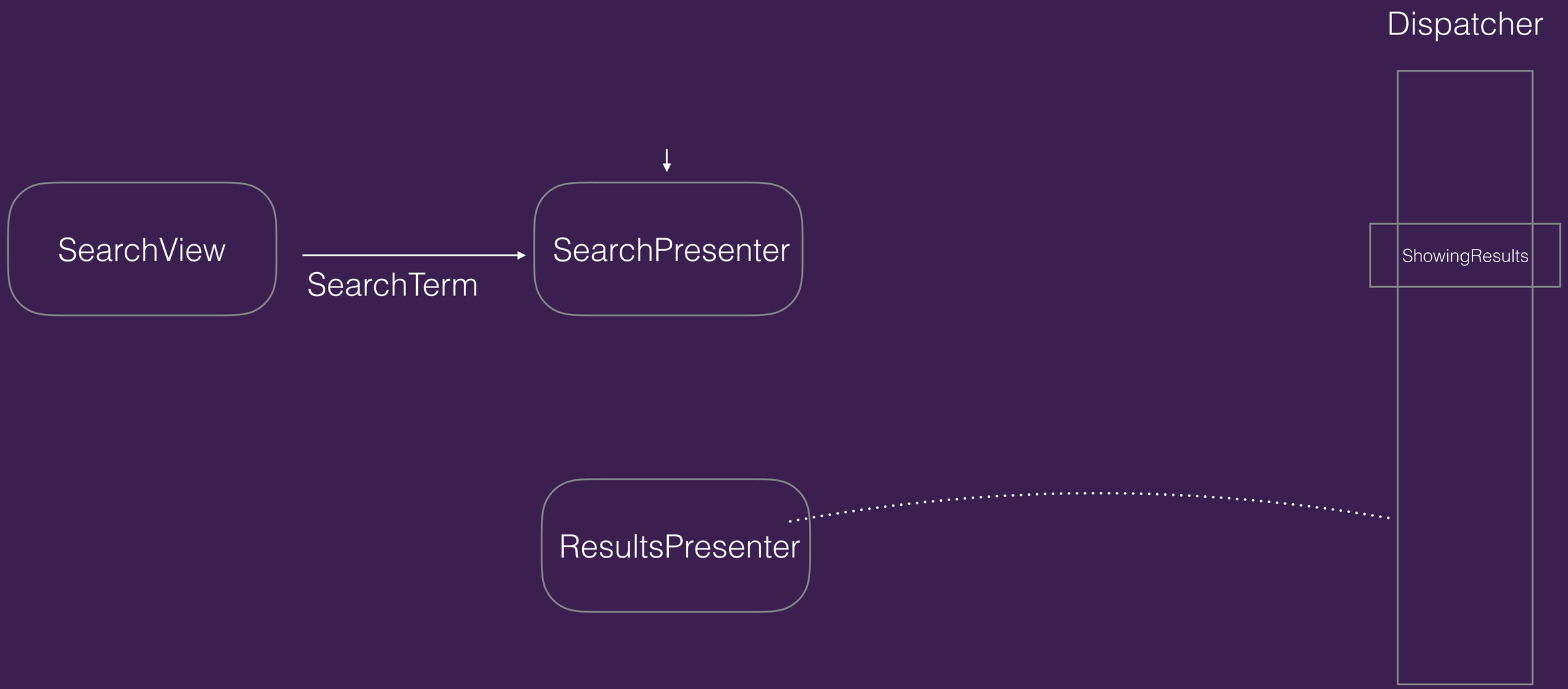
Reactive state

Search Presenter calls dispatcher.dispatch(State.ShowingResults(resultData)



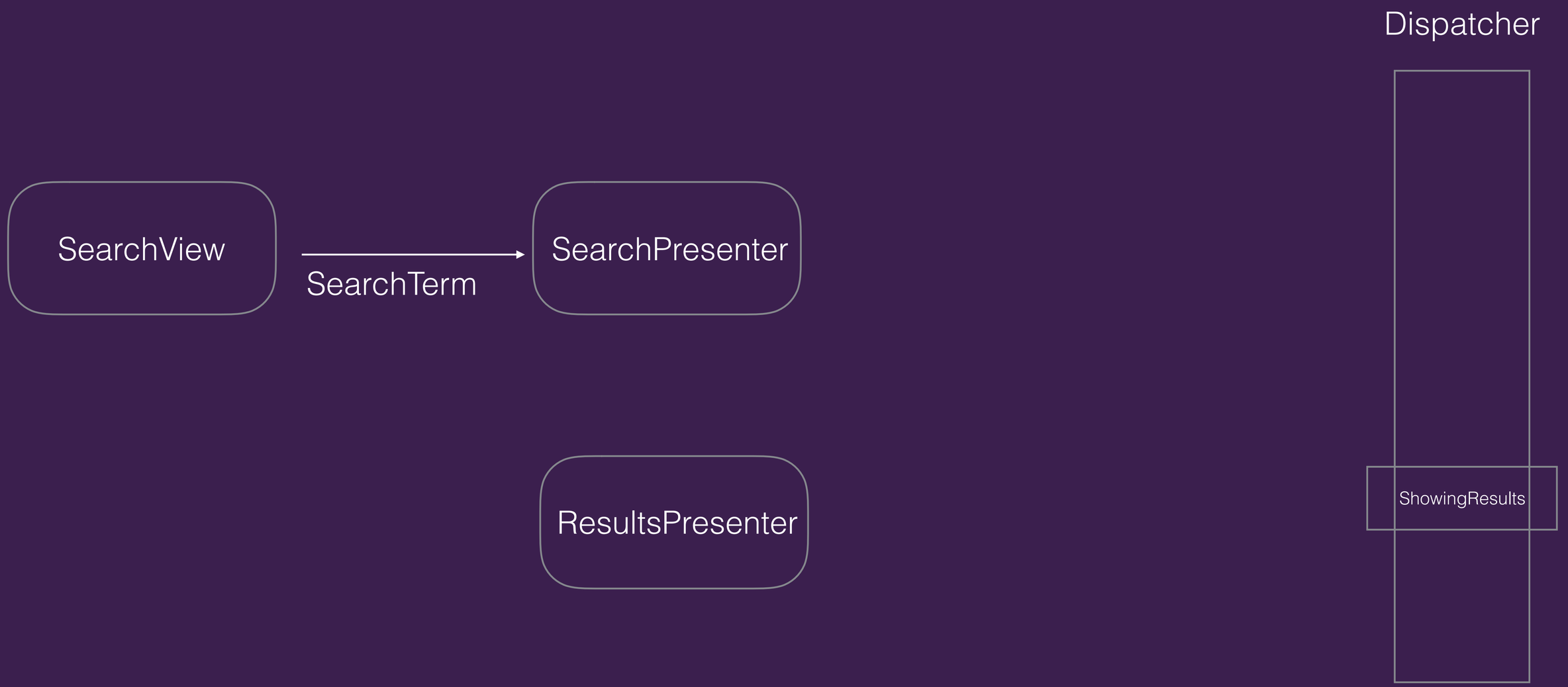
Reactive state

Dispatcher needs to emit a new State to subscribers



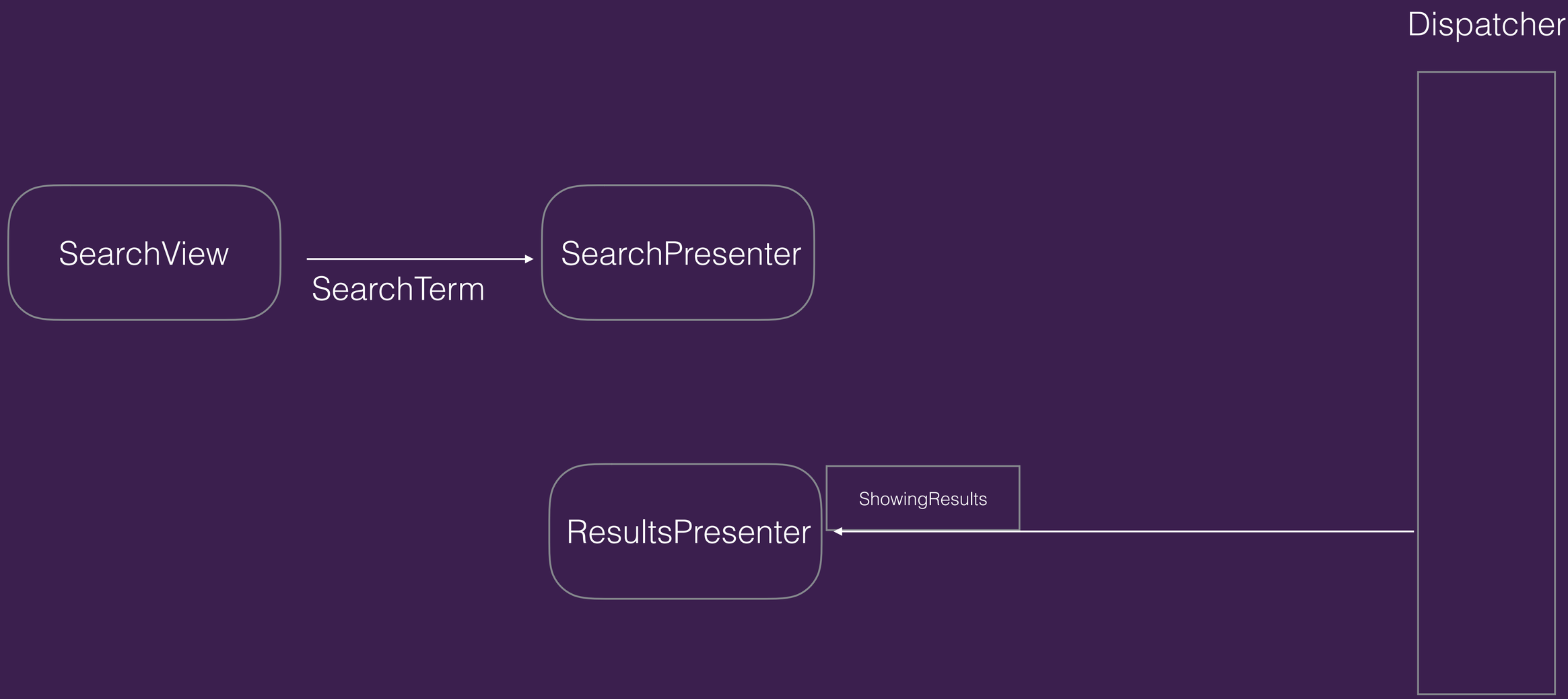
Reactive state

Dispatcher Emits new ShowingResults State to ResultsPresenter



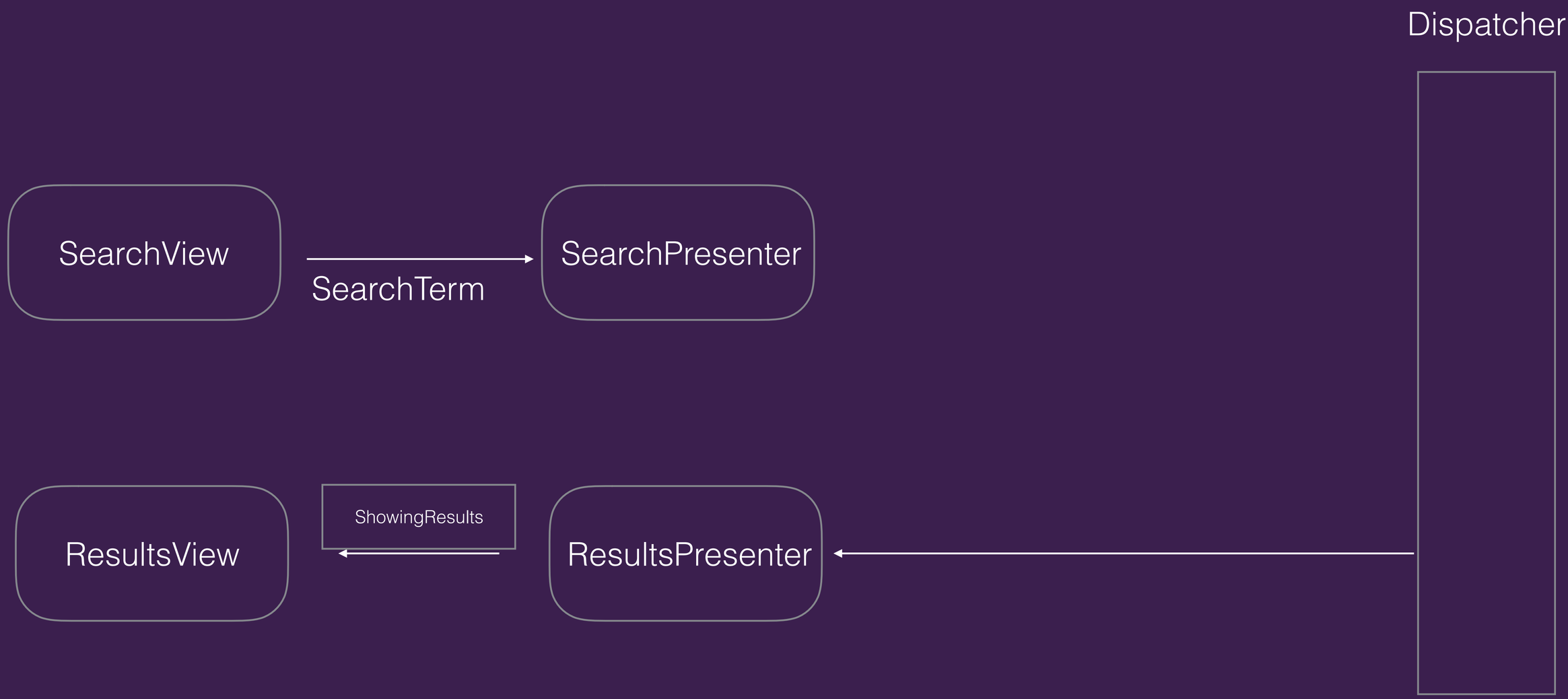
Reactive state

Dispatcher Emits new ShowingResults State to subscribers



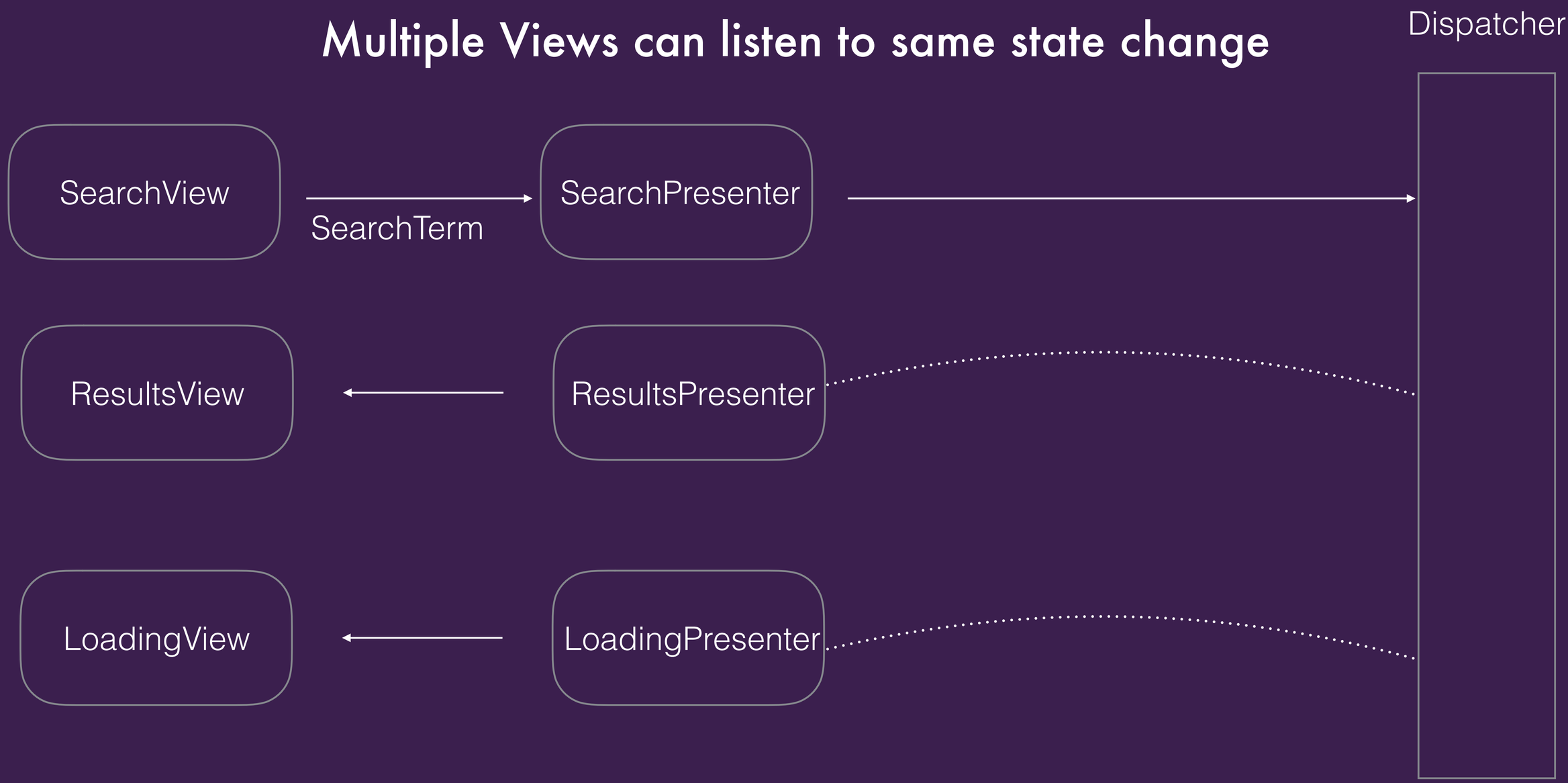
Reactive state

Dispatcher Emits new ShowingResults State to subscribers

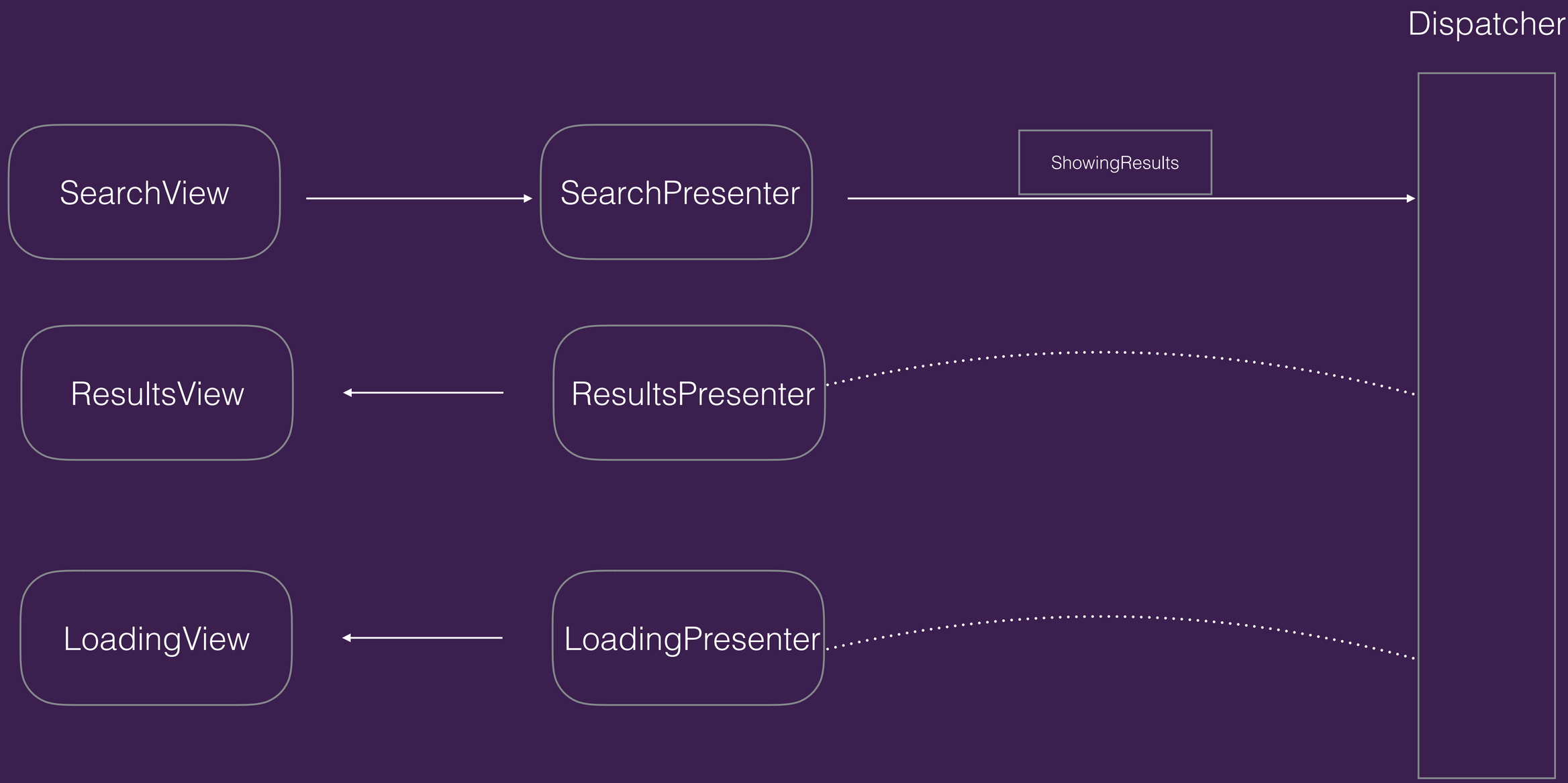


Reactive state

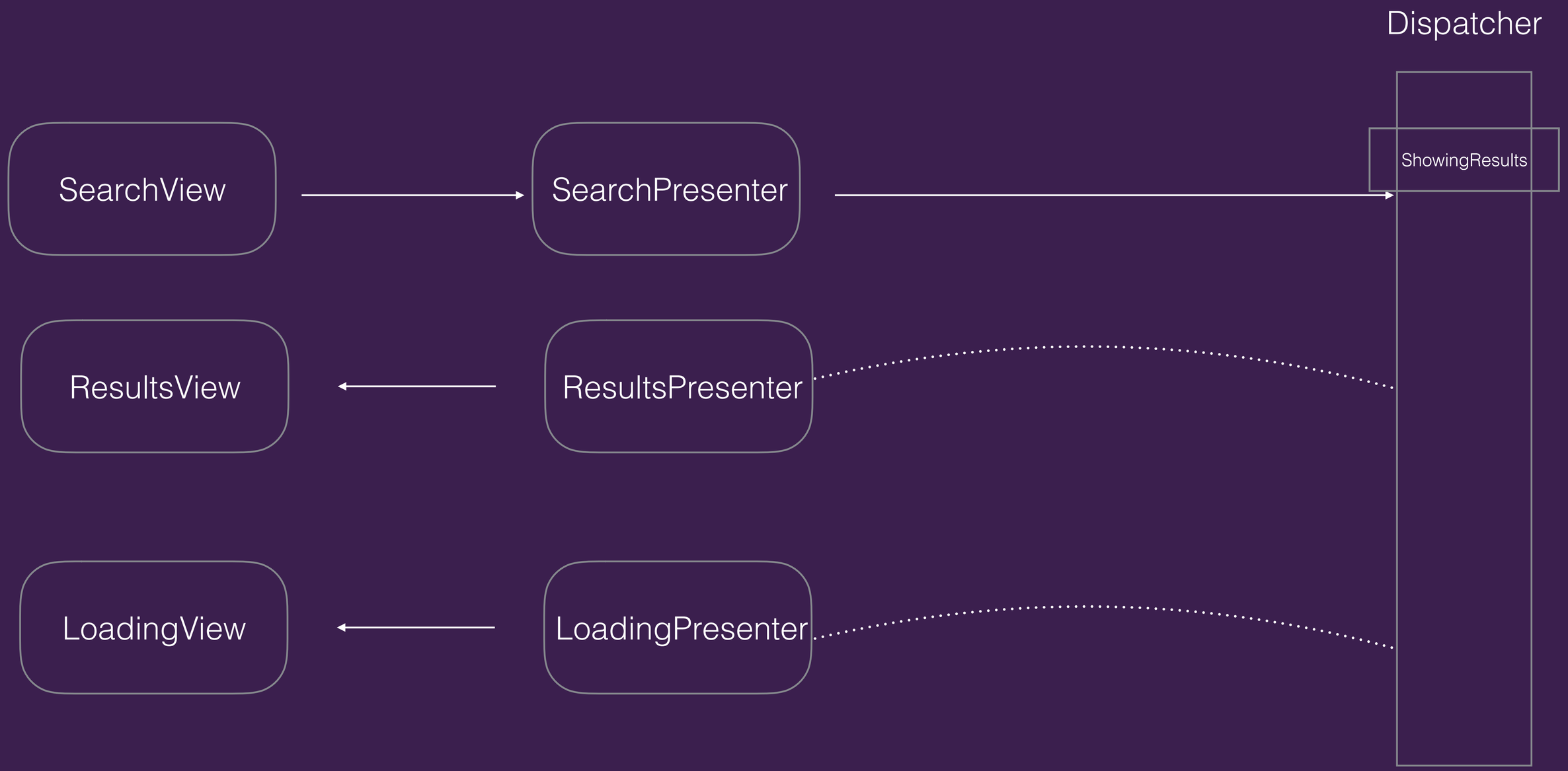
Multiple Views can listen to same state change



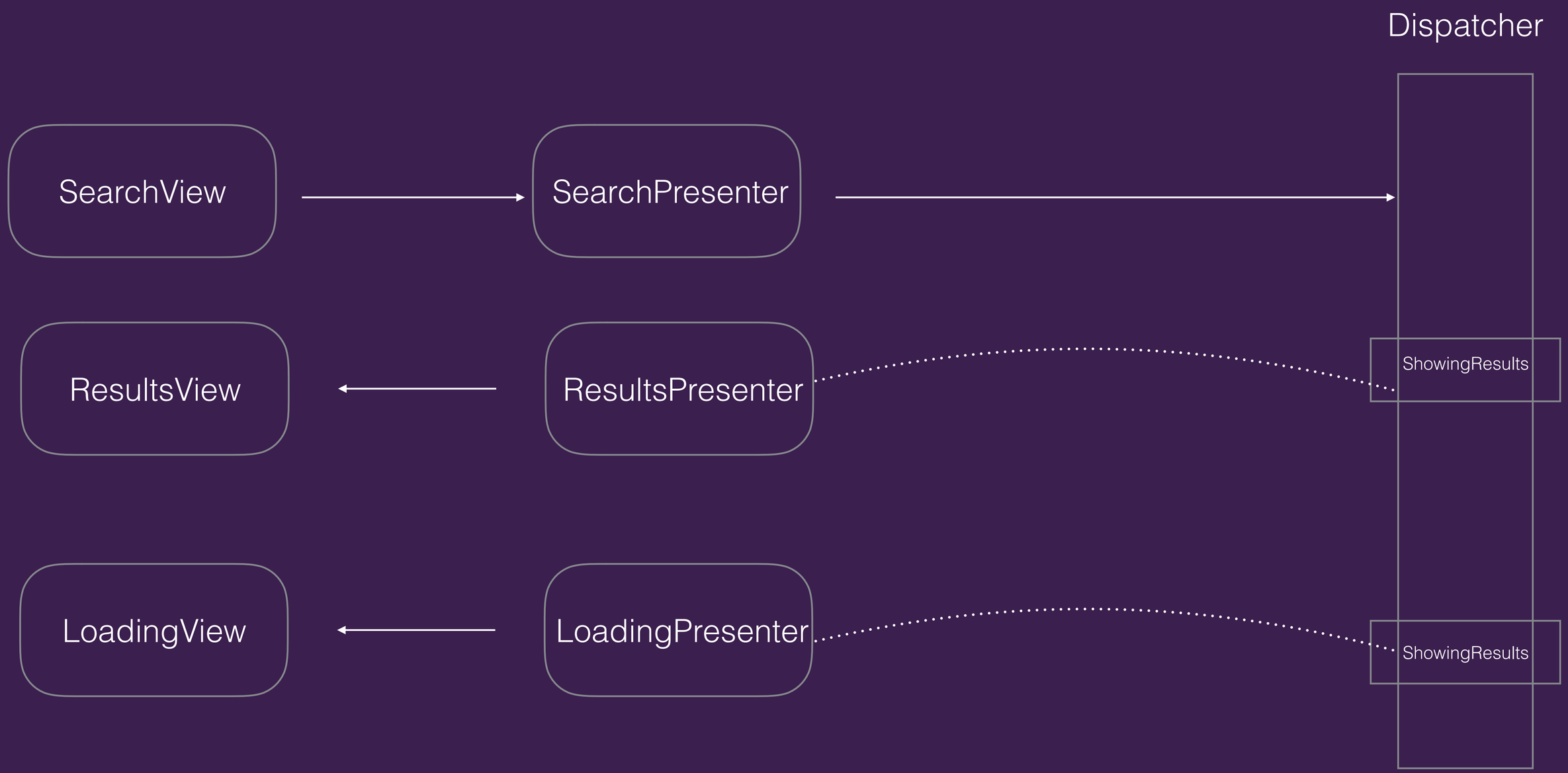
Reactive state



Reactive state



Reactive state



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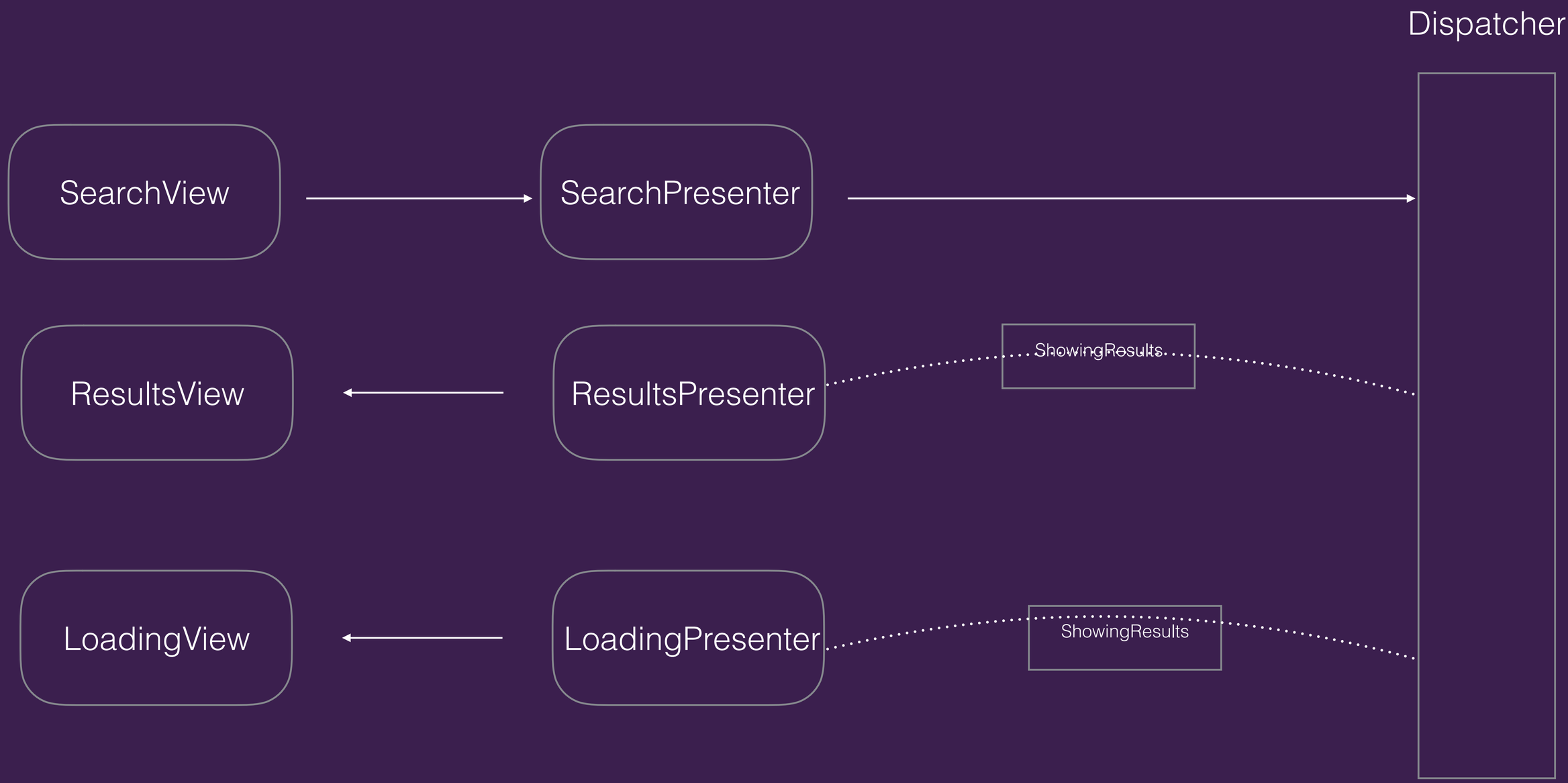

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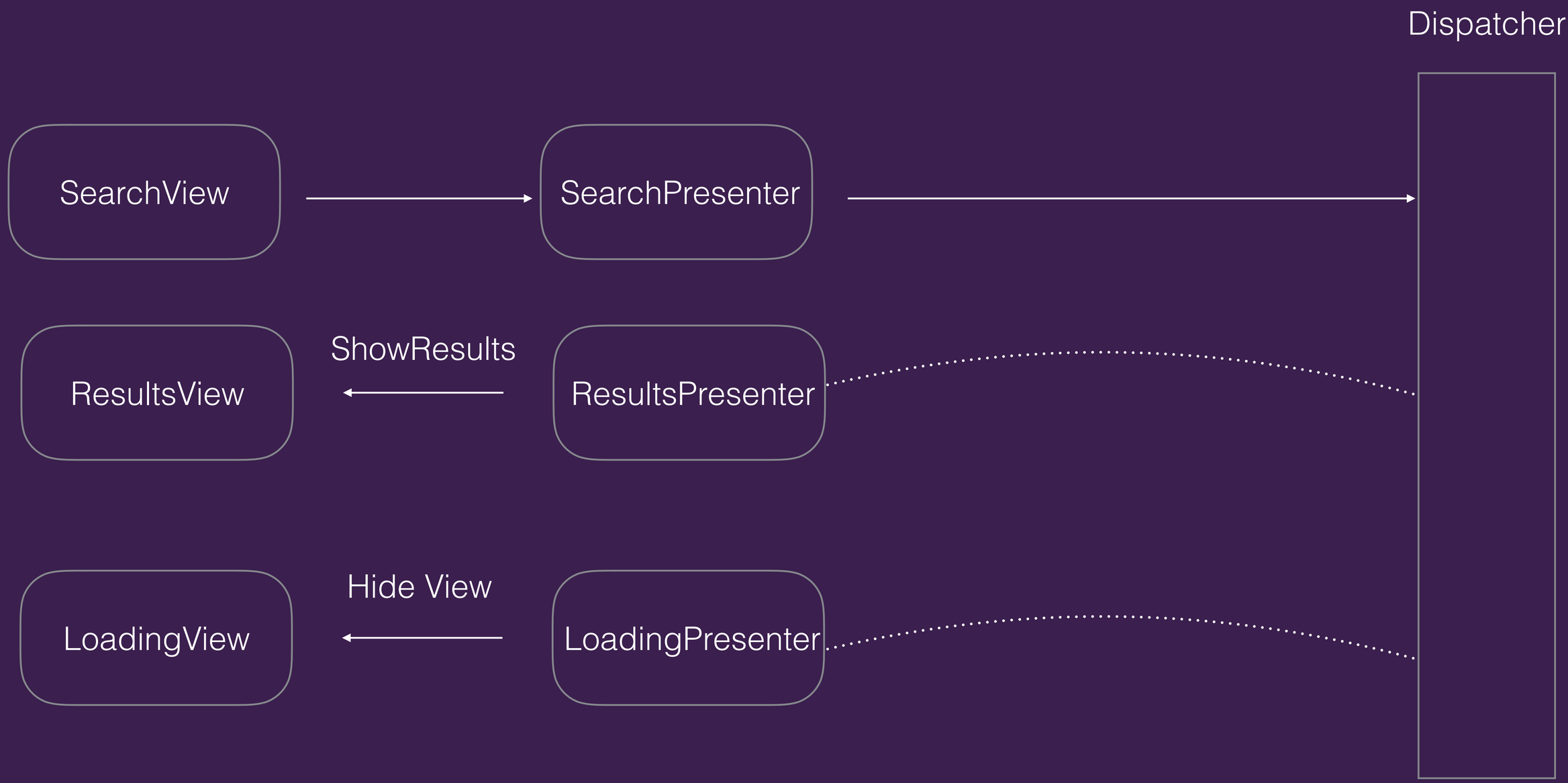


Interacting with a dispatcher

Presenter subscribes on attach


```
override fun attachView(view: NearYouMVPView) {
        rxState.ofType(State.Results)
                .map{it.data}
                .subscribe{  mvpView.updateUI(data) }
}
```

Another presenter dispatches state change


```
fun searchFor(searchTerm:String){
    store.getResults(searchTerm)
        .subscribe{dispatcher.dispatch(State.Results(data=it.results)}
```

Dispatcher emits state change

```
fun searchFor(searchTerm:String){
   store.getResults(searchTerm)
        .subscribe{dispatcher.dispatch(State.Results(data=it.results)}
```


```
override fun attachView(view: NearYouMVPView) {
        rxState.ofType(State.Results)
                .map{it.data}
                .subscribe{  mvpView.updateUI(data) }
}
```

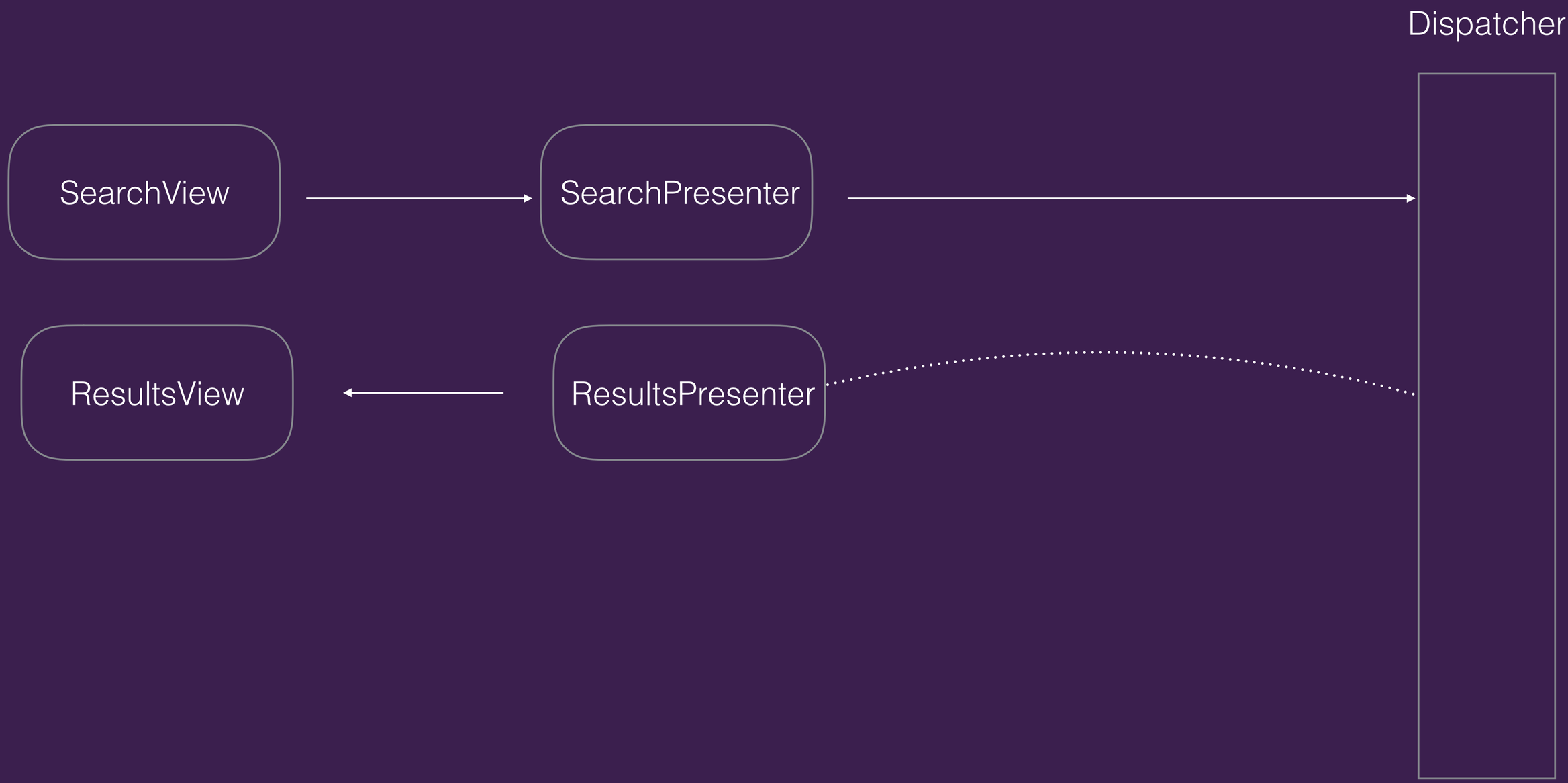
Consumers & Producers of state stay decoupled

```
fun searchFor(searchTerm:String){
   store.getResults(searchTerm)
        .subscribe{dispatcher.dispatch(State.Results(data=it.results)}
```

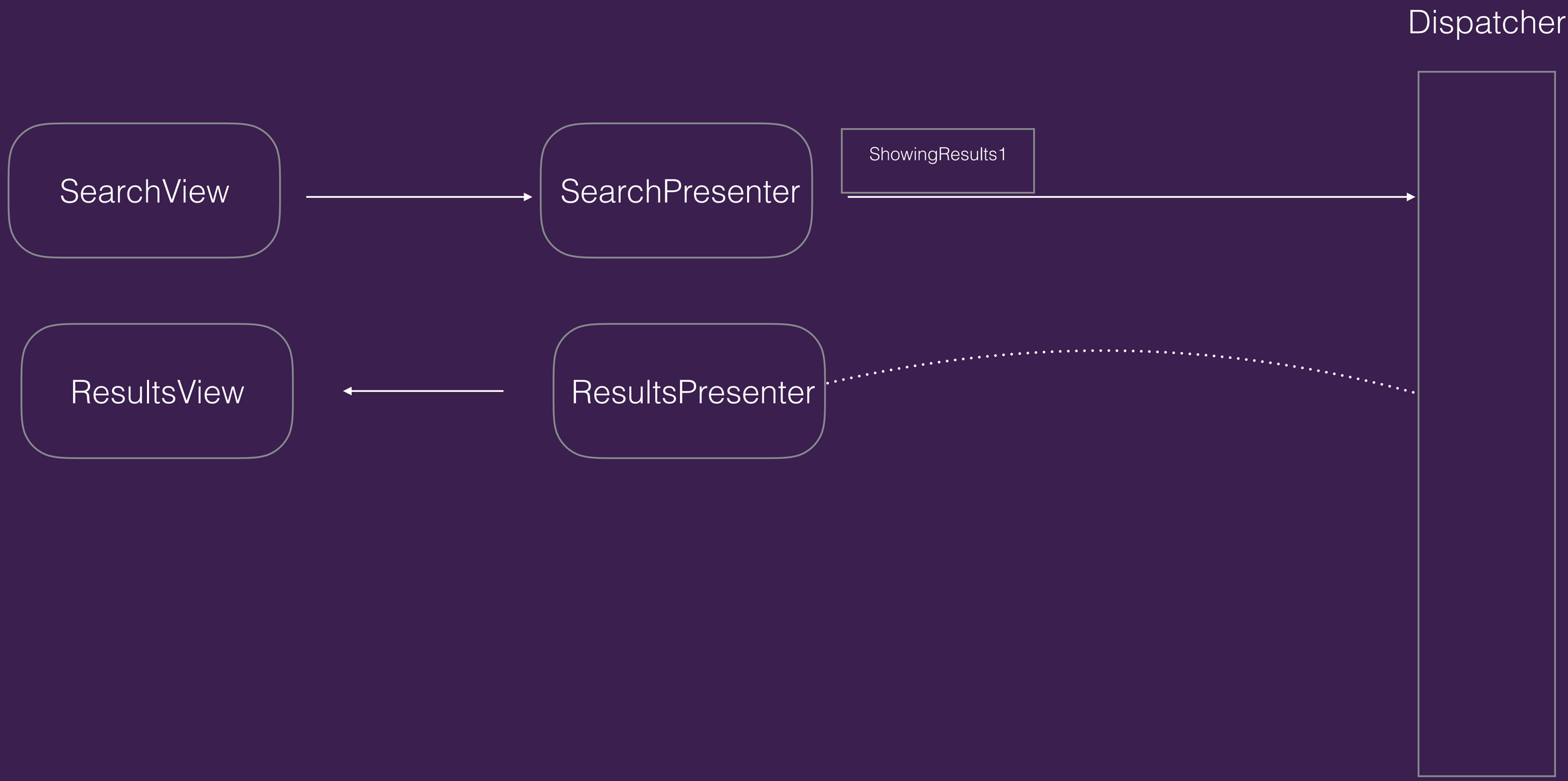

```
override fun attachView(view: NearYouMVPView) {
        rxState.ofType(State.Results)
                .map{it.data}
                .subscribe{  mvpView.updateUI(data) }
}
```

How does data flow?

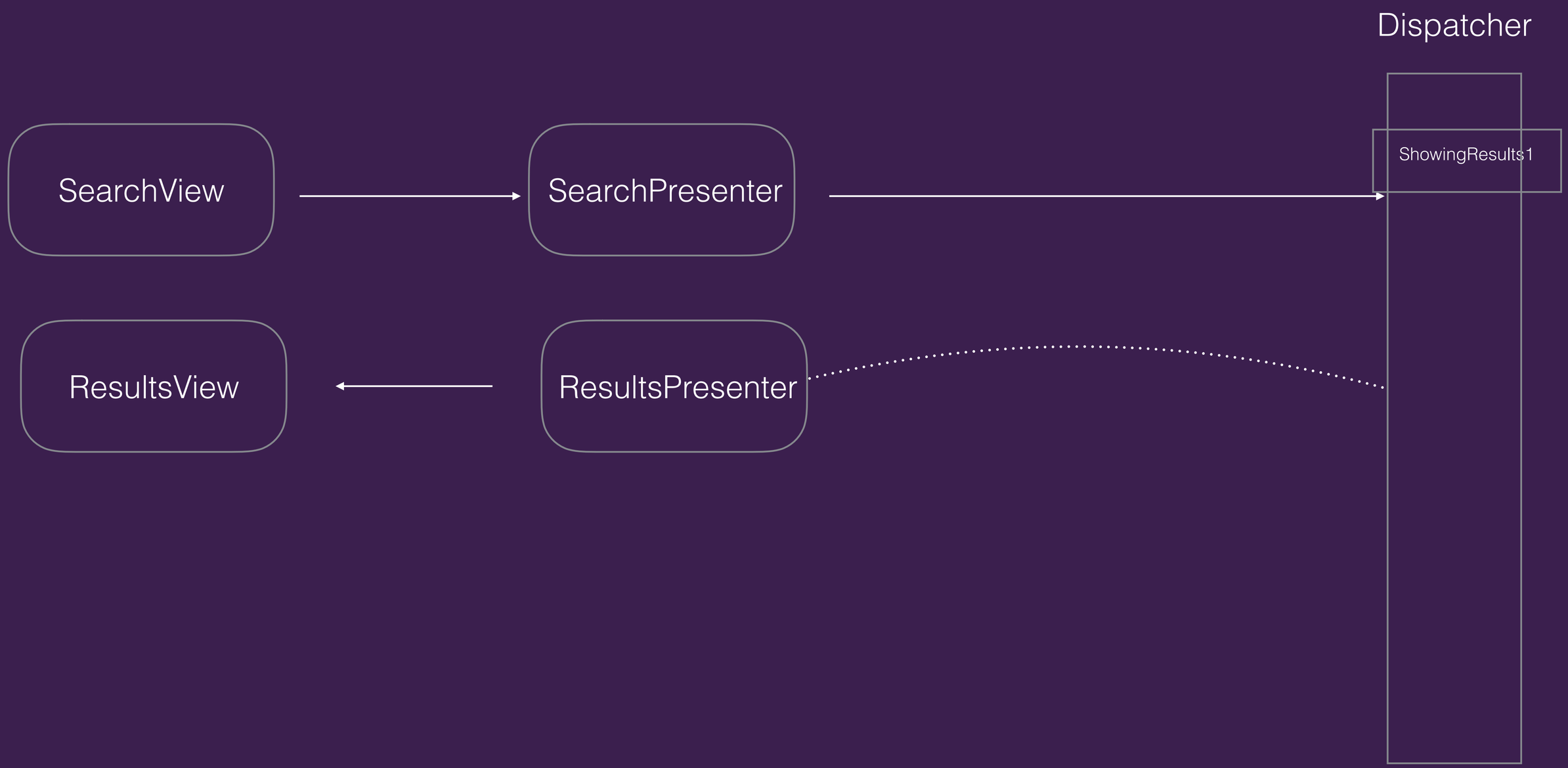
Reactive state



Reactive state



Reactive state



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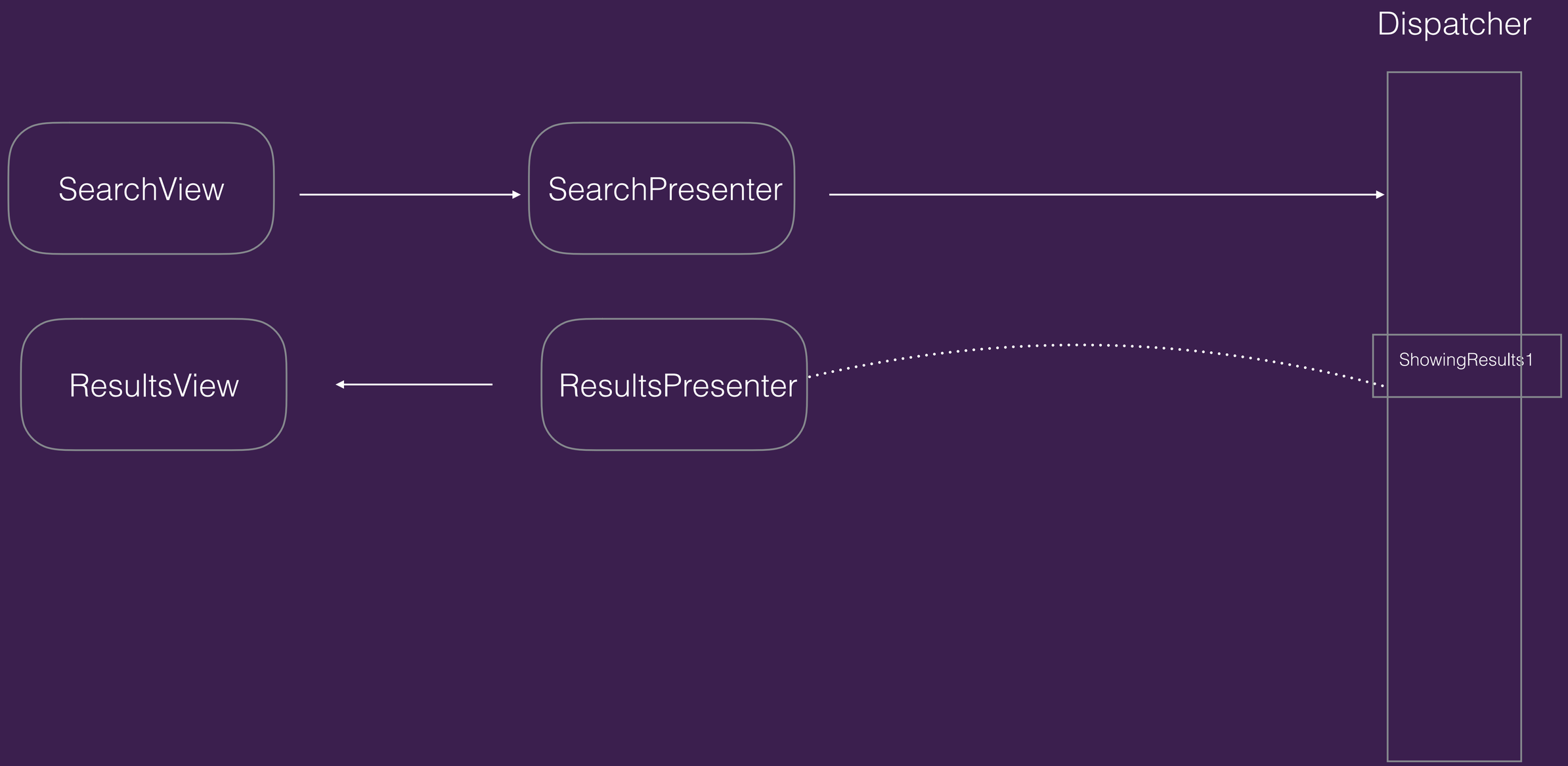

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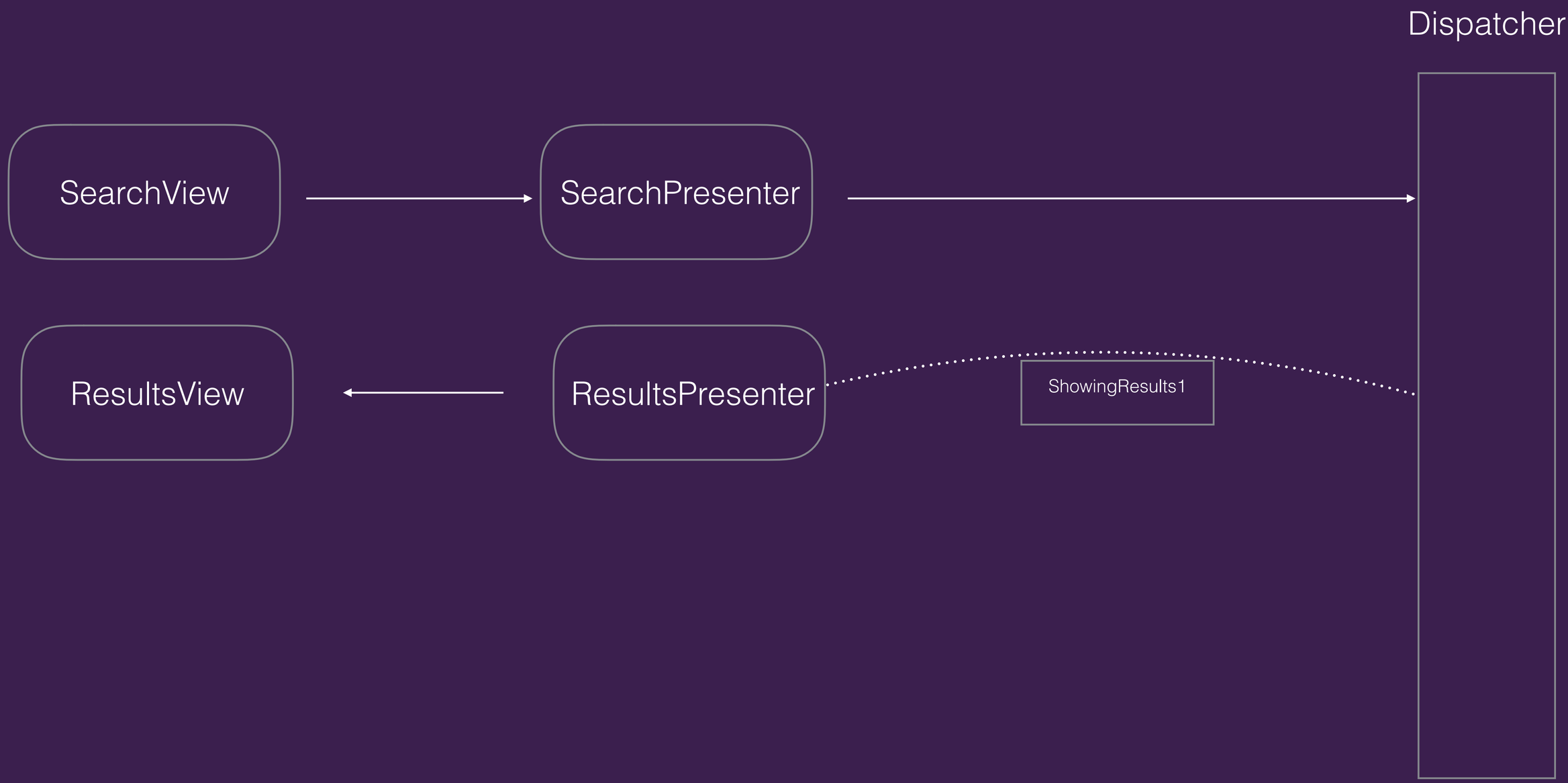

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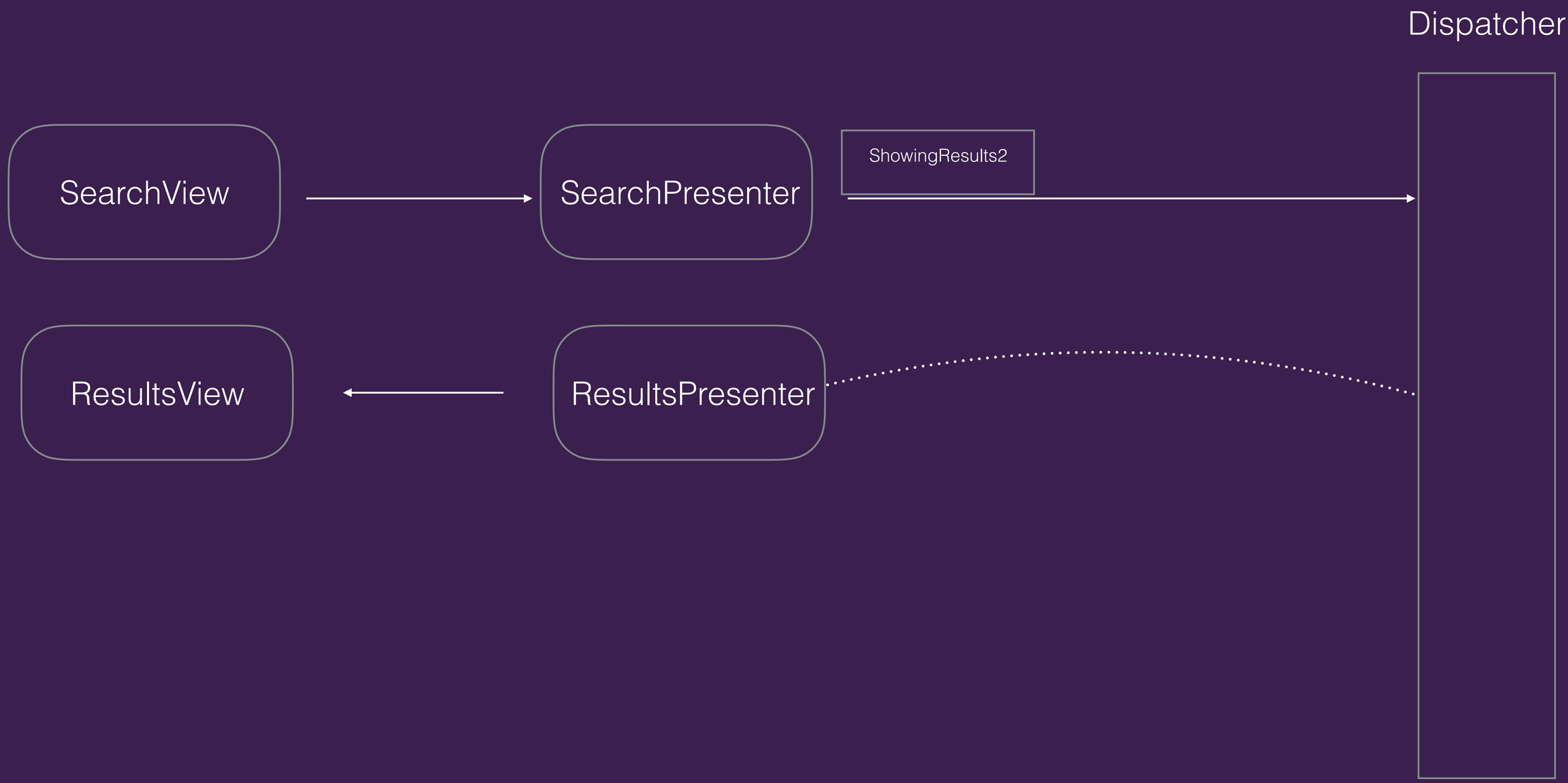
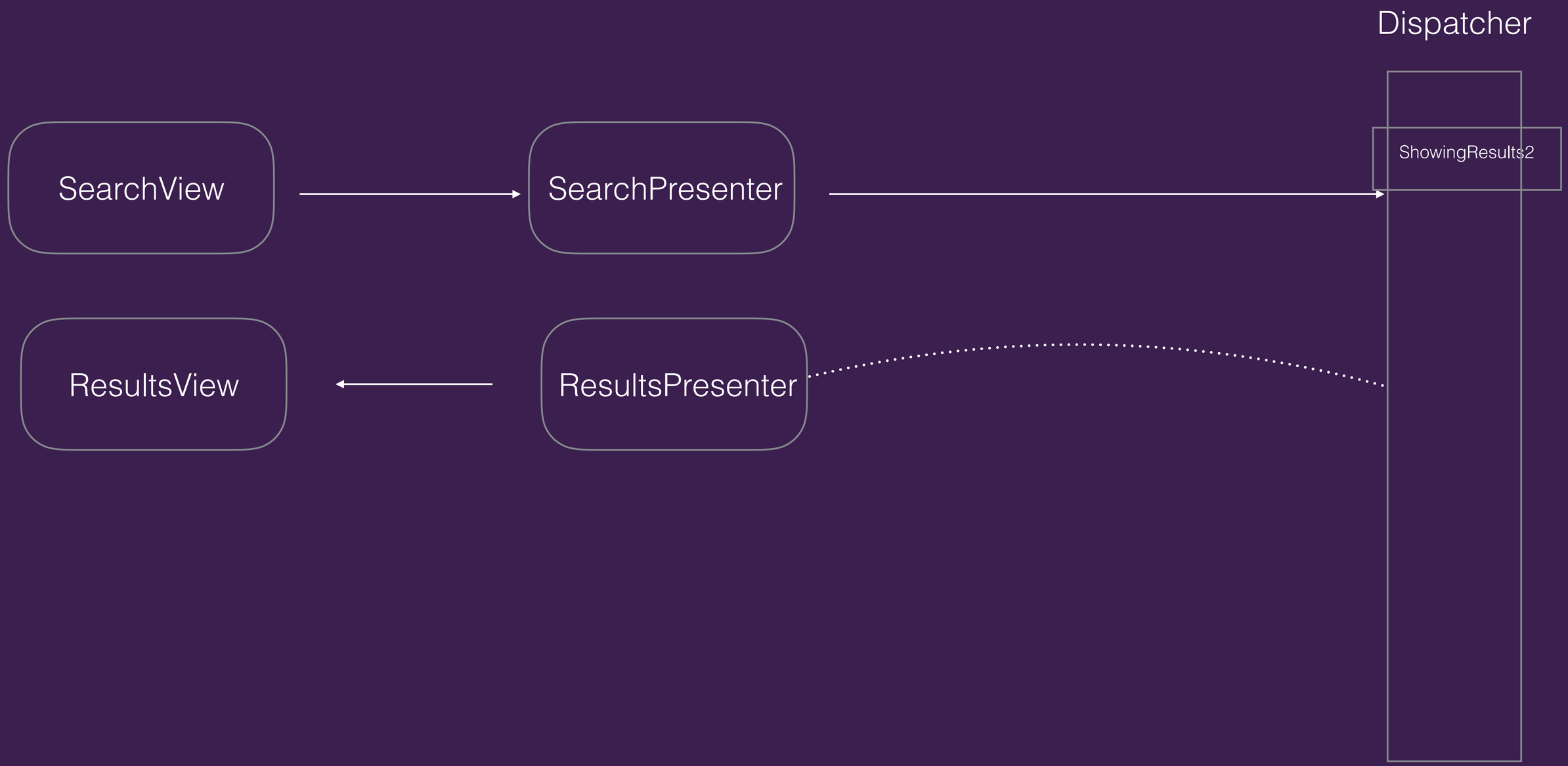
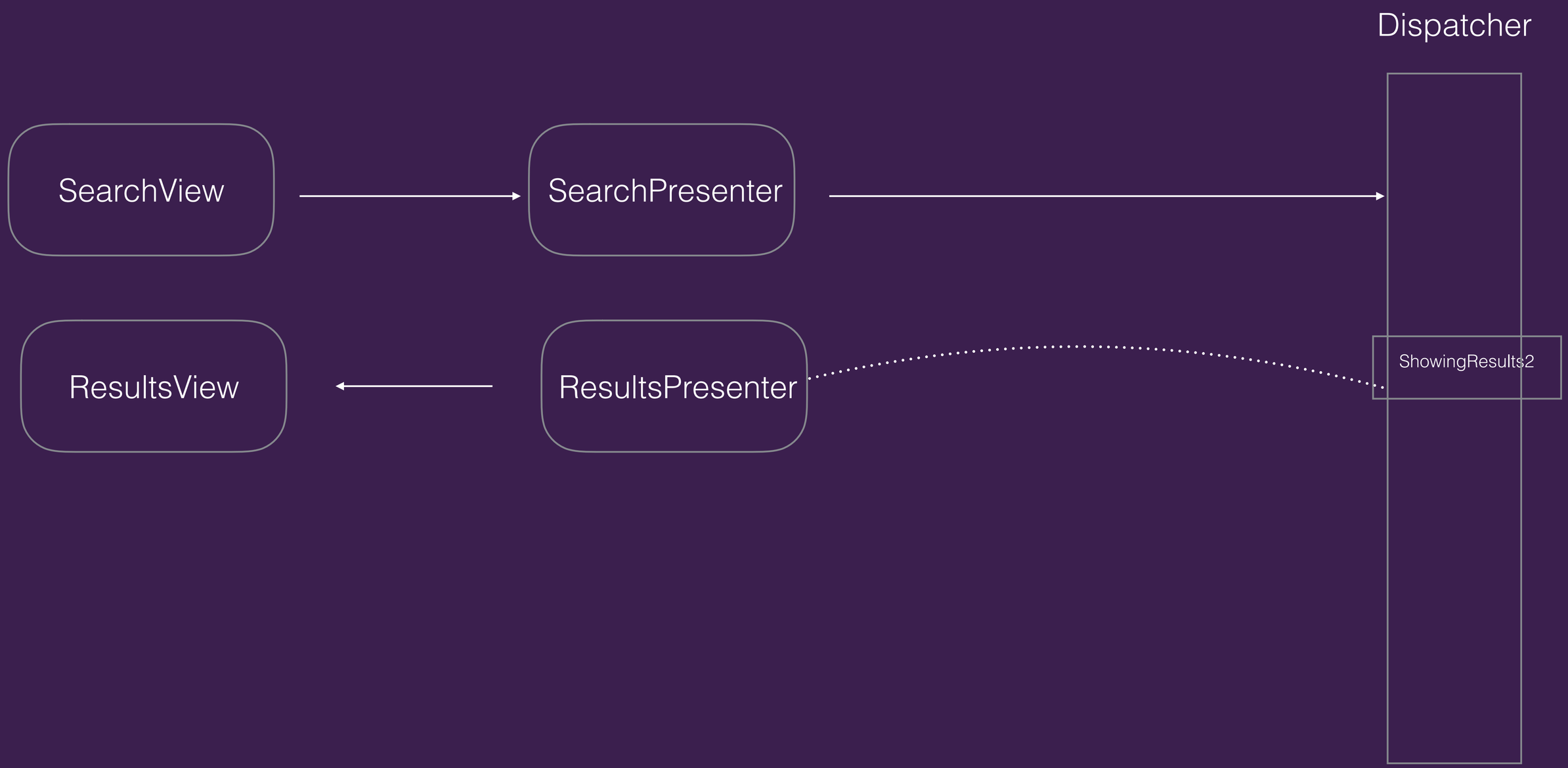


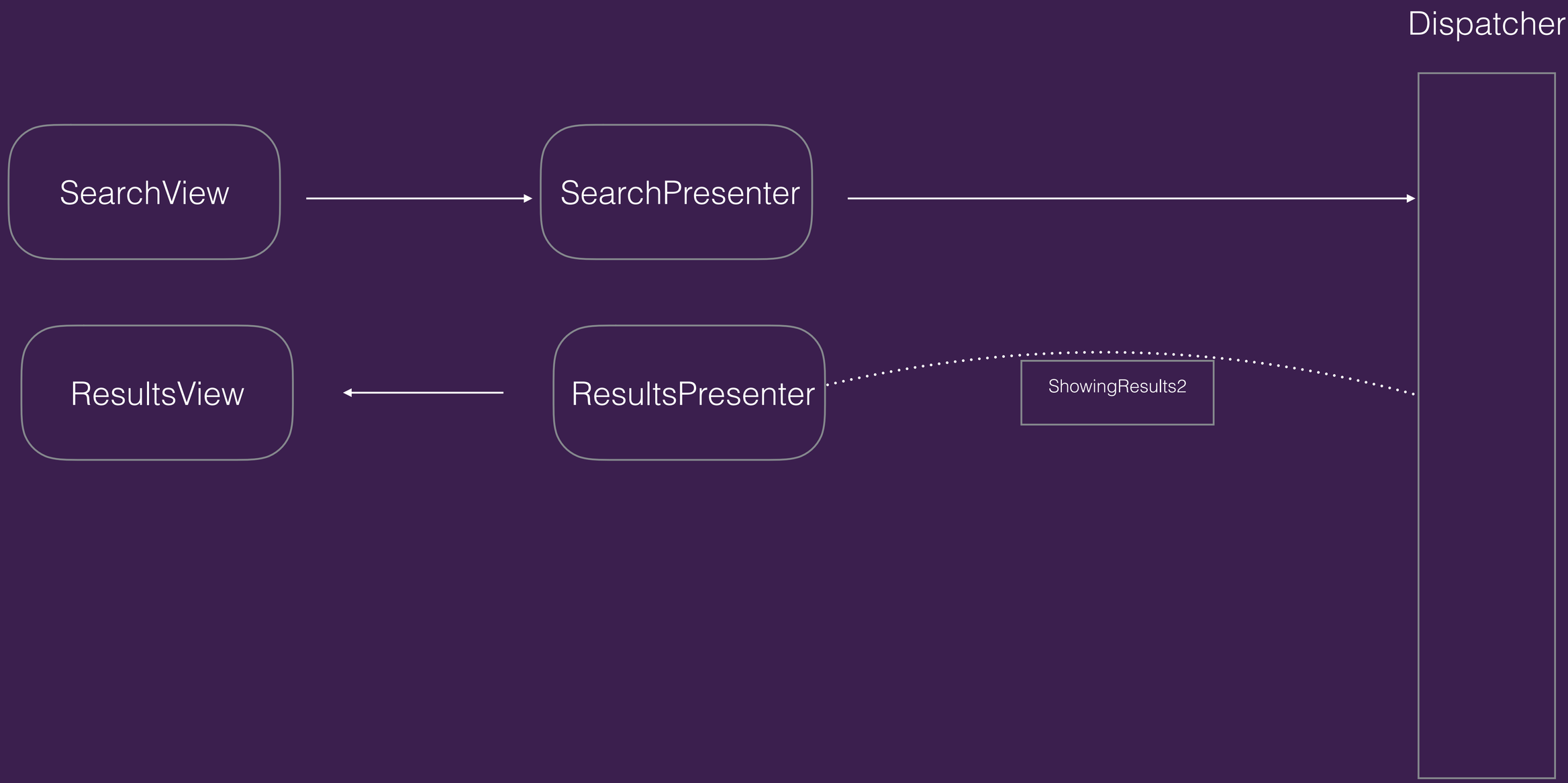
Reactive state



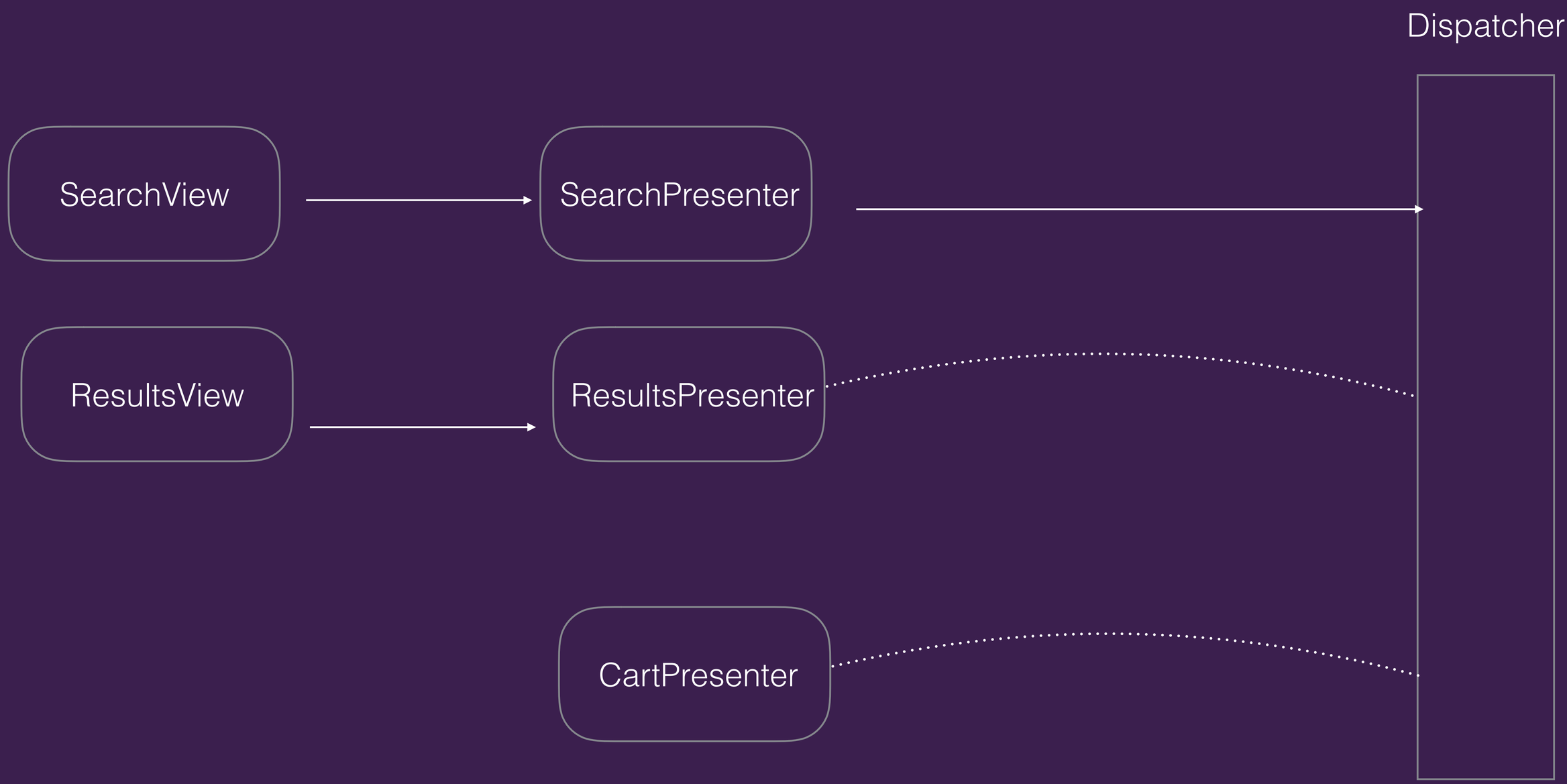
Reactive state



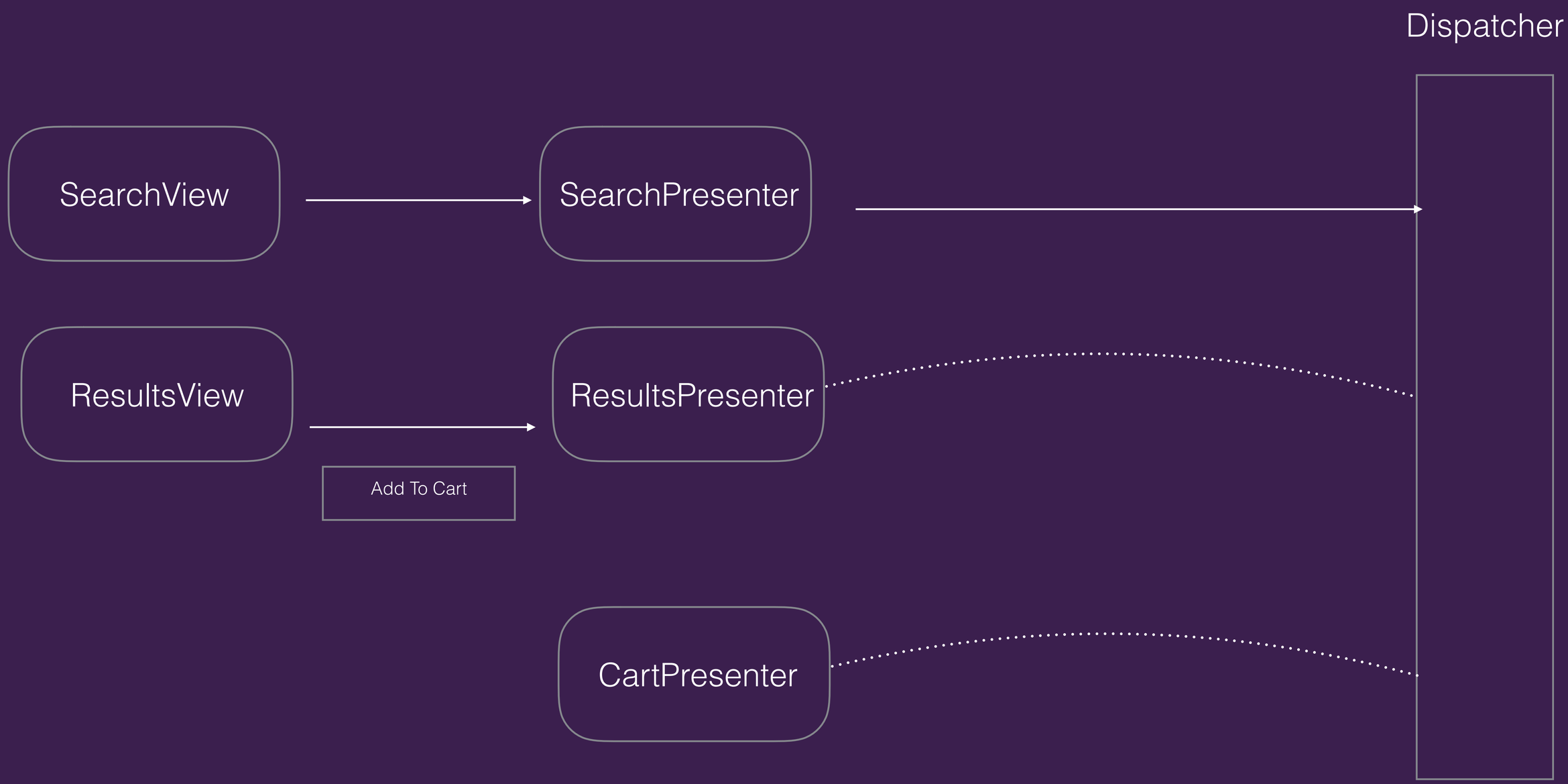
Reactive state



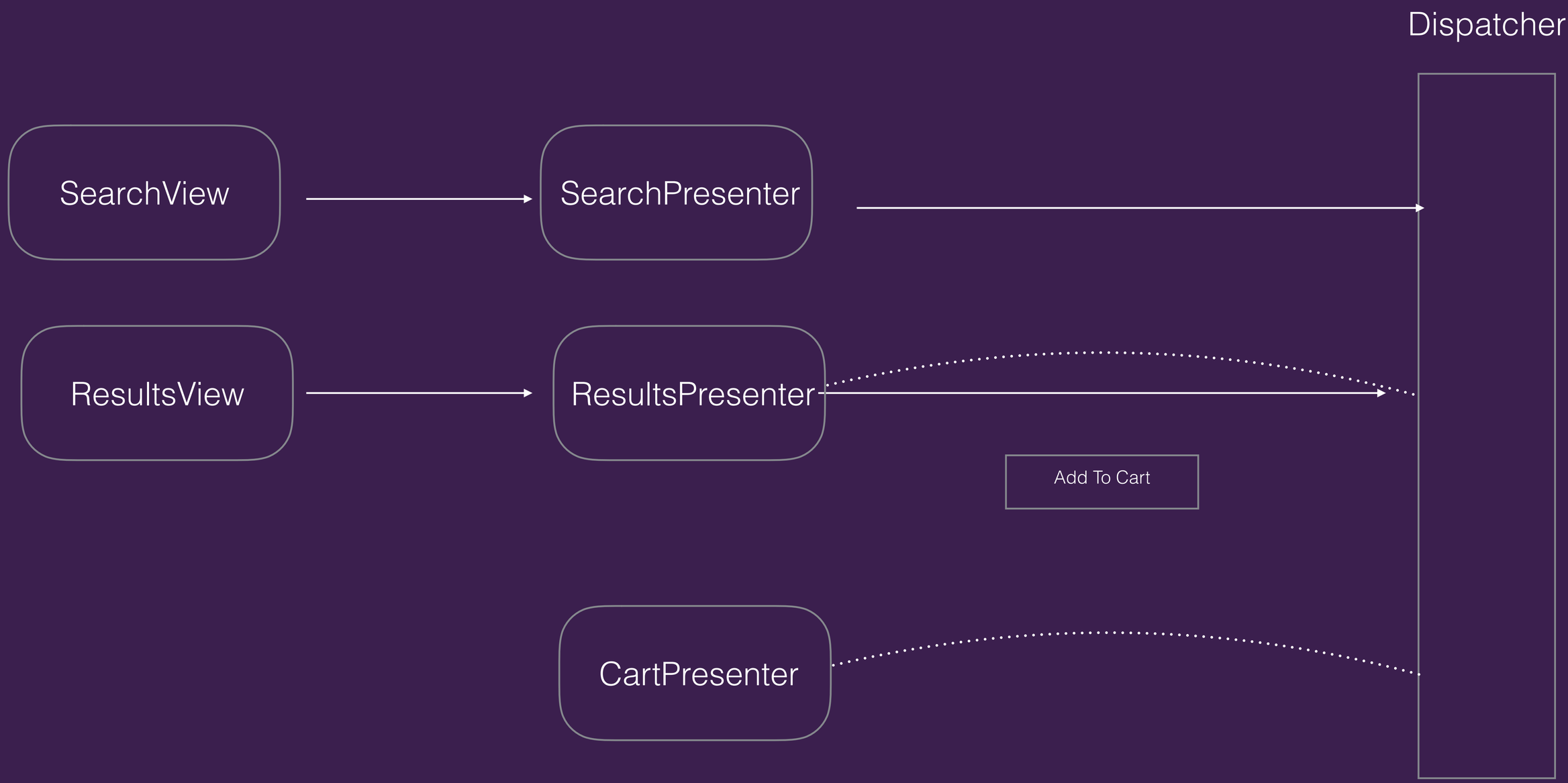
Reactive state



More state


Dispatcher
SearchView
SearchPresenter
ResultsView
ResultsPresenter
Add To Cart
CartPresenter

More state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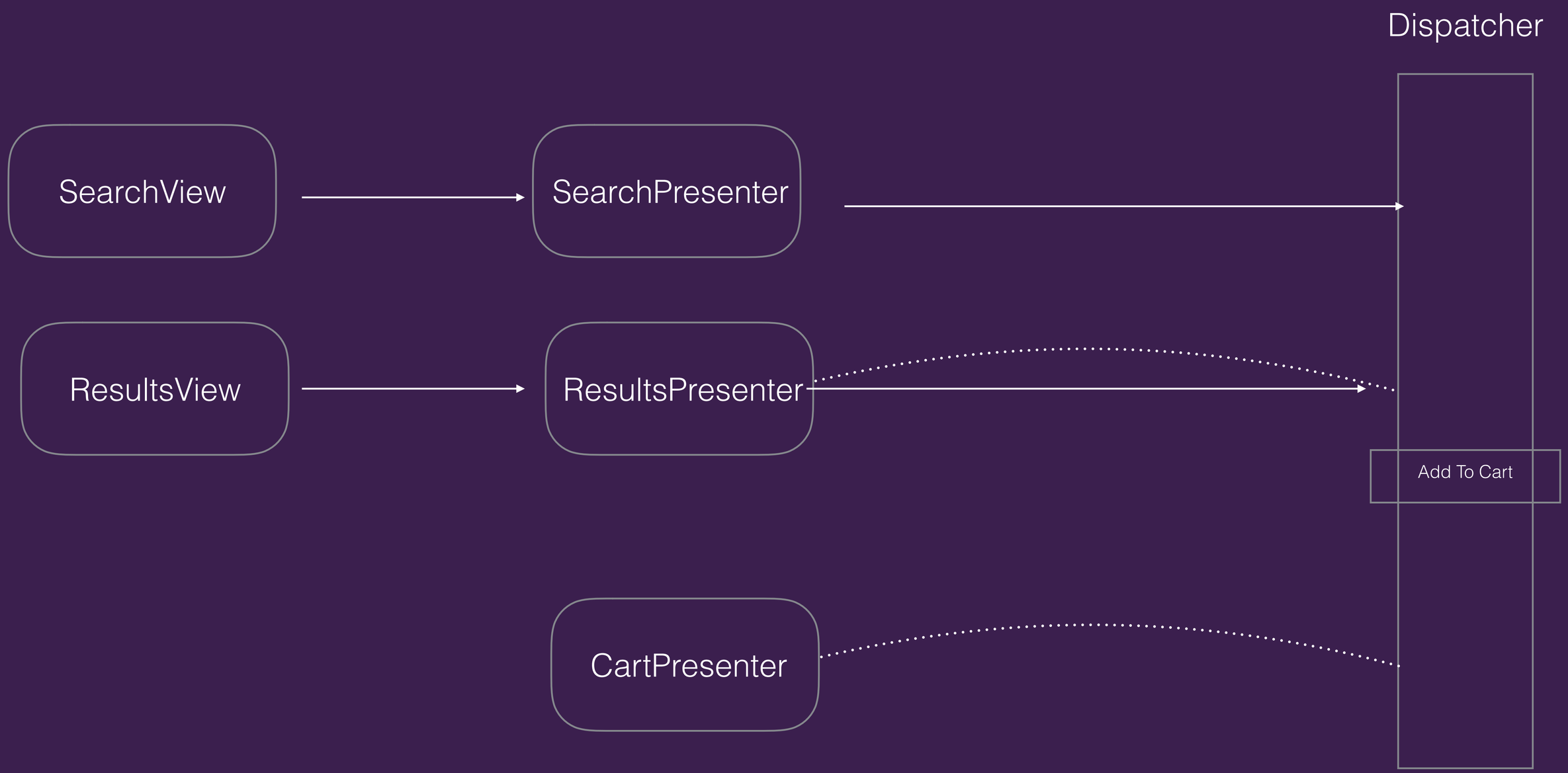
More state


Dispatcher
SearchView
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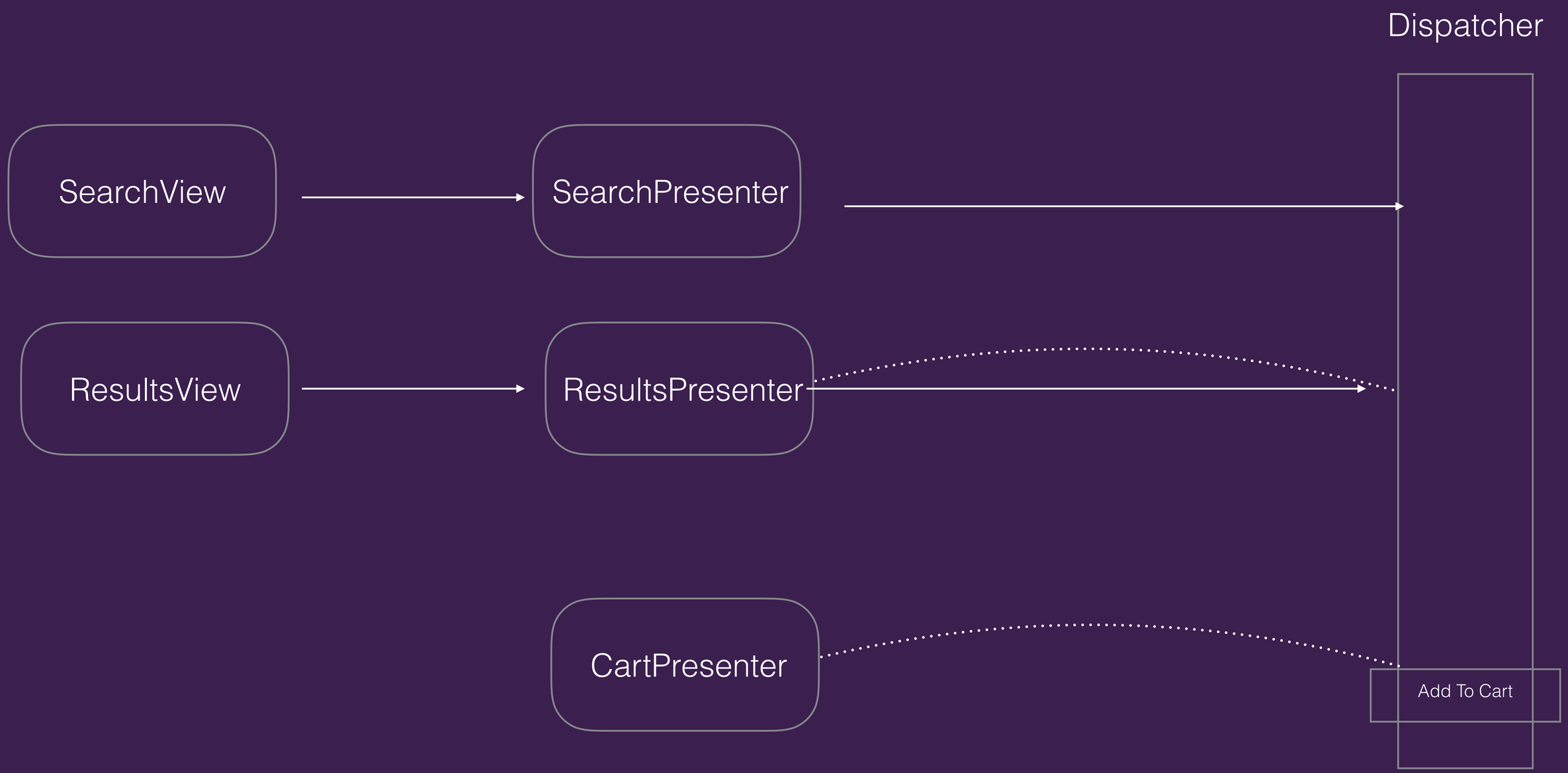
Add To Cart
CartPresenter

More state


Dispatcher
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ResultsView
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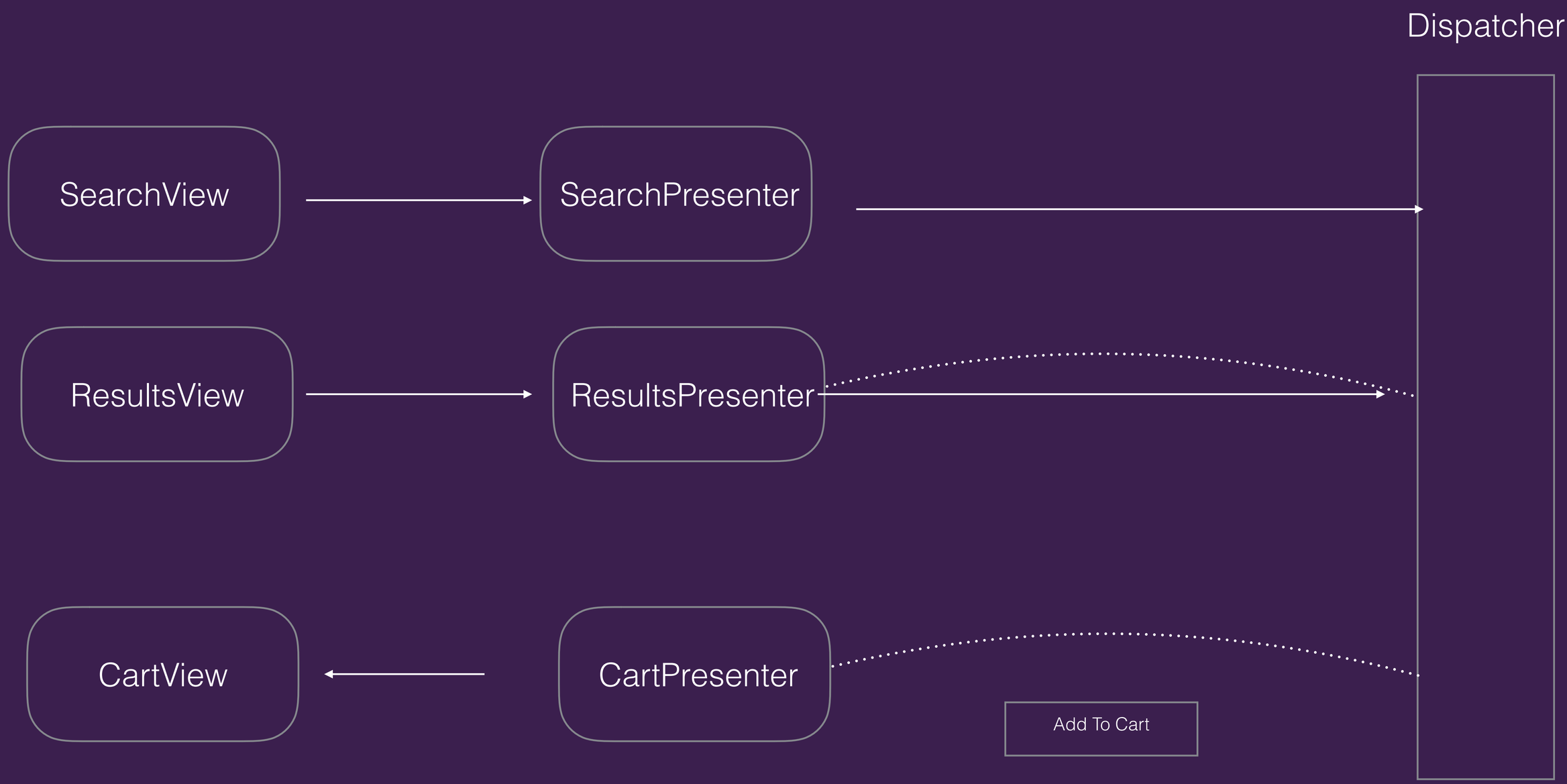
CartPresenter
Add To Cart

More state


Dispatcher
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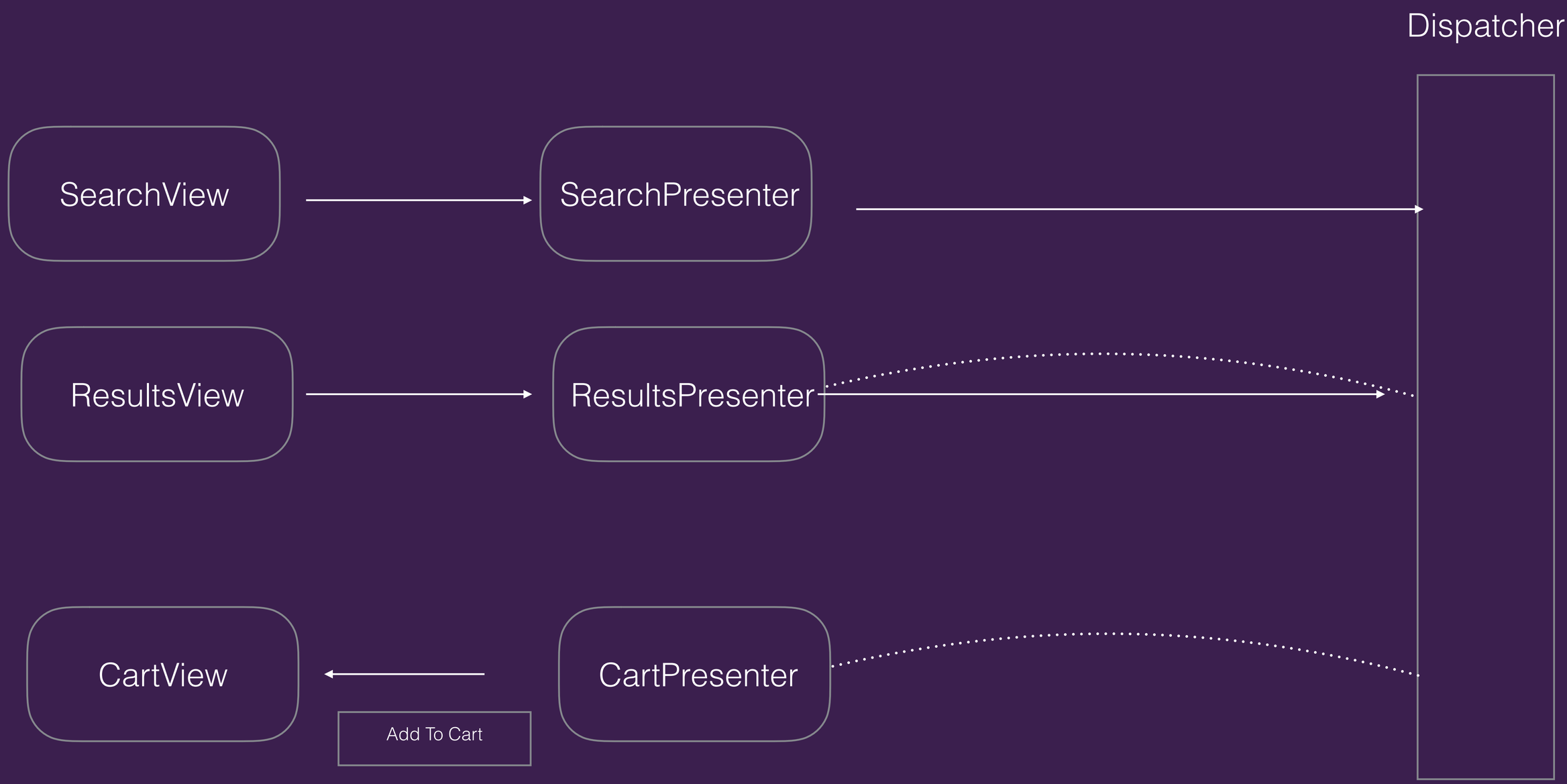
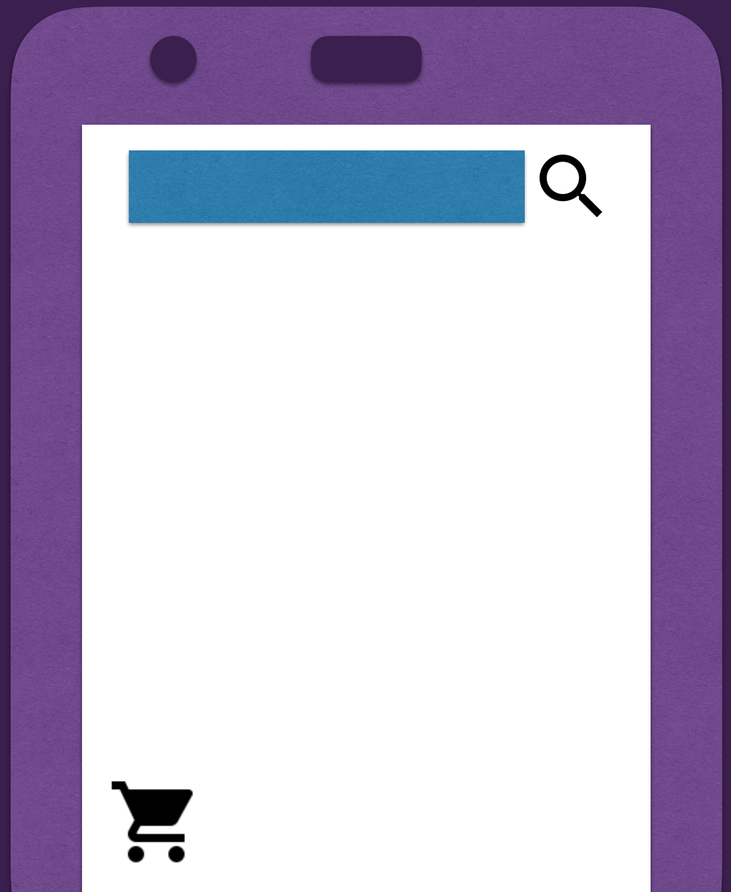
ResultsView
ResultsPresenter
CartView
CartPresenter
Add To Cart

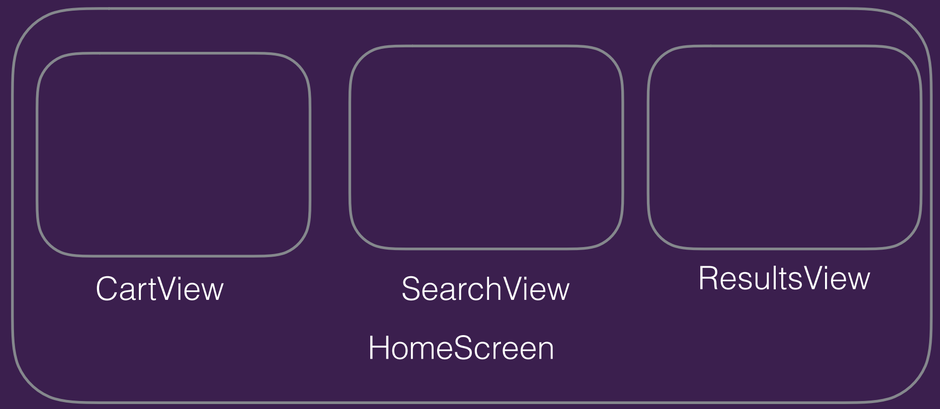
More state


Dispatcher
SearchView
SearchPresenter
ResultsView
ResultsPresenter
CartView
CartPresenter
Add To Cart

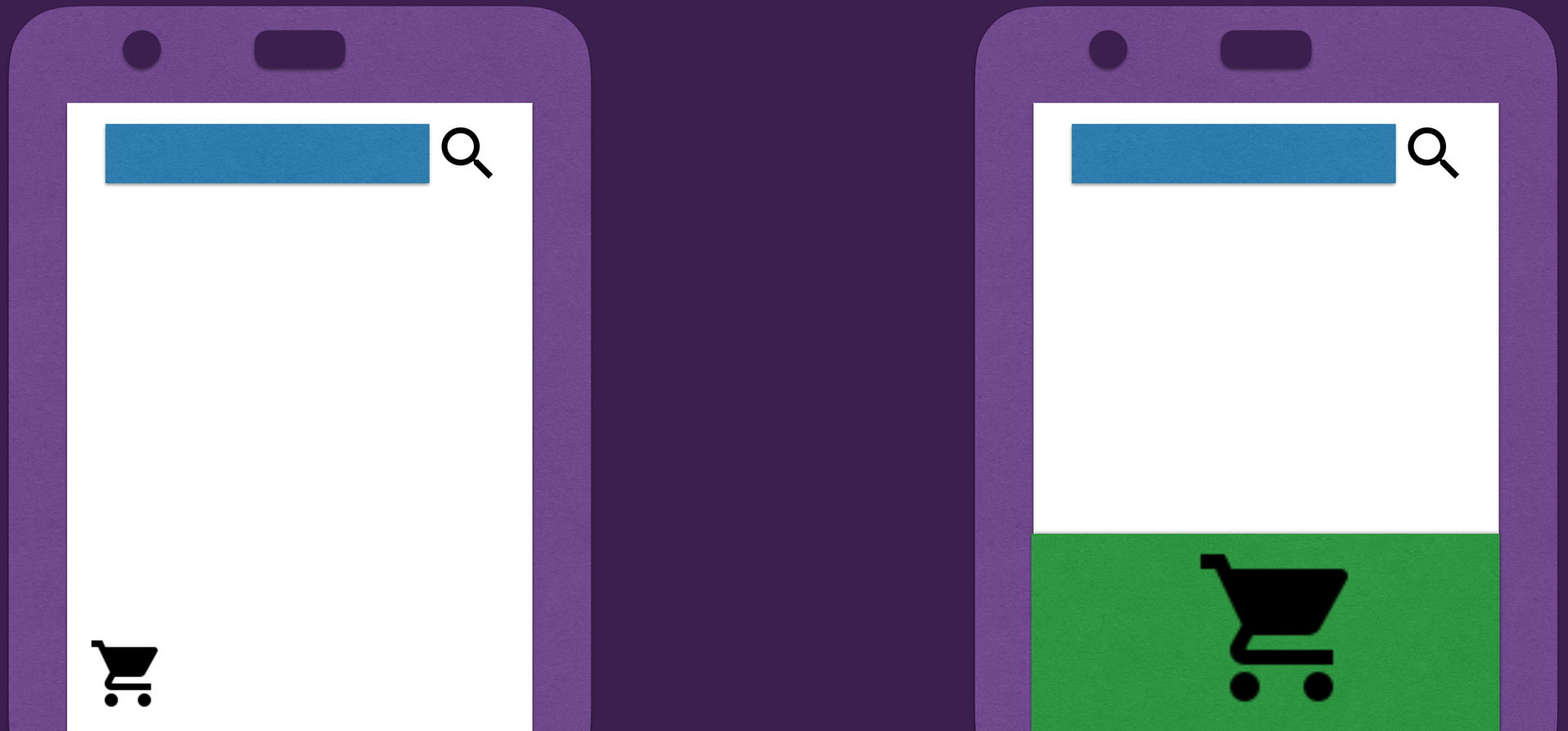

Emitting data is nice…
How about showing/hiding views?

When user clicks on cart, we should show the cart view





How?




We can combine state changes
through composition

Showing states

```
sealed class State {
    object Cart : State()
    data class Showing(val state: State) : State()
}
```

Showing states

```
sealed class State {
    object Cart : State()
    data class Showing(val state: State) : State()
}

dispatcher.dispatch(State.Showing(Cart))
```

Showing states

```
interface RxState {
    fun showingNot(clazz: Class<out Screen>): Observable<Showing>
    fun showing(clazz: Class<out Screen>): Observable<Showing>
}
```

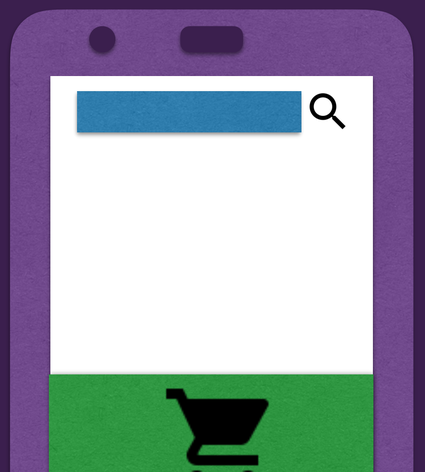
```
rxState.showing(Cart::class.java))
                .subscribe({
                    mvpView.showCart()
                }))
```

We can show/hide views based on showing states

```
rxState.showing(Cart::class.java))
        .subscribe({
            mvpView.showCart()
        }))

rxState.showingNot(Cart::class.java))
        .subscribe({
            mvpView.hide()
        }))
```

Dispatching showing cart

```
dispatcher.dispatch(State.Showing(Cart))
```



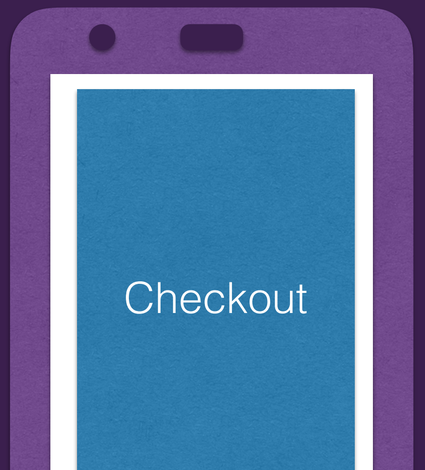
```
rxState.showing(Cart::class.java))
        .subscribe({
            mvpView.showCart()
        }))

rxState.showingNot(Cart::class.java))
        .subscribe({
            mvpView.hide()
        }))
```

Dispatching Showing Checkout

```
dispatcher.dispatch(State.Showing(Checkout))
```

```
rxState.showing(Cart::class.java))
        .subscribe({
            mvpView.showCart()
        }))
```

```
rxState.showingNot(Cart::class.java))
        .subscribe({
            mvpView.hide()
        }))
```



Showing/hiding works well
when all views attached

Showing/hiding works well
when all views attached

Not very scalable in real apps

How do we deal with deep flows?

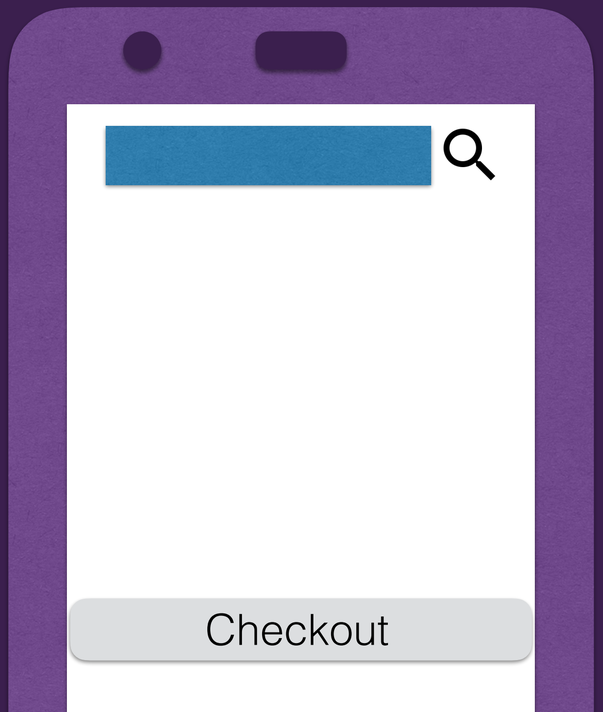
How do we deal with deep flows?

Treat screen creation/routing as a state change


Dispatching screens workflow

CartView

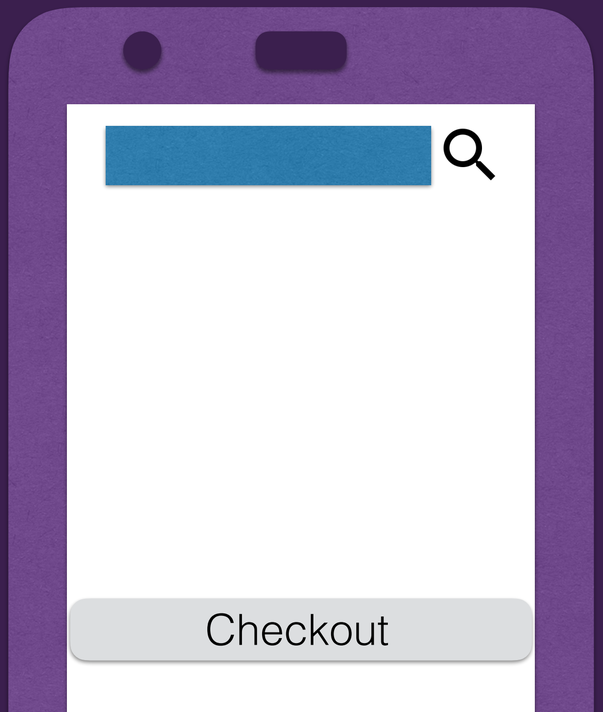
CartPresenter



CartView

Go To Checkout

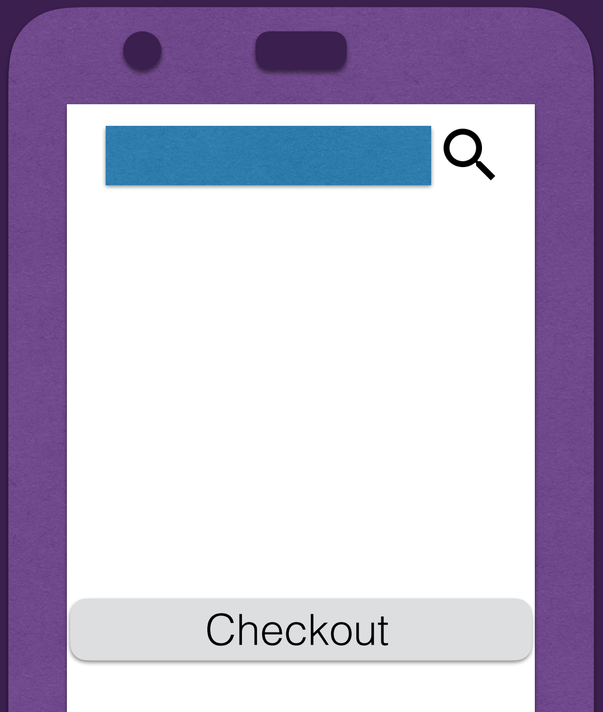
CartPresenter



CartView

CartPresenter

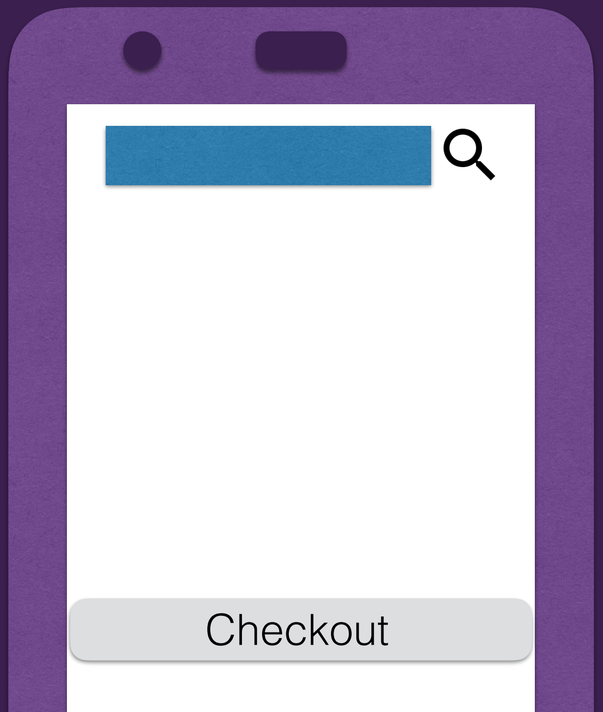
Screen.Checkout



CartView

CartPresenter

Screen.Checkout

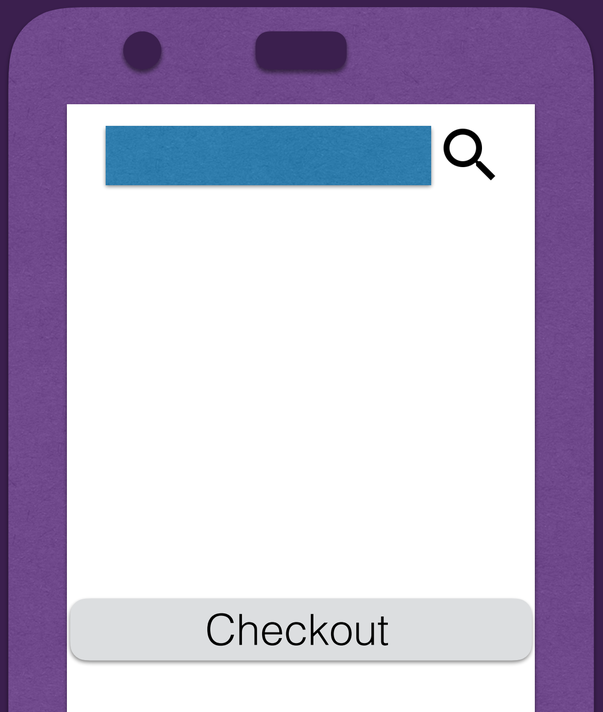


CartView

CartPresenter

ScreenCreator

Creating(Screen.Checkout)

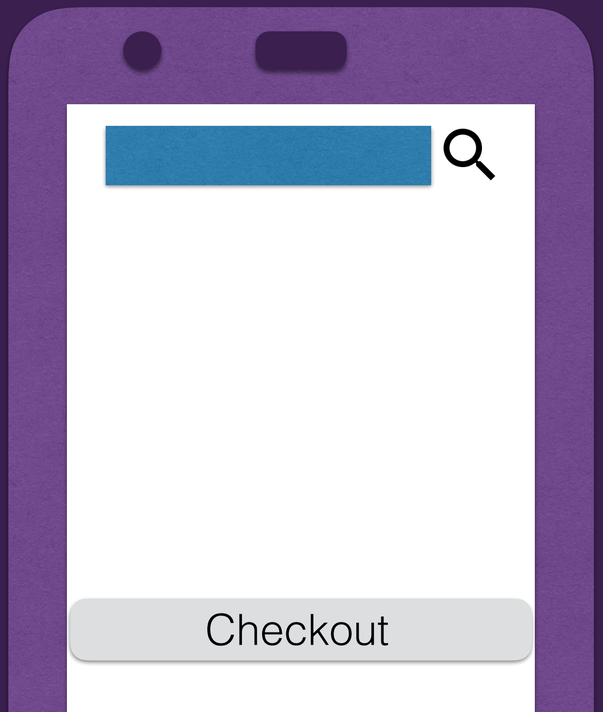


CartView

CartPresenter

Creating(Screen.Checkout)

ScreenCreator



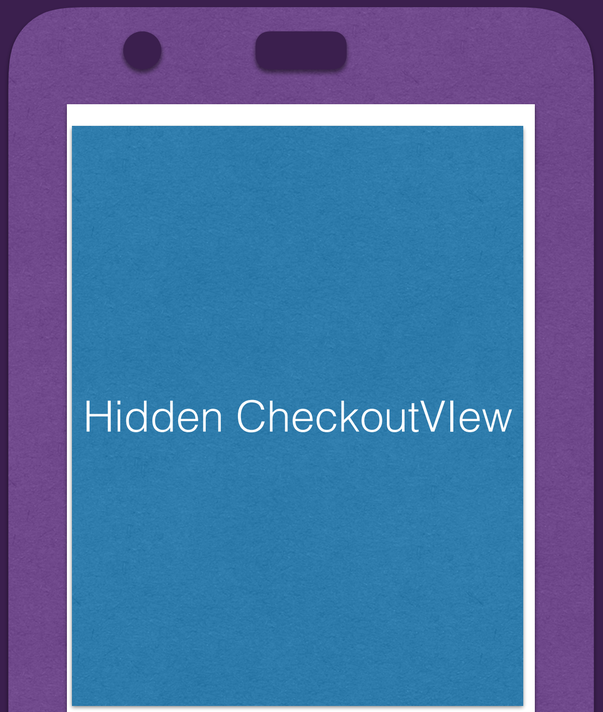
CartView

CartPresenter

Screen.Checkout
ScreenCreator

CheckoutPresenter

CheckoutView



CartView

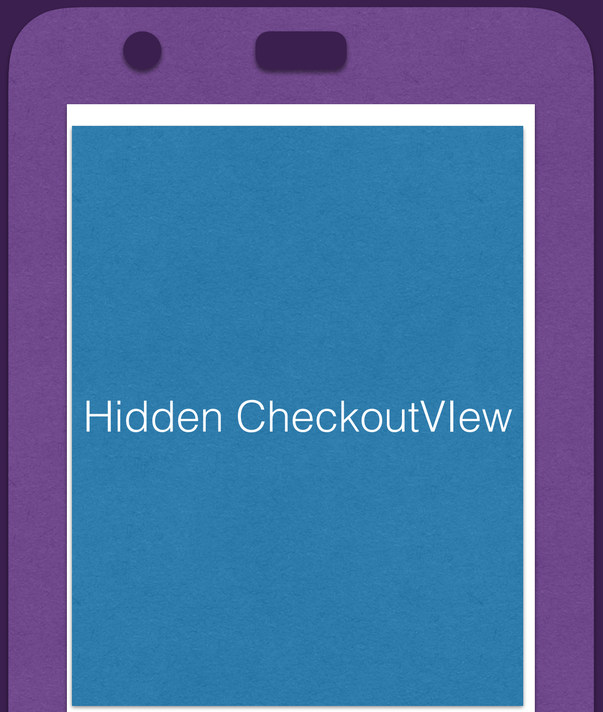
CartPresenter

ScreenCreator

Showing(Screen.Checkout)

CheckoutPresenter

CheckoutView



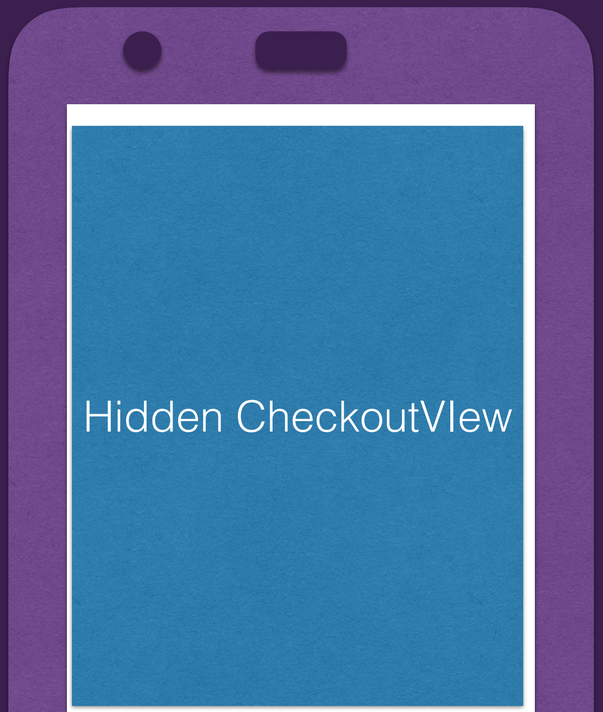
CartView

CartPresenter

ScreenCreator

CheckoutPresenter

CheckoutView



Showing(Screen.Checkout)

CartView

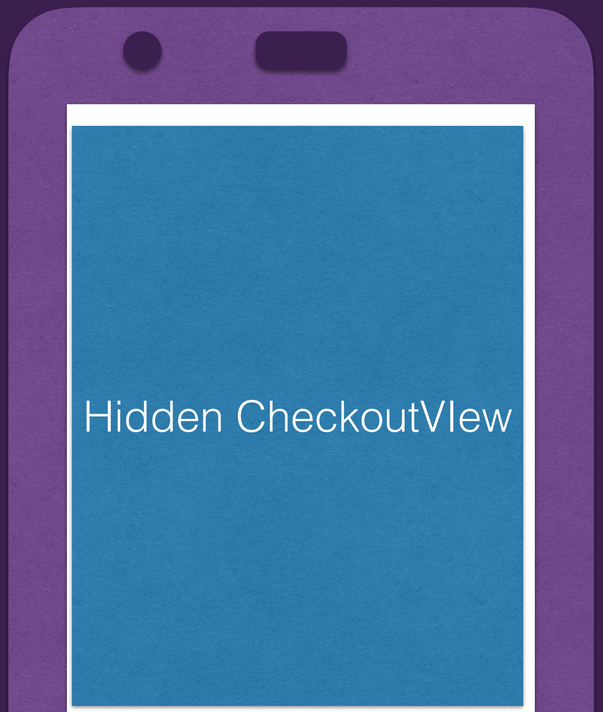
CartPresenter

ScreenCreator

CheckoutPresenter

Showing(Screen.Checkout)

CheckoutView

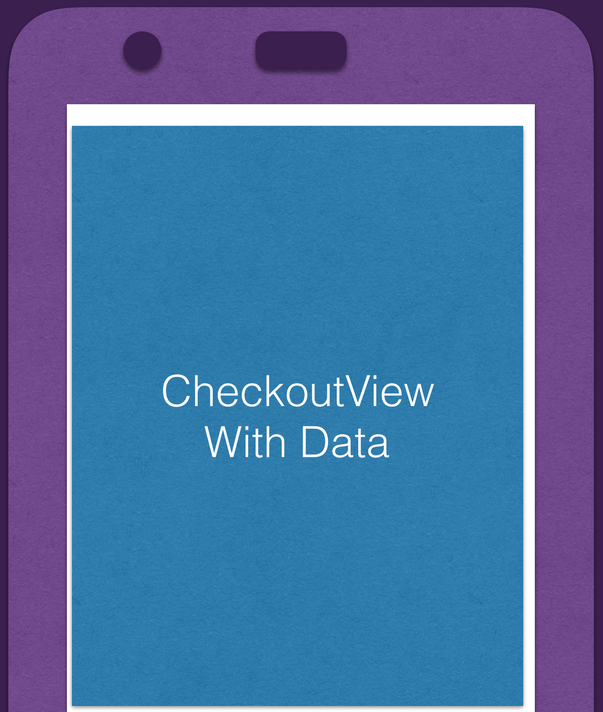


CartView

CartPresenter

ScreenCreator

CheckoutPresenter



Showing(Screen.Checkout)

CheckoutView

View tells presenter to go to new screen

```
presenter.openCart()
```

Presenter dispatches new screen state

```
sealed class Screen : State() {
    data class Checkout(val payload:String) : Screen()
}
dispatcher.dispatch(Screen.Checkout)
```

Dispatcher encapsulates in a creating state

```
dispatcher.dispatch(Creating(Screen.Checkout))
```

Screen creator creates view/presenter

```
rxState.creating()
        .subscribe({
            createScreen(it)
        })
```

Dispatches a showing state

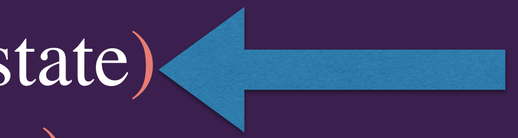
```
rxState.creating()
        .subscribe({
            createScreen(it)
            dispatcher.dispatch(Showing(it.screen))
        })
```

Dispatcher adds each showing event to a back stack

```
override fun dispatch(state: State) {
        when (state) {
            is Showing->{
                backstack.push(state)
                rxState.push(state)
            }
            else -> rxState.push(state)
        }
}
```

Dispatcher adds each showing event to a back stack

```
override fun dispatch(state: State) {
    when (state) {
        is Showing->{
            backstack.push(state)
            rxState.push(state)
        }
        else -> rxState.push(state)
    }
}
```



```
val backstack: Stack<Showing> = Stack()
```

Dispatcher pushes new state to subscribers

```
override fun dispatch(state: State) {
        when (state) {
            is Showing->{
                backstack.push(state)
                rxState.push(state)
            }
            else -> rxState.push(state)
        }
}
```

Presenter reacts to the showing state

```
override fun attachView(mvpView: CheckoutMVPView) {
        rxState.showing(Screen.Checkout::class.java)
                .observeOn(AndroidSchedulers.mainThread())
                .subscribe { mvpView.show() }
```

Screens = States

```
sealed class Screen : State() {
    object Search : Screen()
    object Cart:Screen()
    Data class Checkout(val items:List<Item>) : Screen()
    data class Payment(val items:List<Item>) : Screen()
}
```

Routing becomes a state change

```
sealed class Screen : State() {
    object Search : Screen()
    object Cart:Screen()
    Data class Checkout(val items:List<Item>) : Screen()
    data class Payment(val items:List<Item>) : Screen()
}
```

```
fun goToSearch() {dispatcher.dispatch(Screen.Search)}
fun openCart() { dispatcher.dispatch(Screen.Cart) }

fun submitNames(firstName: String, lastName: String) {
    userRepository.update(firstName, lastName)
        .subscribe { dispatcher.dispatch(Screen.CheckoutPayment(cartItems)) }
}
```

Need to go back?

Dispatcher.goBack()

```
interface Dispatcher {
    fun dispatch(state: State)
    fun goBack()
}
```

```
override fun onBackPressed() {
    dispatcher.goBack()
}
```

Dispatcher.goBack()

```
interface Dispatcher {
    fun dispatch(state: State)
    fun goBack()
}
```

```
override fun onBackPressed() {
    dispatcher.goBack()
}
```

Dispatcher will pop current showing state and dispatch previous one again

State Stack = Back Stack

```
interface Dispatcher {
    fun dispatch(state: State)
    fun goBack()
}
```

```
override fun onBackPressed() {
    dispatcher.goBack()
}
```

Back Stack = State Stack

```
interface Dispatcher {
    fun dispatch(state: State)
    fun goBack()
}
```

```
override fun onBackPressed() {
    dispatcher.goBack()
}
```

Routing becomes a state change

Every view interaction becomes a state change

Your UI becomes a representation of dispatched state

Which is dispatched by your UI

TLDR: Your app becomes a cycle

TLDR: Your app becomes a cycle
User interacts with view

TLDR: Your app becomes a cycle
User interacts with view
View dispatches state change

TLDR: Your app becomes a cycle
User interacts with view
View dispatches state change
View reacts to state change

TLDR: Your app becomes a cycle

User interacts with view

View dispatches state change

View reacts to state change

User interacts with view

github.com/
digitalbuddha/Dispatcher

Big thank you to Efeturi
Money for the UI