# Reactive Jersey Client

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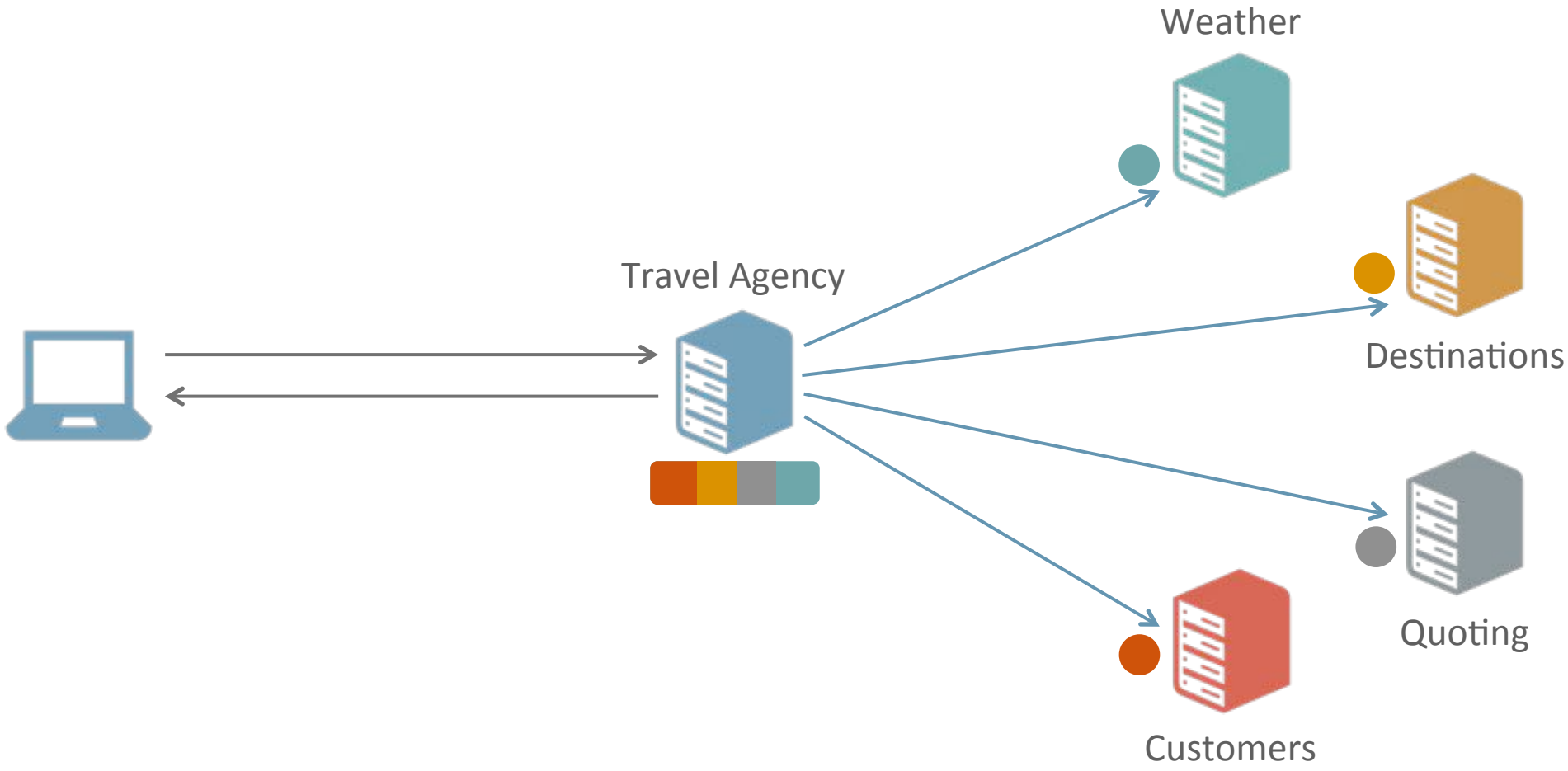
# The Problem

## A Travel Agency

# Orchestrating Services

## A Travel Agency Service



# The Why

# The Why

## Building an Orchestration Layer

- Client specific API
  - Different needs for various devices: screen size, payment methods, ...
- Single Entry Point
  - No need to communicate with multiple services
- Thinner client
  - No need to consume different formats of data
- Less frequent client updates
  - Doesn't matter if one service is removed in favor of another service

# The How

## JAX-RS 2.0 and Jersey 2

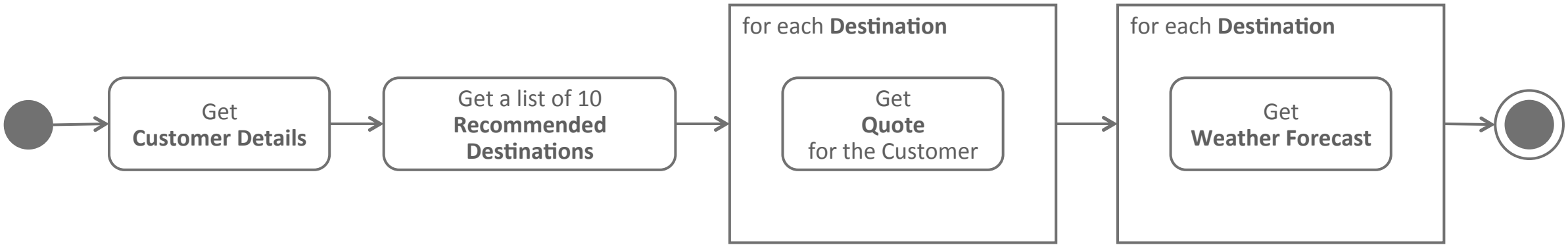
# Demo Application

## Exposed resources

- “Remote”
  - application/json, application/xml
  - delays
- “Agent”
  - application/json
  - dependent calls

# Implementing the Service

## A Naïve Approach



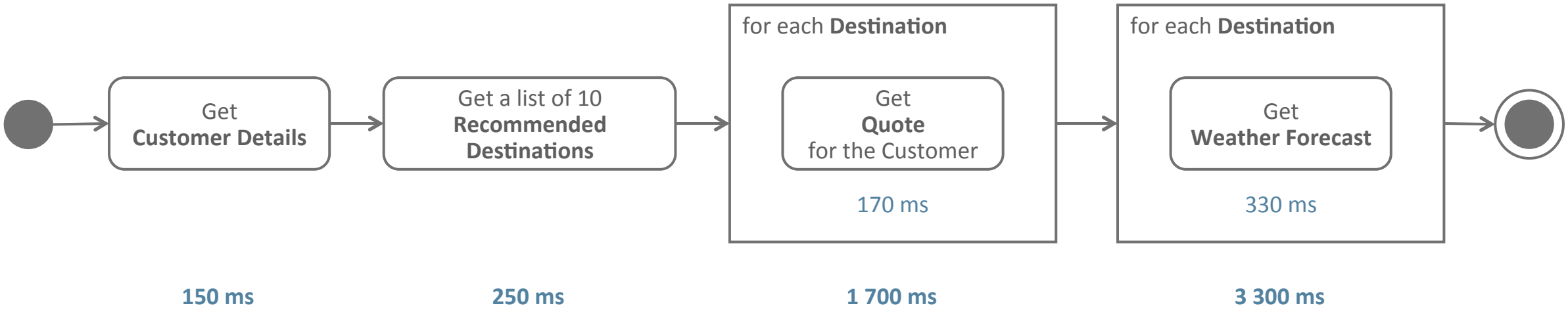
# JAX-RS 2.0 Client – Synchronous

```
Client client = ClientBuilder.newClient();

WebTarget rx = client.target("http://example.com/rx").register(JacksonFeature.class);

WebTarget forecasts = rx.path("remote/forecast/{destination}");

Forecast forecast = forecasts.resolveTemplate("destination", dest.getDestination())
                             .request("application/xml")
                             .get(Forecast.class);
```

# DEMO

# Implementing the Service

## A Naïve Approach



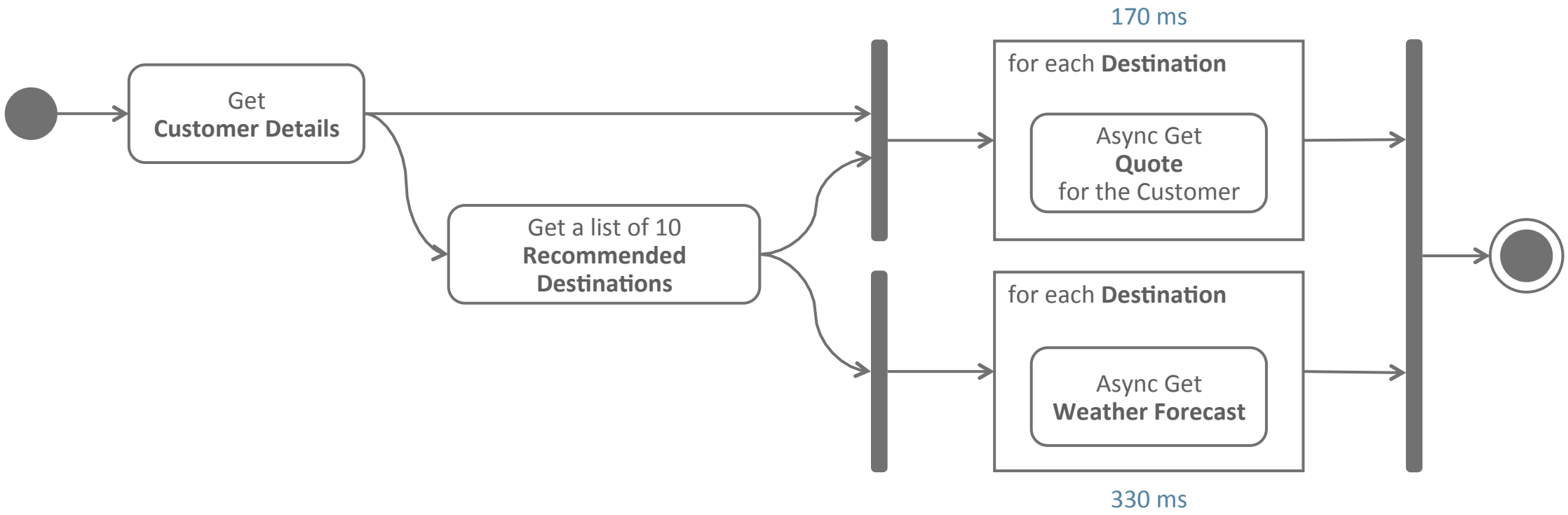

**5 400 ms**

# Client – Synchronous Approach

- Easy to read, understand and debug
  - Simple requests, Composed requests
- Slow
  - Sequential processing even for independent requests
- Wasting resources
  - Waiting threads
- Suitable for
  - Lower number of requests
  - Single request that depends on the result of previous operation

# Implementing the Service

## Optimized Approach



# JAX-RS 2.0 Client – Asynchronous

```
Future<Forecast> forecast = forecasts.resolveTemplate("destination", d.getDestination())
                                     .request()
                                     .async()
                                     .get(new InvocationCallback<Forecast>() {
                                         @Override
                                         public void completed(Forecast forecast) {
                                             // Do Something.
                                         }

                                        @Override
                                        public void failed(Throwable throwable) {
                                            // Do Something else.
                                        }
                                     });
while (!forecast.isDone()) {
    // Do Something.
}
System.out.println(forecast.get());
```

# DEMO

# Client – Asynchronous Approach

**Futures**

- Returns immediately after submitting a request
  - Future
- Harder to understand, debug
  - Especially when dealing with multiple futures
- Fast
  - Each request can run on a separate thread
  - Need to actively check for completion event (future.isDone()) or block (slow)

# Client – Asynchronous Approach

## The Callback Hell

- "Don't call us, we'll call you"
- Harder to read, understand and debug
  - Especially for composed calls (dependent)
- Need to find out when all Async requests finished
  - Relevant only for 2 or more requests (CountDownLatch)
- Fast
  - Each request can run on a separate thread
- Suitable for
  - Many independent calls

# Beyond The Callback Hell

## Reactive (Jersey) Client

# Client – Reactive Approach

- Data-Flows
  - Execution model propagates changes through the flow
- Asynchronous
  - Preferably, Speed
- Event-based
  - Notify user code or another item in flow about continuation, error, completion
- Composable
  - Compose/Transform multiple flows into the resulting one

# Reactive Java Libraries

- RxJava – `Observable`
  - Analogy to `Iterable`
  - Currently most advanced reactive API in Java
  - Contributed by Netflix – hardened & tested in production
- Java SE 8 – `CompletionStage` and `CompletableFuture`
  - Native part of JDK
  - Fits the new Java `Stream` API programming model
  - JSR166e – Support for `CompletableFuture` on Java SE 6 and Java SE 7
- Guava – `ListenableFuture` and `Futures`
  - Similar to Java SE 8

# Observable

- Observable (push)
  - retrieve data – `onNext(T)`
  - discover error – `onError(Exception)`
  - complete – `onCompleted()`
- Iterable (pull)
  - retrieve data – `T next()`
  - discover error – throws `Exception`
  - complete – `!hasNext()`

# An Observable<Response> Example

```
Observable<Response> response = … ;

List<String> visited = new ArrayList<>(10);

// Read a list of destinations from JAX-RS response
response.map(resp -> resp.readEntity(new GenericType<List<Destination>>() {}))
        // If an exception is thrown, continue with an empty list
        .onErrorReturn(throwable -> Collections.emptyList())
        // Emit list of destinations as a new Observable
        .flatMap(Observable::from)
        // Take the first 10 destinations
        .take(10)
        // Obtain a string representation of a destination
        .map(Destination::getDestination)
        // Observe the destination events on a separate thread
        .observeOn(Schedulers.io())
        // Subscribe to callbacks – OnNext, OnError, OnComplete
        .subscribe(visited::add, async::resume, () -> async.resume(visited));
```

# Reactive Jersey Client

## Extension of JAX-RS Client

- Remember `#request()` and `#request().async()` ?
  - request() returns **Invocation.Builder**; **SyncInvoker** – sync HTTP methods
  - request().async() returns **AsyncInvoker** – async HTTP methods
- **`#rx()`** and **`#rx(ExecutorService)`**
  - Return an extension of RxInvoker

# SyncInvoker and AsyncInvoker

```
public interface SyncInvoker {

    Response get();

    <T> T get(Class<T> responseType);

    <T> T get(GenericType<T> responseType);

    // ...
}

public interface AsyncInvoker {

    Future<Response> get();

    <T> Future<T> get(Class<T> responseType);

    <T> Future<T> get(GenericType<T> responseType);

    // ...
}
```

# RxInvoker and an extension Example

```
public interface RxInvoker<T> {

    T get();

    <R> T get(Class<R> responseType);

    <R> T get(GenericType<R> responseType);

    // ...
}

public interface RxObservableInvoker extends RxInvoker<Observable> {

    Observable<Response> get();

    <T> Observable<T> get(Class<T> responseType);

    <T> Observable<T> get(GenericType<T> responseType);

    // ...
}
```

# Reactive Jersey Client – contd

## Extension of JAX-RS Client

- Affected JAX-RS interfaces
  - RxInvocationBuilder<RX extends RxInvoker> extends Invocation.Builder
  - RxWebTarget<RX extends RxInvoker> extends WebTarget
  - RxClient<RX extends RxInvoker> extends Client
- Rx class
  - RxObservable
  - RxCompletionStage
  - RxListenableFuture
  - RxCompletableFuture (JSR 166e)

# Reactive Client – Creation

```
Client client = ClientBuilder.newClient();
WebTarget target = client.target("...");


// Rx
RxClient<RxObservableInvoker> rxClient = Rx.newClient(RxObservableInvoker.class);
RxClient<RxObservableInvoker> rxClient = Rx.client(client, RxObservableInvoker.class);

RxWebTarget<RxObservableInvoker> rxTarget =
    Rx.target(target, RxObservableInvoker.class);


// RxObservable
RxClient<RxObservableInvoker> rxClient = RxObservable.newClient();
RxClient<RxObservableInvoker> rxClient = RxObservable.client(client);

RxWebTarget<RxObservableInvoker> rxTarget = RxObservable.target(target);
```

# DEMO

# Q&A

# Resources

## JAX-RS and Jersey

- JAX-RS Client API
  - https://jax-rs-spec.java.net/nonav/2.0/apidocs/overview-summary.html
  - https://jersey.java.net/documentation/latest/client.html
- Jersey Rx Client
  - https://github.com/jersey/jersey/tree/master/incubator/rx/rx-client
  - https://github.com/jersey/jersey/tree/master/incubator/rx/rx-client-guava
  - https://github.com/jersey/jersey/tree/master/incubator/rx/rx-client-java8
  - https://github.com/jersey/jersey/tree/master/incubator/rx/rx-client-jsr166e
  - https://github.com/jersey/jersey/tree/master/incubator/rx/rx-client-rxjava

# Resources

## Example and Libraries

- 3rd party libraries
  - https://code.google.com/p/guava-libraries/
  - https://github.com/ReactiveX/RxJava
  - http://docs.oracle.com/javase/8/docs/api/java/util/concurrent/package-summary.html
  - http://gee.cs.oswego.edu/dl/concurrency-interest/index.html
- Example (JDK7)
  - https://github.com/jersey/jersey/tree/master/examples/rx-client-webapp