Modernizing systems with Microservices, Hystrix and RxJava

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Wir lösen das – persönlich!

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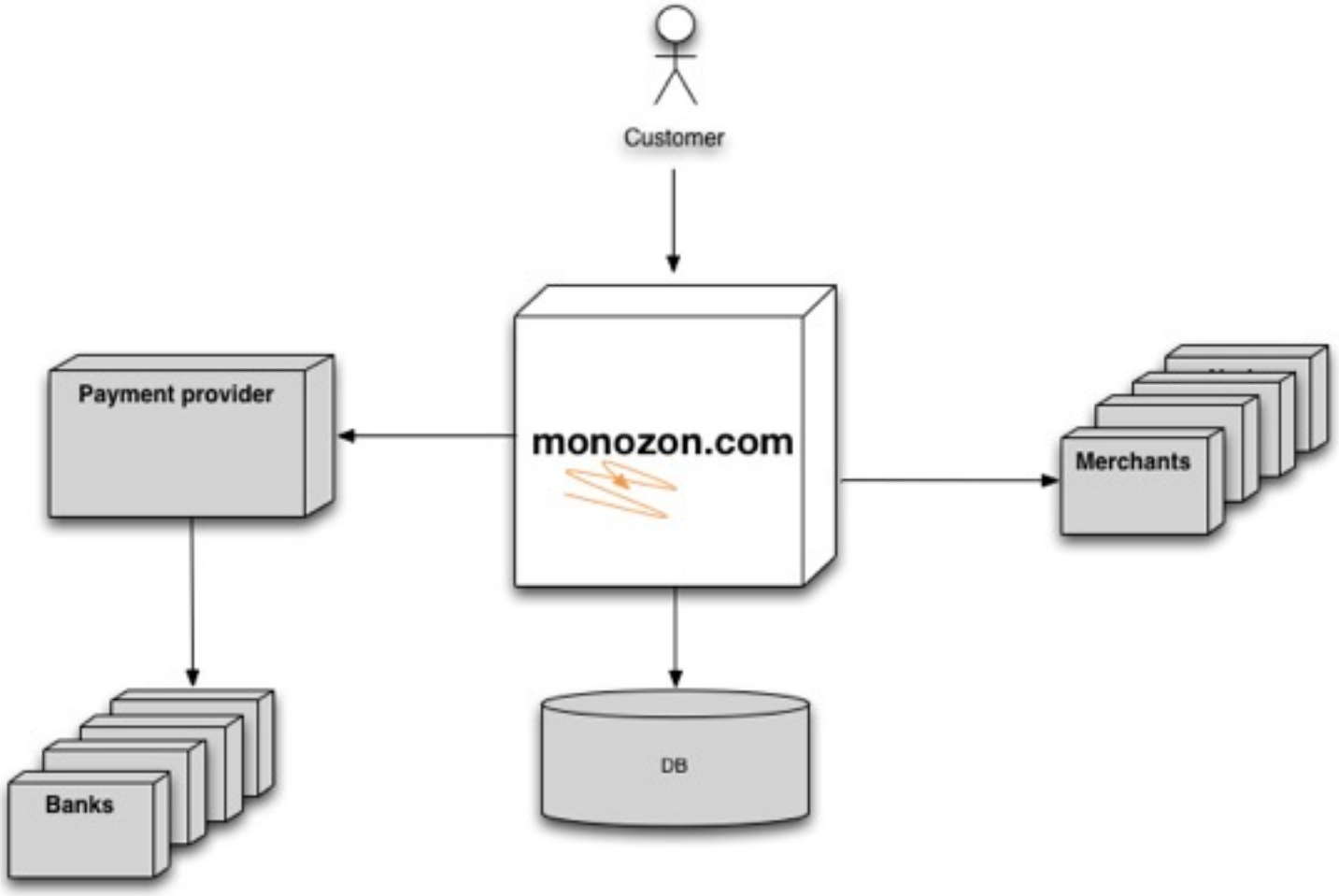
A typical system

The context



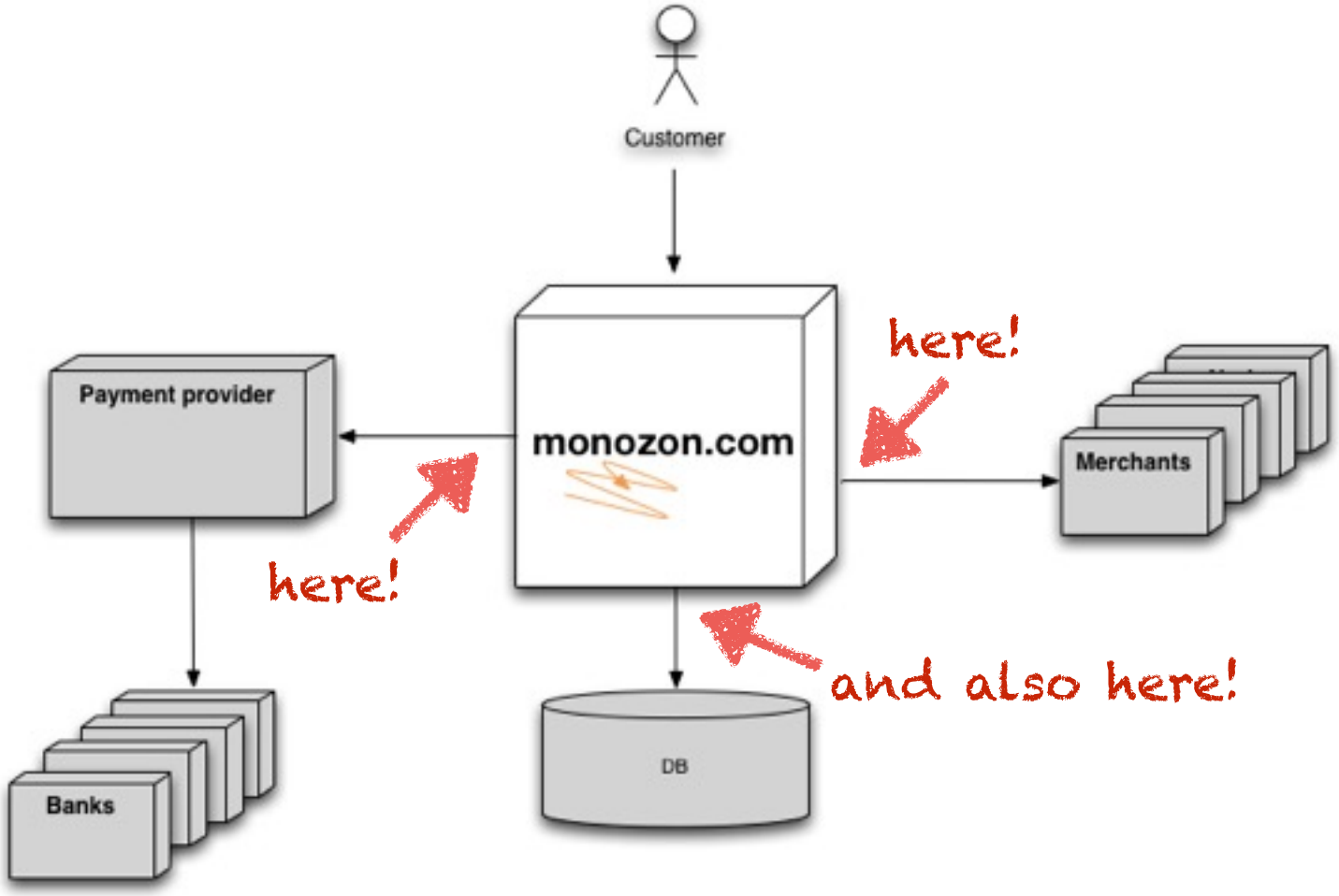
Current problems

- Maintenance is difficult
- New features need a lot of time
- Very unstable
- Outdated technology
- Doesn't scale

+ frustrated developers :(

Stabilize first!

External dependencies



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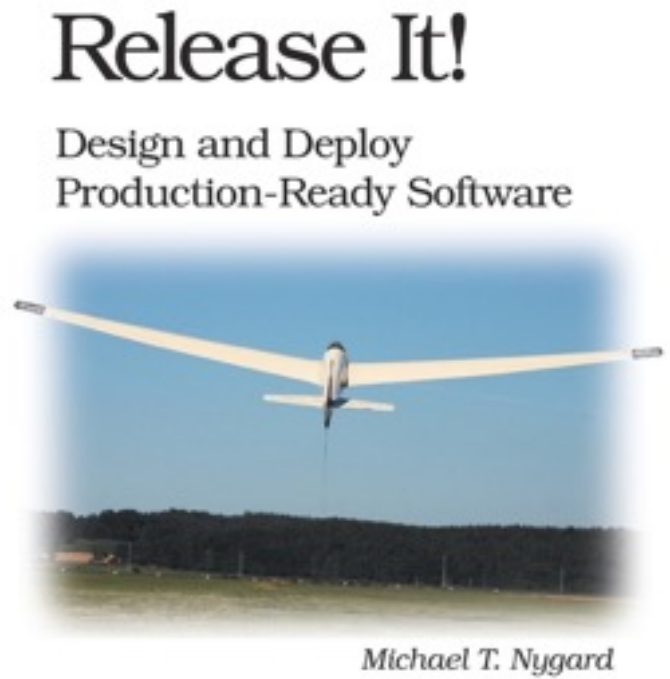
Stability patterns

- Timeouts
- Circuit Breaker
- Bulkheads



... Fail Fast, Steady State , Handshaking, Test Harness, Decoupling Middleware

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Bulkheads

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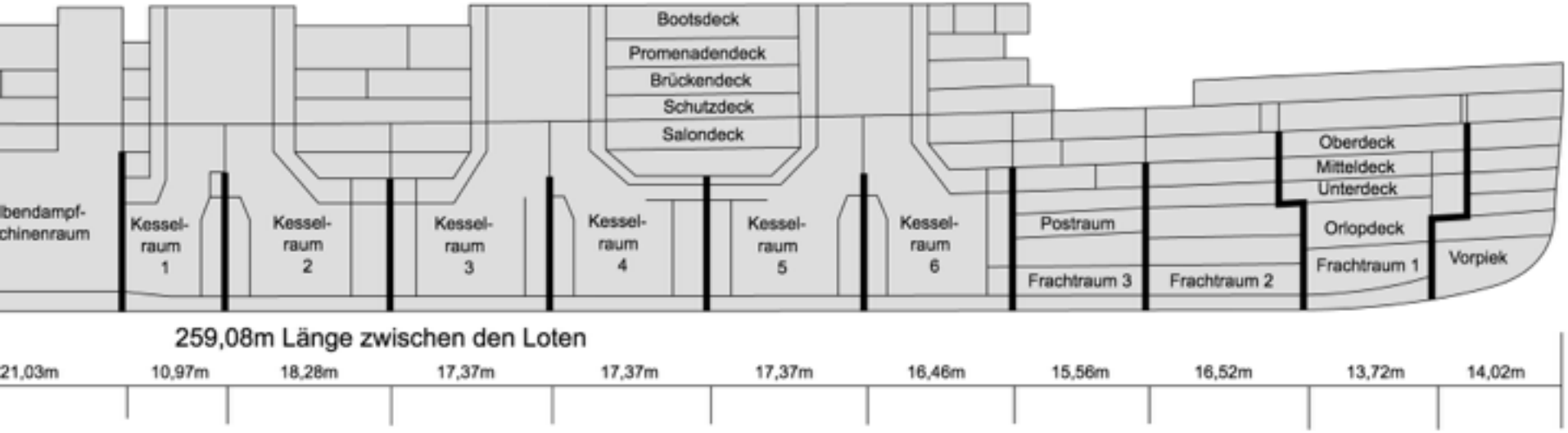
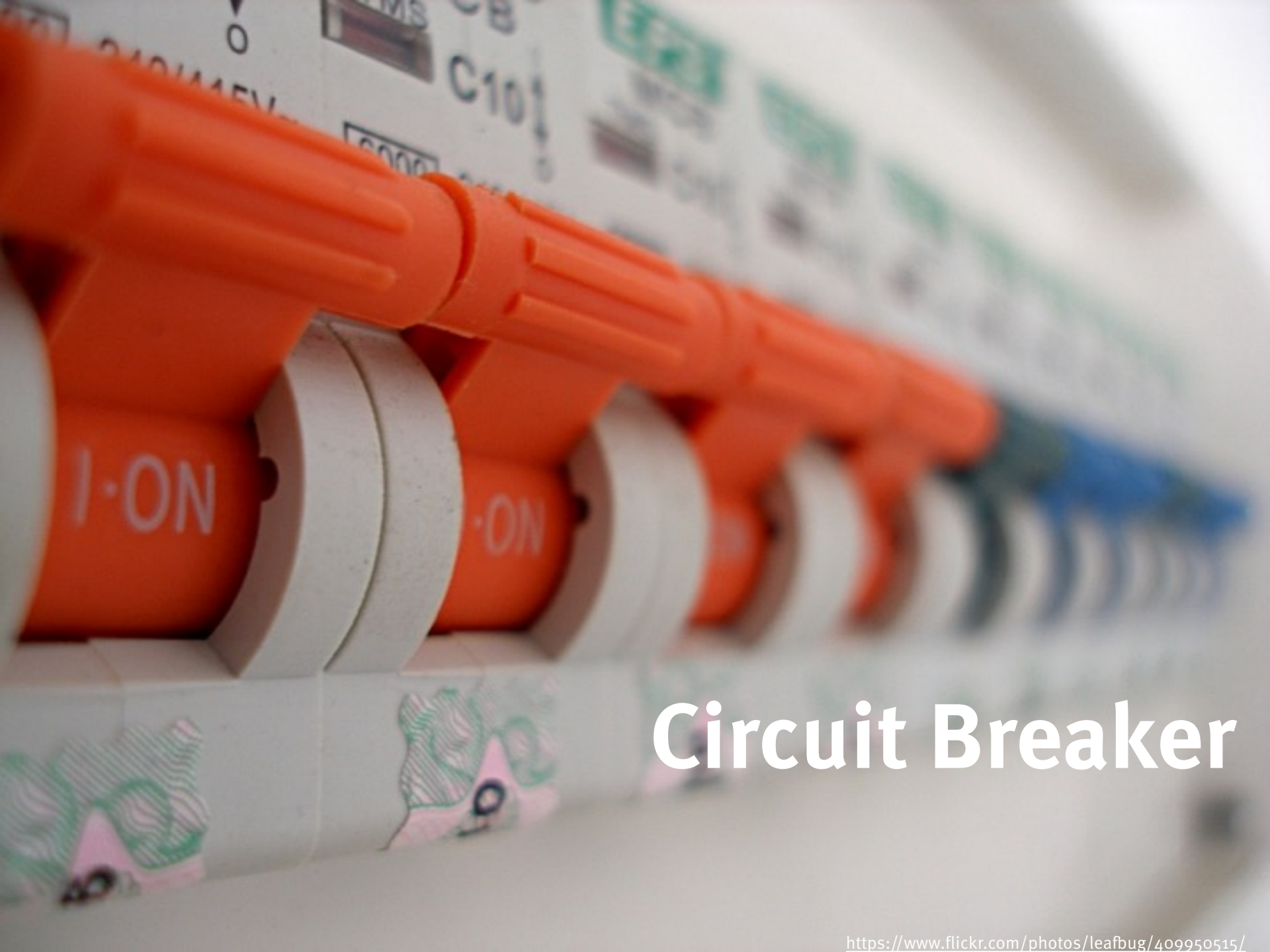
Ships



http://de.wikipedia.org/wiki/RMS_Titanic#/media/File:Titanic_Structure_de.svg

Bulkheads and IT

- Thread pools
- Database connection pools
- Instances
- Server
- Data center



Circuit Breaker

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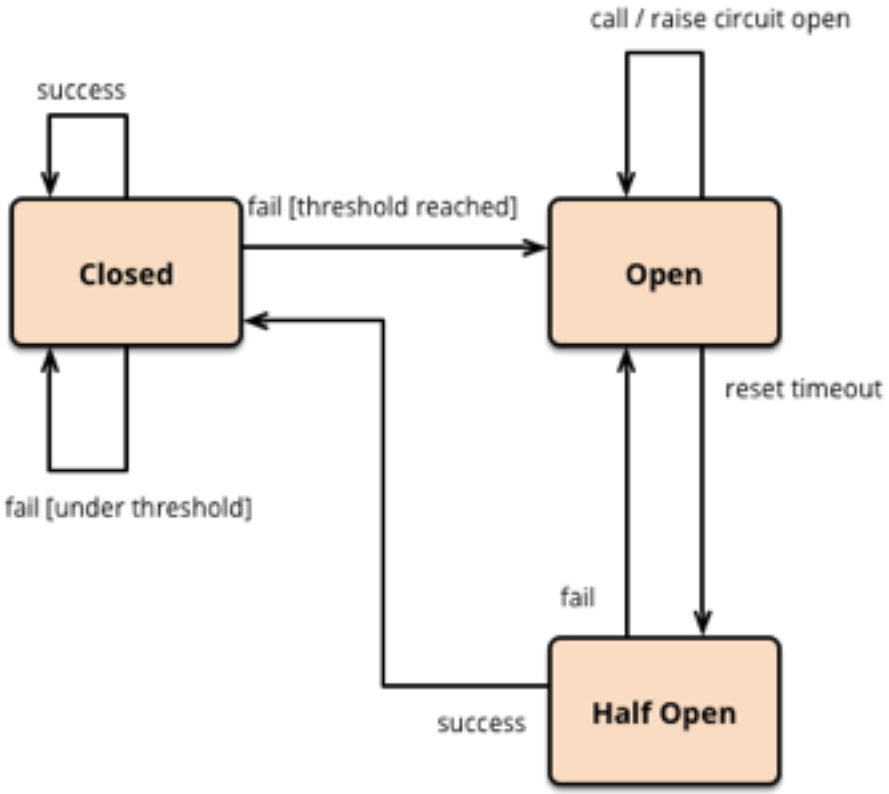
Circuit Breaker



http://martinfowler.com/bliki/CircuitBreaker.html

Hystrix

- Library from Netflix
- Resilience Library
- Command Pattern
- Metrics
- Dashboard

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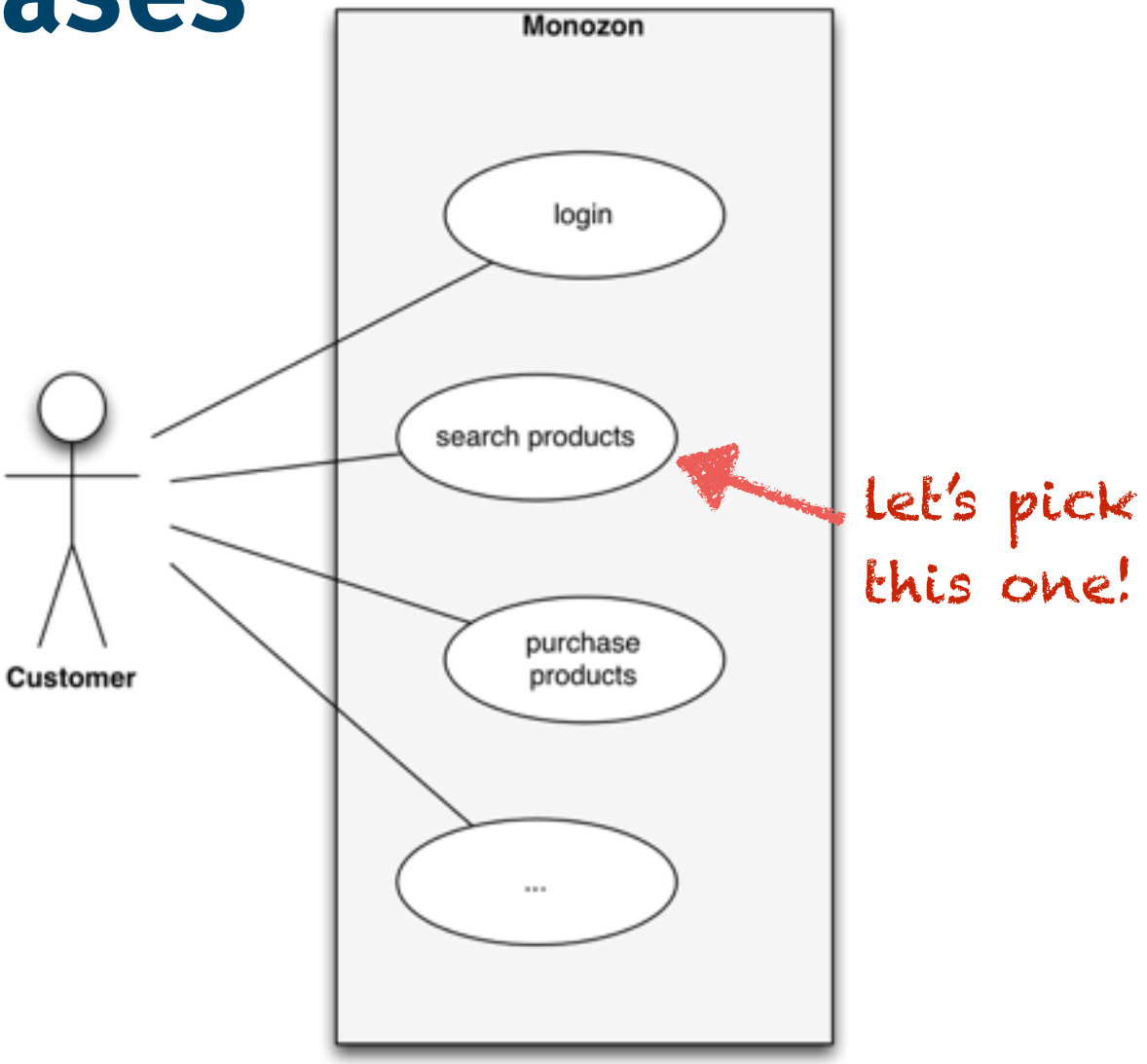
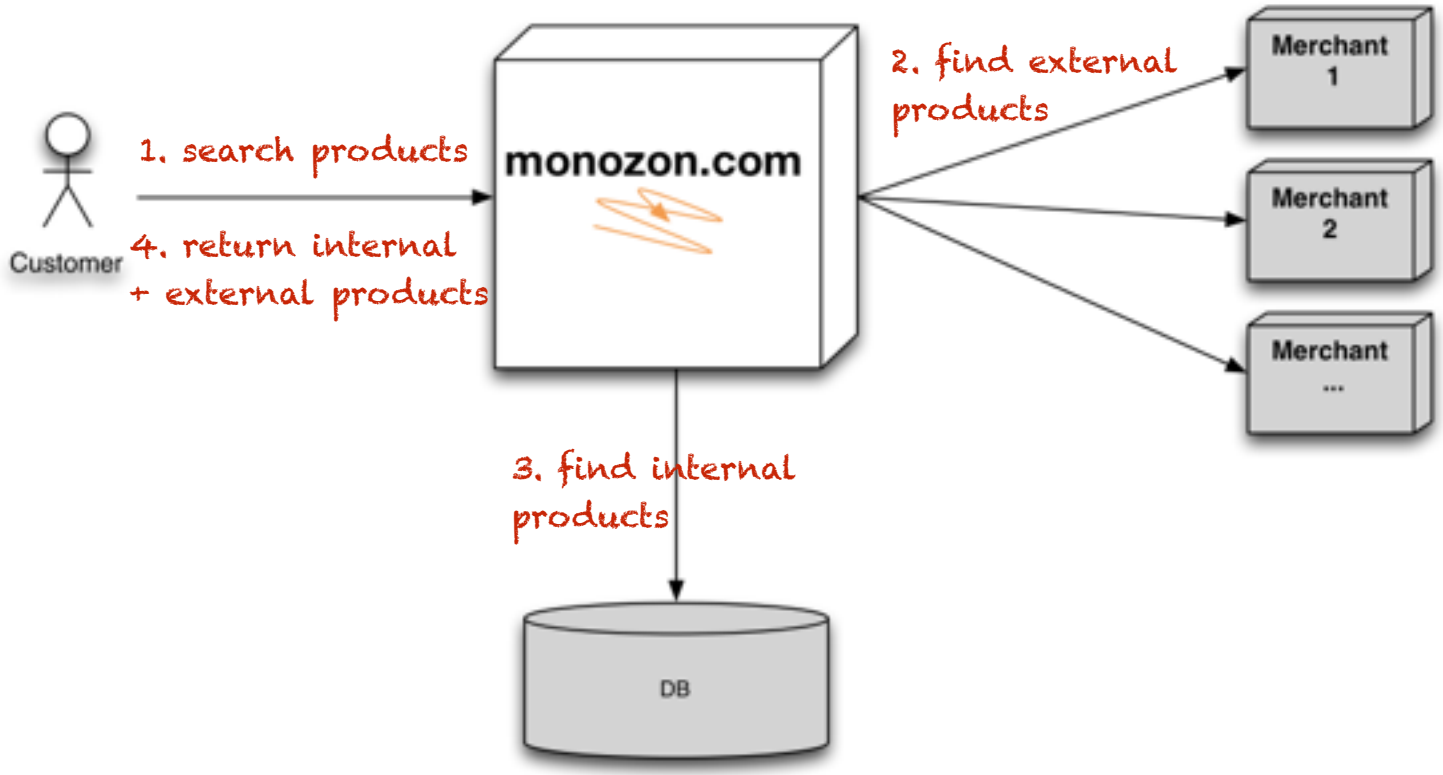
Use Cases



Search Products



Search Products

```
➜  /  http GET http://monozon:8080/products | jq '.'
[
  "internalProduct_1",
  "internalProduct_2",
  "merchant_1",
  "merchant_2",
  "merchant_3",
  "merchant_4"
]
```

Call without Hystrix

```
private List<Product> findProducts(String query) {
    ClientResponse clientResponse =
            Client.create()
                    .resource("http://merchant1/products/")
                    .queryParam("query", query)
                    .get(ClientResponse.class);

    return toProduct(clientResponse);
}
```

cascading failures incoming!

Simple Command

```
public class GetMerchant1Products
        extends HystrixCommand<List<Product>> {

    private final String query;

    public GetMerchant1Products(String query) {
        super(HystrixCommandGroupKey.Factory.asKey("merchant1"));
        this.query = query;
    }

    @Override
    protected List<Product> run() throws Exception {
        return findProducts(query);
    }
}
```

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Execute it!

```
public List<Product> findExternalProducts(String query) {

    List<Product> productList =
            new GetMerchant1Products(query).execute();

    List<Product> merchant2Products =
            new GetMerchant2Products(query).execute();

    productList.addAll(merchant2Products);

    return productList;
}
```

Execute it asynchronously

```
public List<Product> findExternalProducts(String query) {

    Future<List<Product>> merchant1ProductsFuture =
            new GetMerchant1Products(query).queue();

    Future<List<Product>> merchant2ProductsFuture =
            new GetMerchant2Products(query).queue();

    List<Product> productList = new ArrayList<>();
    productList.addAll(merchant1ProductsFuture.get());
    productList.addAll(merchant2ProductsFuture.get());

    return productList;
}
```

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Fallback

```
@Override
protected List<Product> run() throws Exception {
    return findProducts(query);
}

@Override
protected List<Product> getFallback() {
    return Collections.emptyList();
}
```

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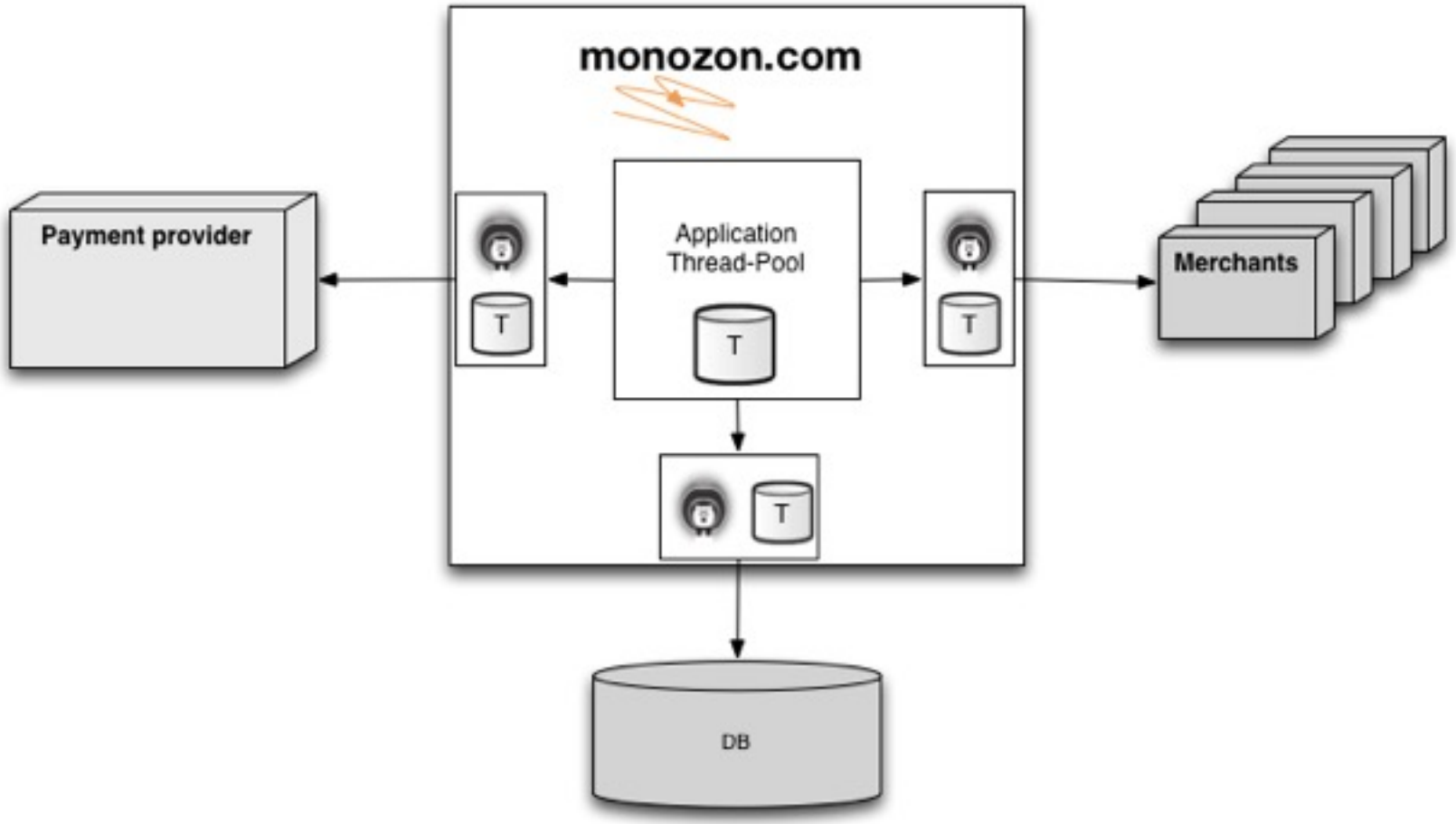
In case Merchant 2 is down:

```
➜  /  http GET http://monozon:8080/products | jq '.'
[
  "internalProduct_1",
  "internalProduct_2",
  "merchant_1",
  "merchant_3",
  "merchant_4"
]
```

The stabilized system



Demo

And now?

Current problems

- Maintenance is difficult
- New features need a lot of time
- ~~Very unstable~~ => enables further distribution
- Outdated technology
- Doesn't scale

https://www.flickr.com/photos/donmaedi/116013352

Monozon is a typical Monolith

- hidden dependencies
- module boundaries are not clear
- distributed business processes
- just one technical platform
- **Everything depends on everything**

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https://www.flickr.com/photos/taefit/8528632756

Our mission:

Creating smaller systems that are

- understandable
- enhanceable
- have clear boundaries and responsibilities
- allow technological diversity

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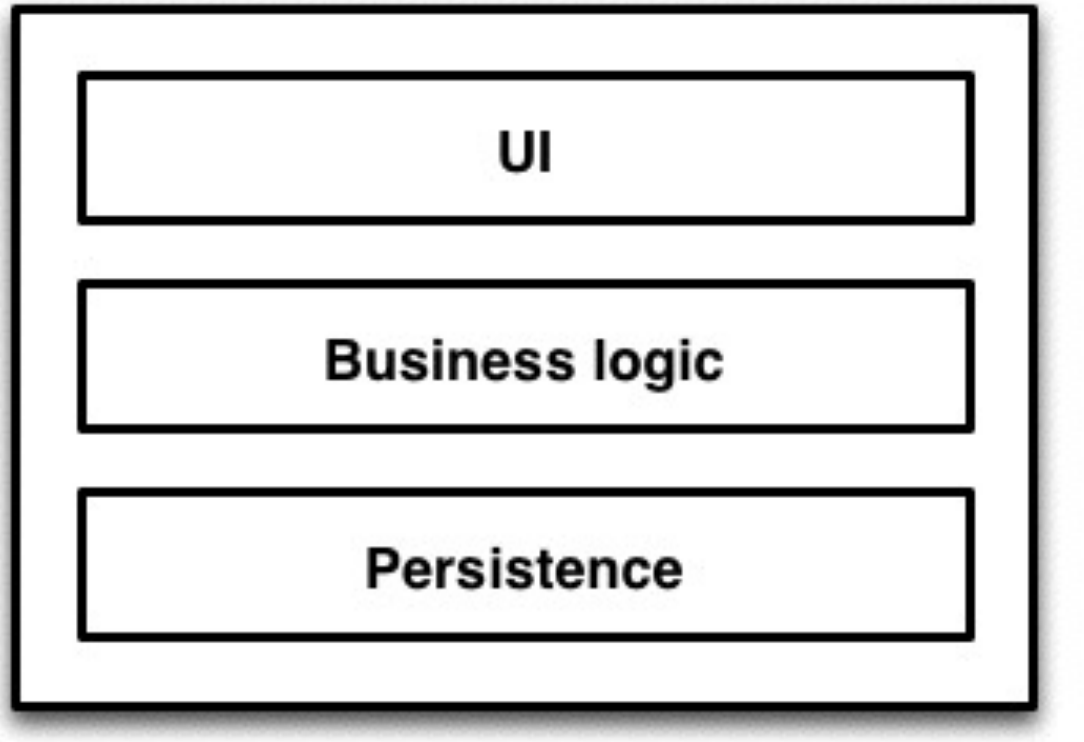
The typical cut



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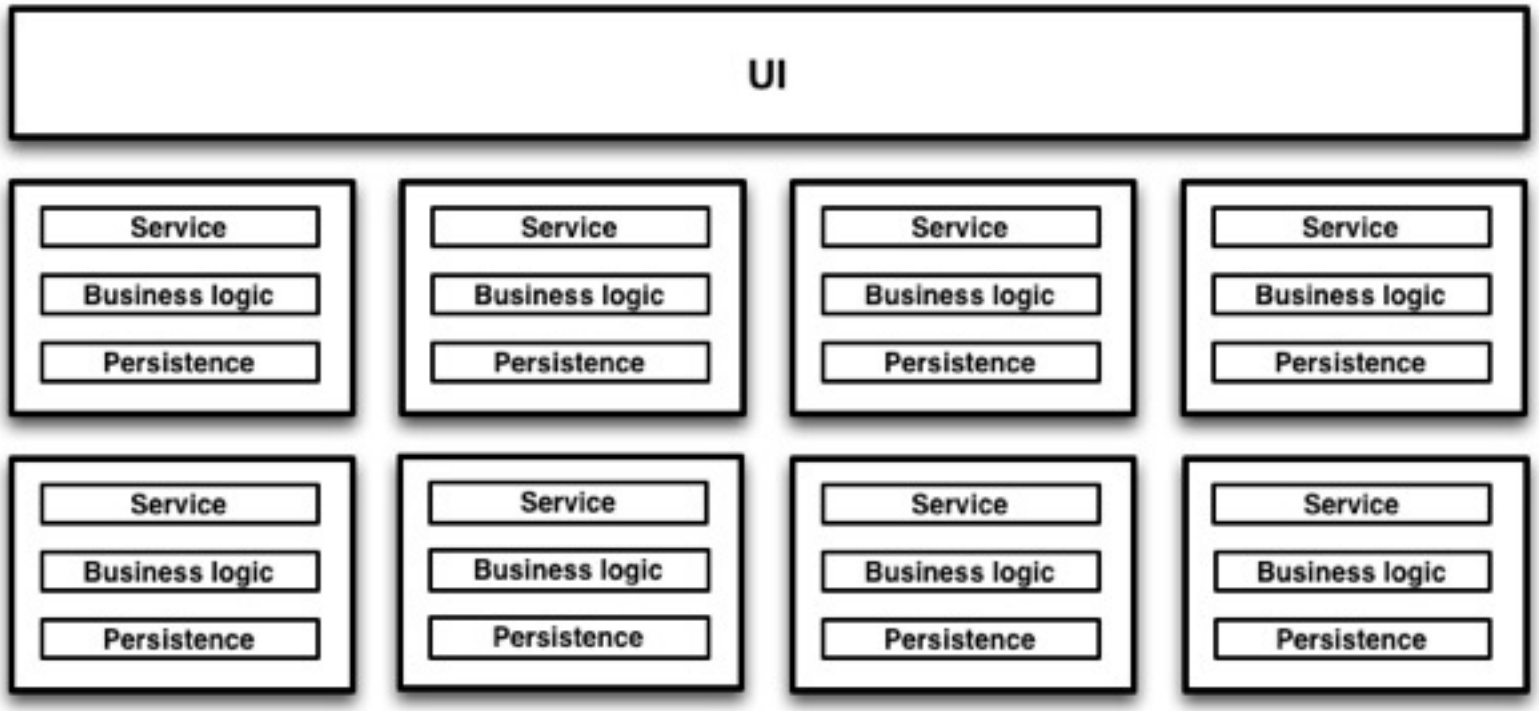
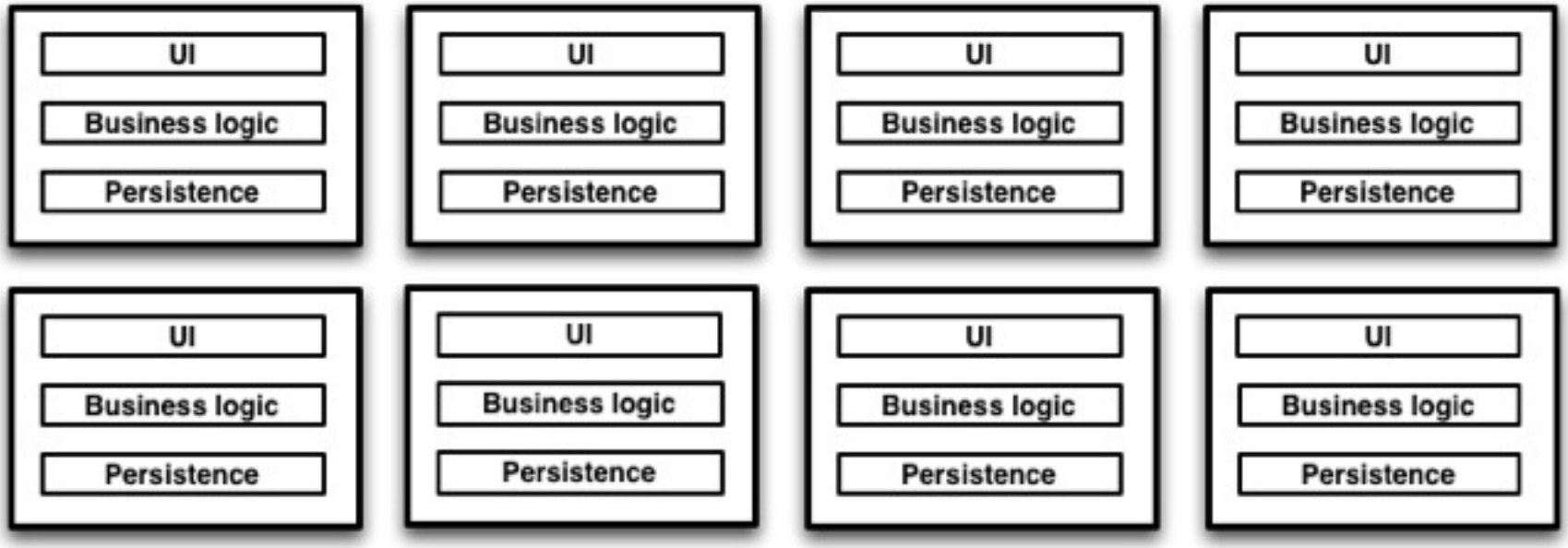
Vertical Services, one UI



Self contained Systems



Micro architecture

- Separate (redundant) persistence
- Internal, separate logic
- Domain models & implementation strategies
- Separate UI
- Separate development and evolution

Domain architecture

- System boundaries reflect business dependencies
- defines who is responsible for which data
- follows the principle of
  - loose coupling
  - high cohesion

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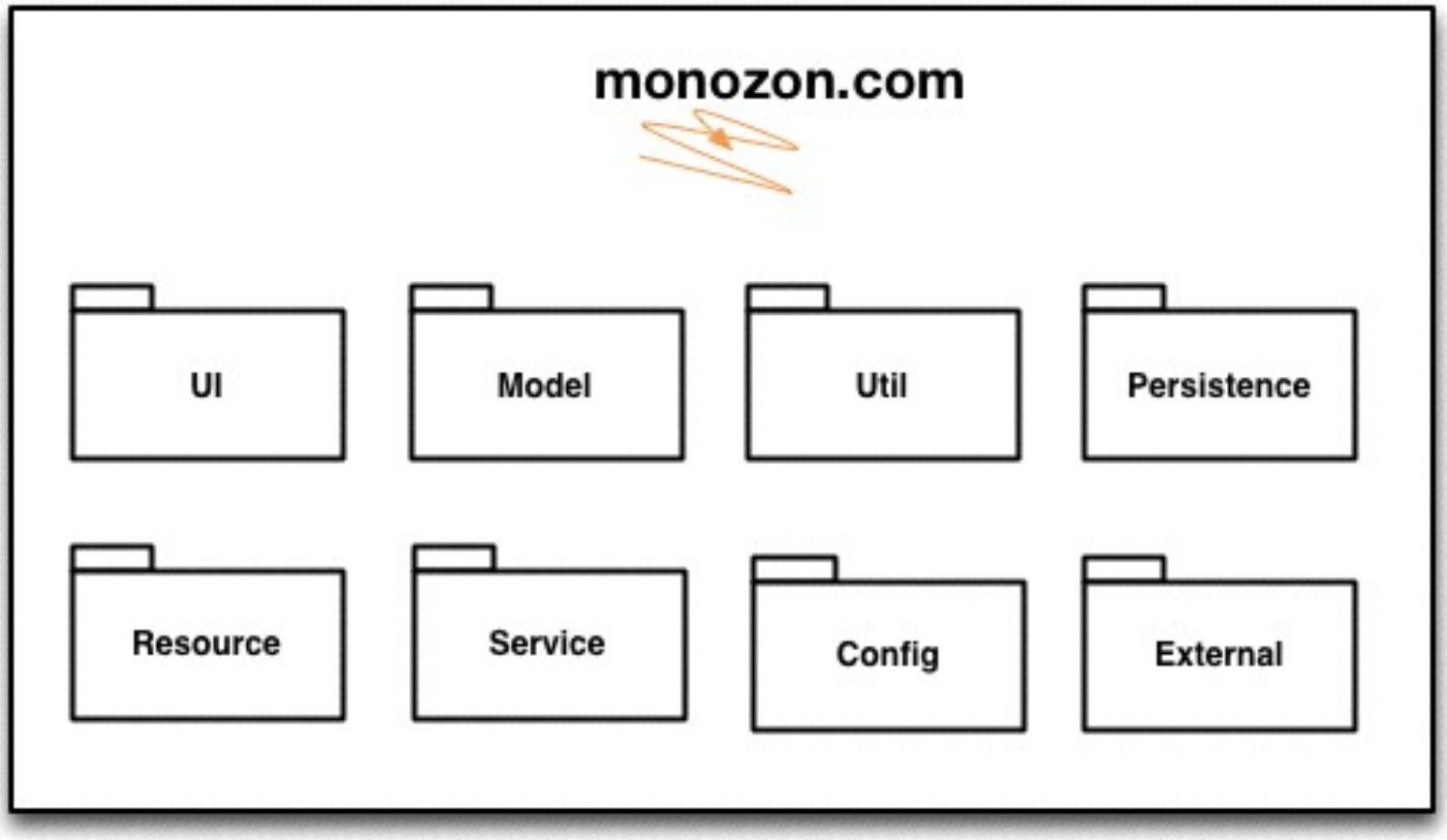
From internal structure



To autonomous systems

Ask the monolith

- identify Bounded Contexts
- define boundaries explicitly
- **The experience with the monolith helps to create clear system boundaries**

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Connect!

https://www.flickr.com/photos/npobre/8189066572

Macro architecture

- defines standards across systems
  - UI integration
  - communication protocols
  - representation formats
  - data redundancy
  - logging, monitoring, security

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Smart endpoints, dump pipes!

Martin Fowler, James Lewis

http://martinfowler.com/articles/microservices.html

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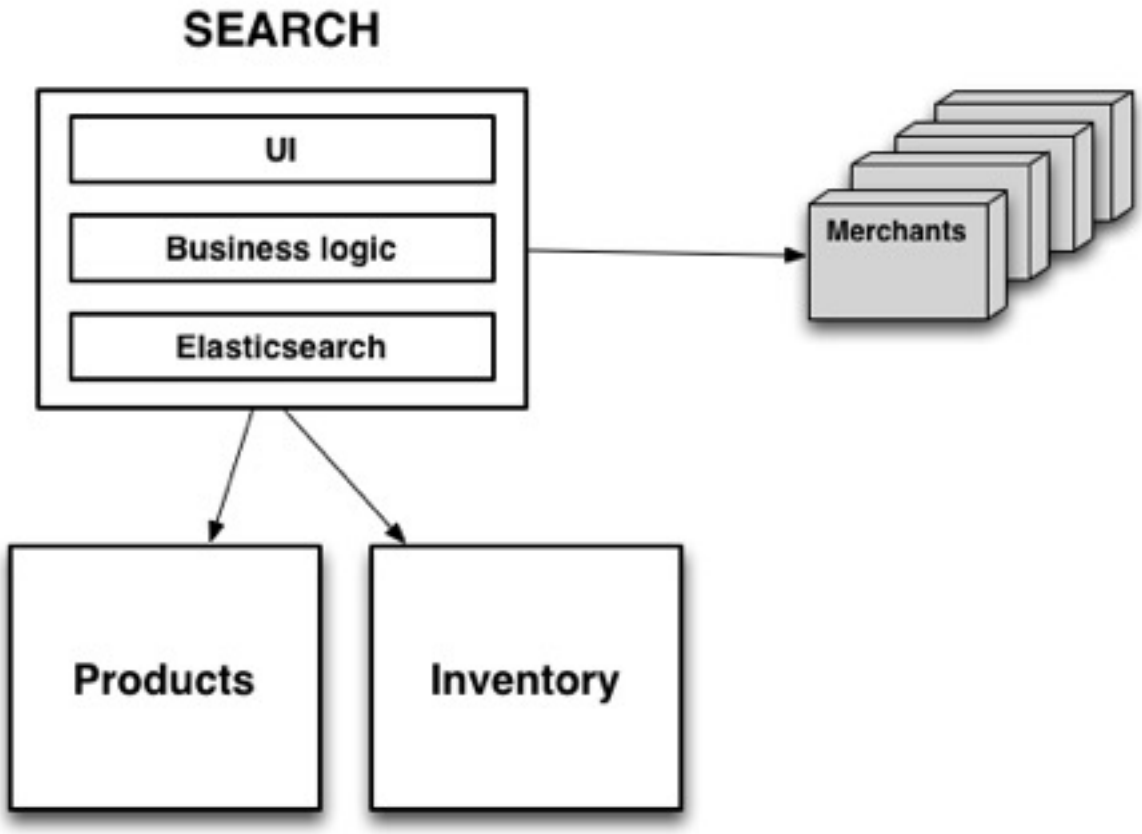
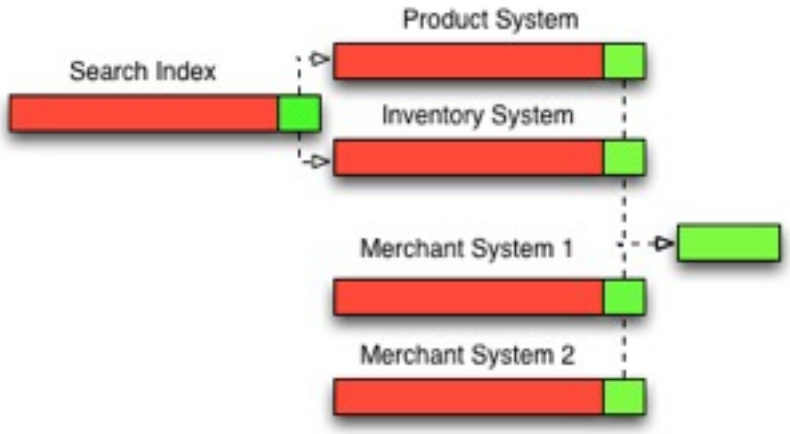
Consequences

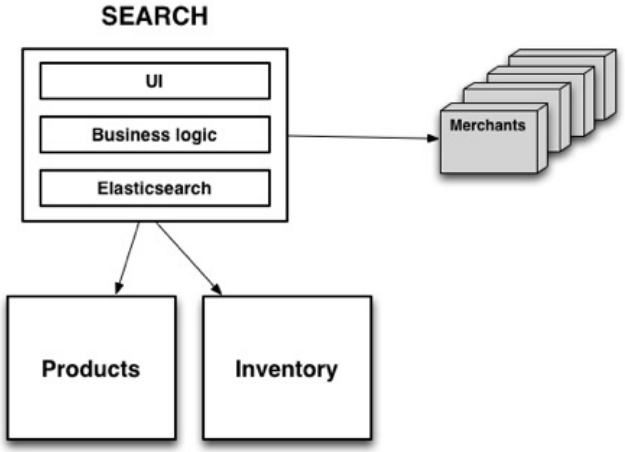
- Transactions contexts are bound to just one system
- Data should be just changed by the systems that are responsible for it
- Processes need Data that are spread over various systems

Connecting data



Synchronous vs. Asynchronous





Time for RxJava!

- Reactive Extensions for the JVM
- Asynchronous streams
- Elements of
  - Iterator patter
  - Observable pattern
  - Functional programming

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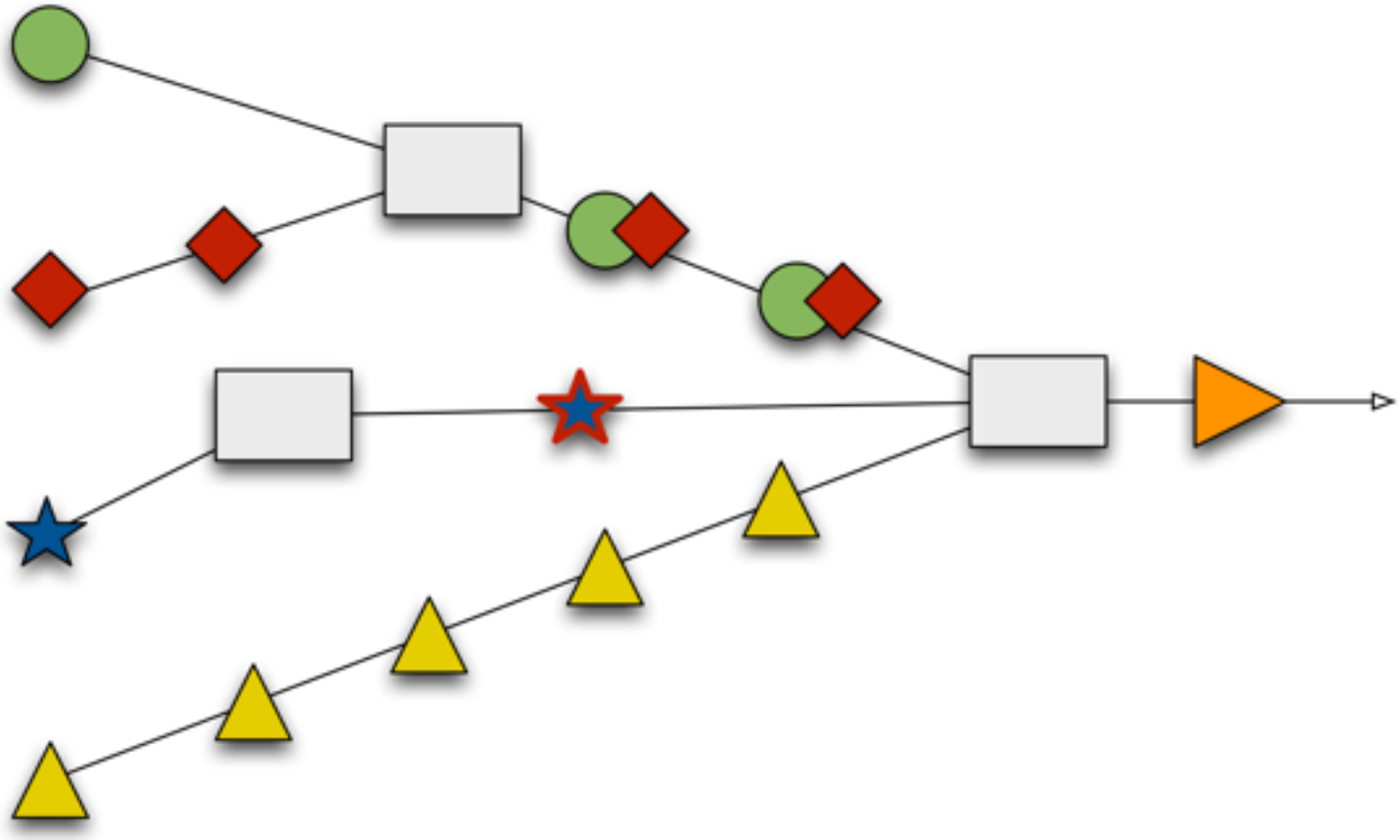
Iterable	Observable
pull	*push*
T next()	onNext(T)
throws Exception	onError(Exception)
returns;	onCompleted()

https://speakerdeck.com/benjchristensen/functional-reactive-programming-with-rxjava-javaone-2013

RxJava in one picture



https://speakerdeck.com/benjchristensen/functional-reactive-programming-with-rxjava-javaone-2013

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Create streams

```
public class GetMerchant2Products
        extends HystrixObservableCommand<Merchant2Product> {

    @Override
    protected Observable<Merchant2Product> construct() {
        return Observable.from(findProducts(query));
    }

    @Override
    protected Observable<Merchant2Product> resumeWithFallback() {
        return Observable.empty();
    }
}
```

Doesn't work

for us!!!

Better

```
public class GetMerchant2Products
        extends HystrixCommand<List<Merchant2Product>> {

    private final String query;

    public GetMerchant2Products(String query) {
        super(HystrixCommandGroupKey.Factory.asKey("merchant2"))
        this.query = query;
    }

    @Override
    public List<Merchant2Product> run() {
        return findProducts(query);
    }
```

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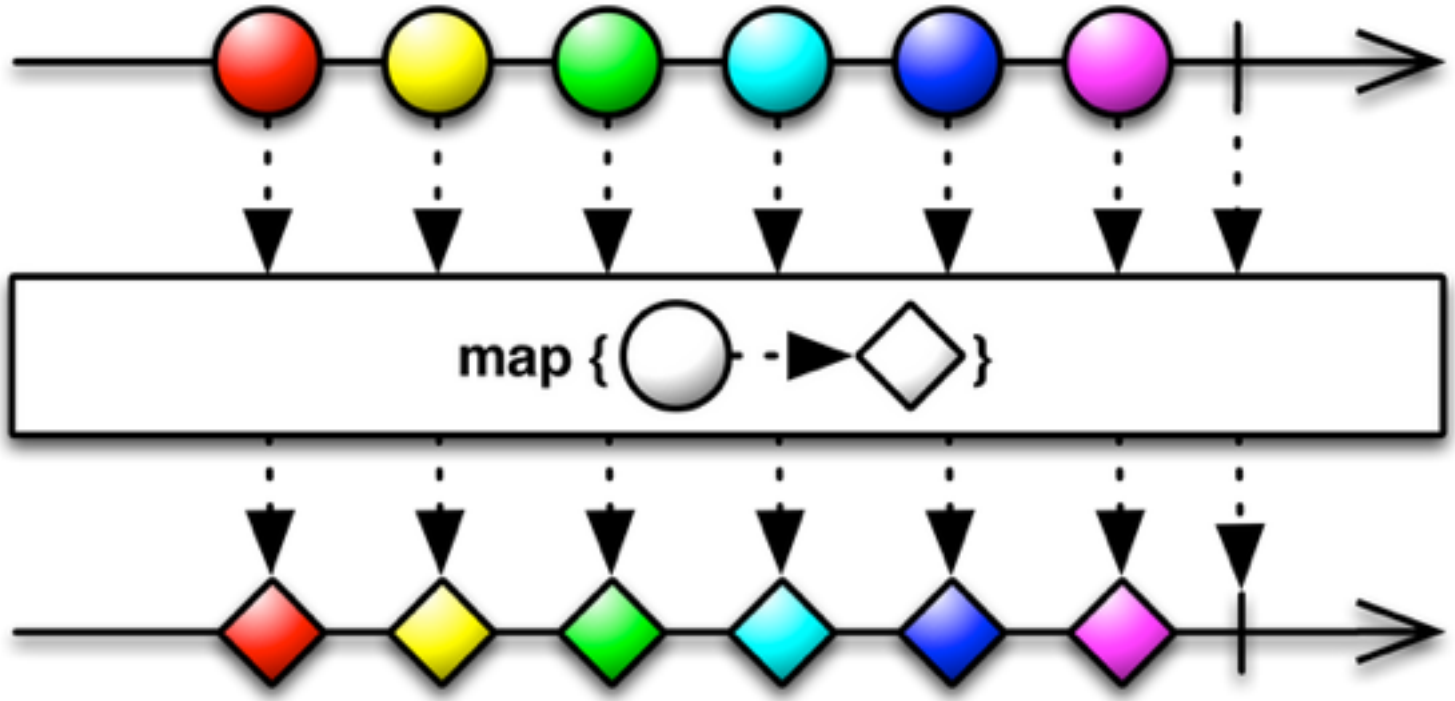
Converting into a stream

```
Observable<List<Merchant2Product>> productM2ListObservable =
        new GetMerchant2Products(query).observe();

Observable<Merchant2Product> productM2Observable =
        productM2ListObservable.flatMap(Observable::from);
```

Transforming with map

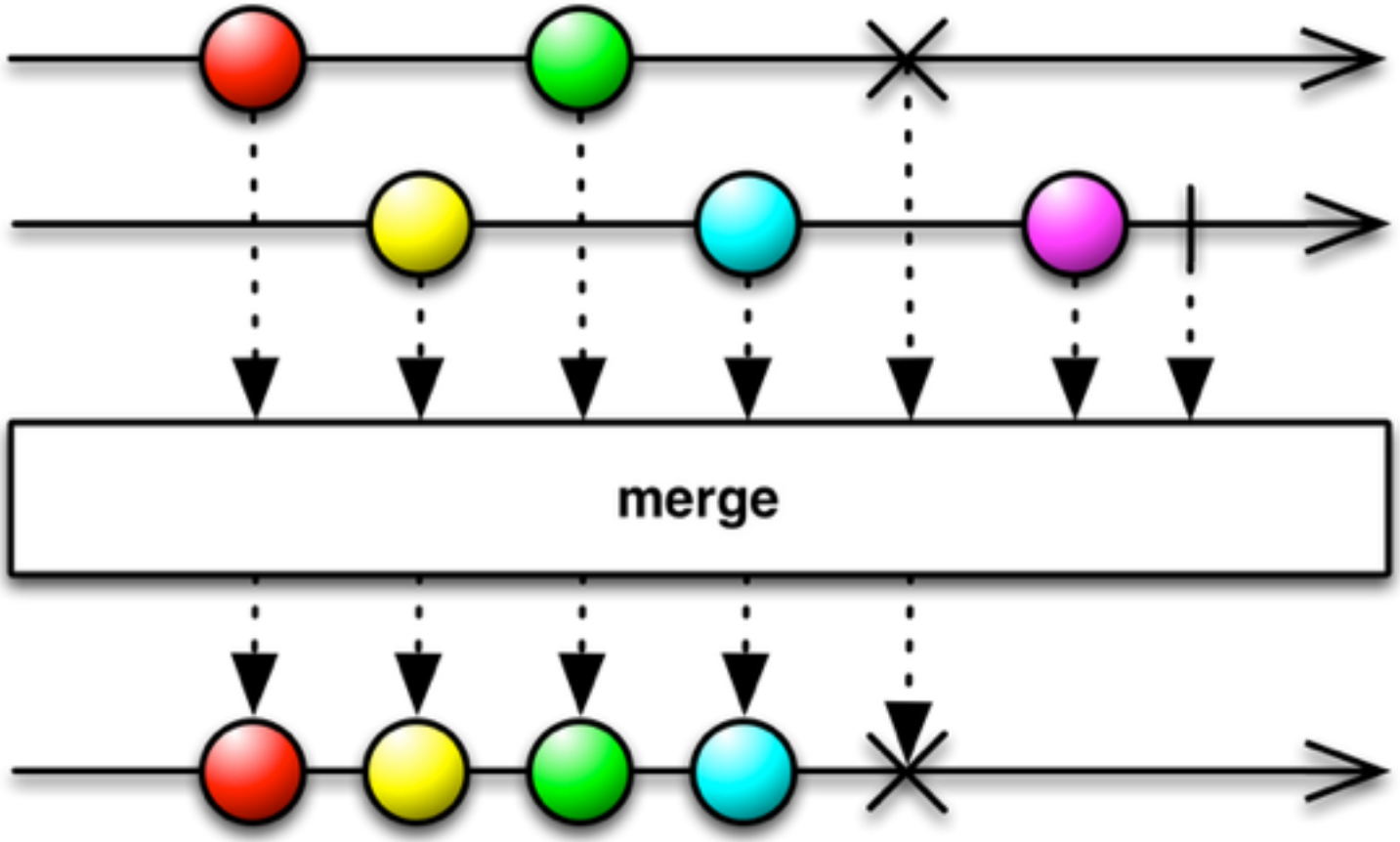


http://reactivex.io/RxJava/javadoc/rx/Observable.html

map in action

```
Observable<SearchResult> searchResultM2Observable
    = productM2Observable.map(this::toSearchResult);
```

Combining with merge

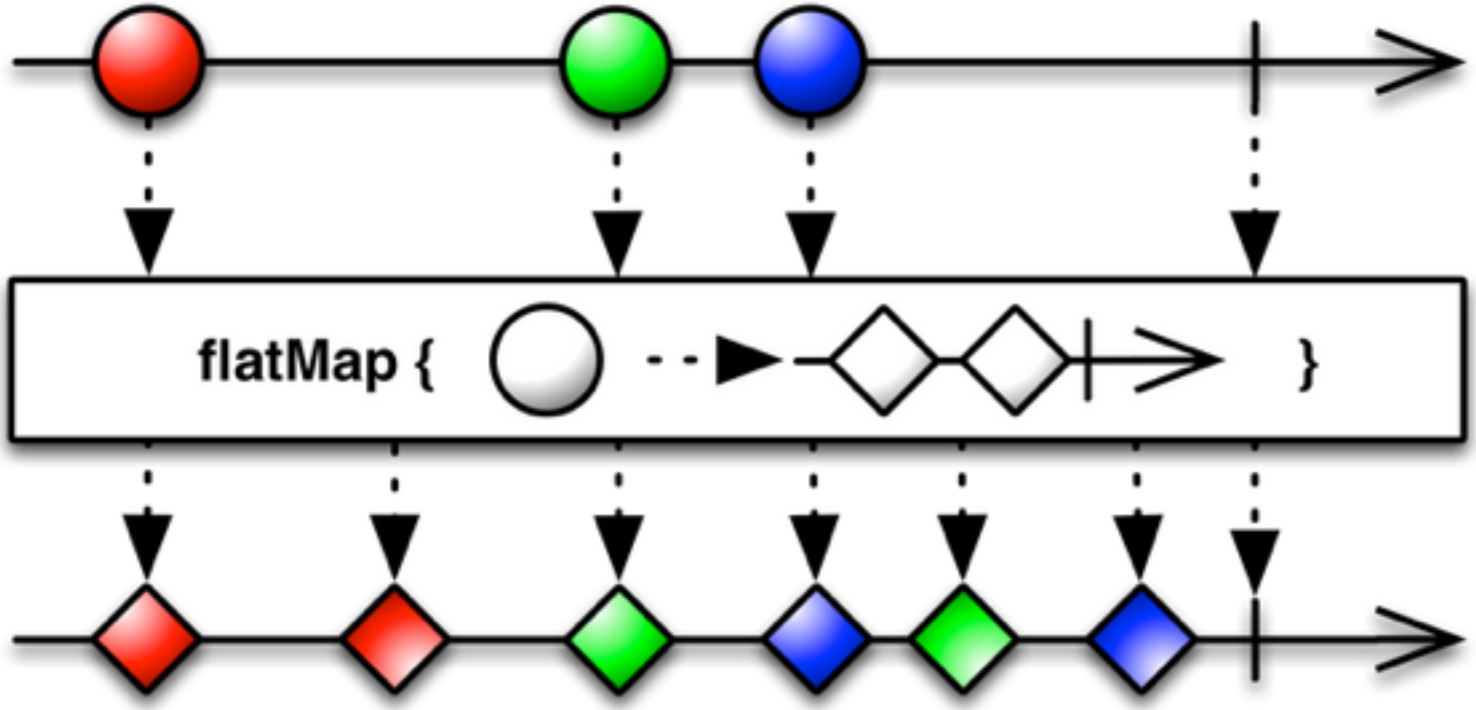


http://reactivex.io/RxJava/javadoc/rx/Observable.html

merge in action

```
Observable<SearchResult> mergedSearchResultObservable =
    searchResultM1Observable.mergeWith(searchResultM2Observable);
```

Collecting details with flatMap



http://reactivex.io/RxJava/javadoc/rx/Observable.html

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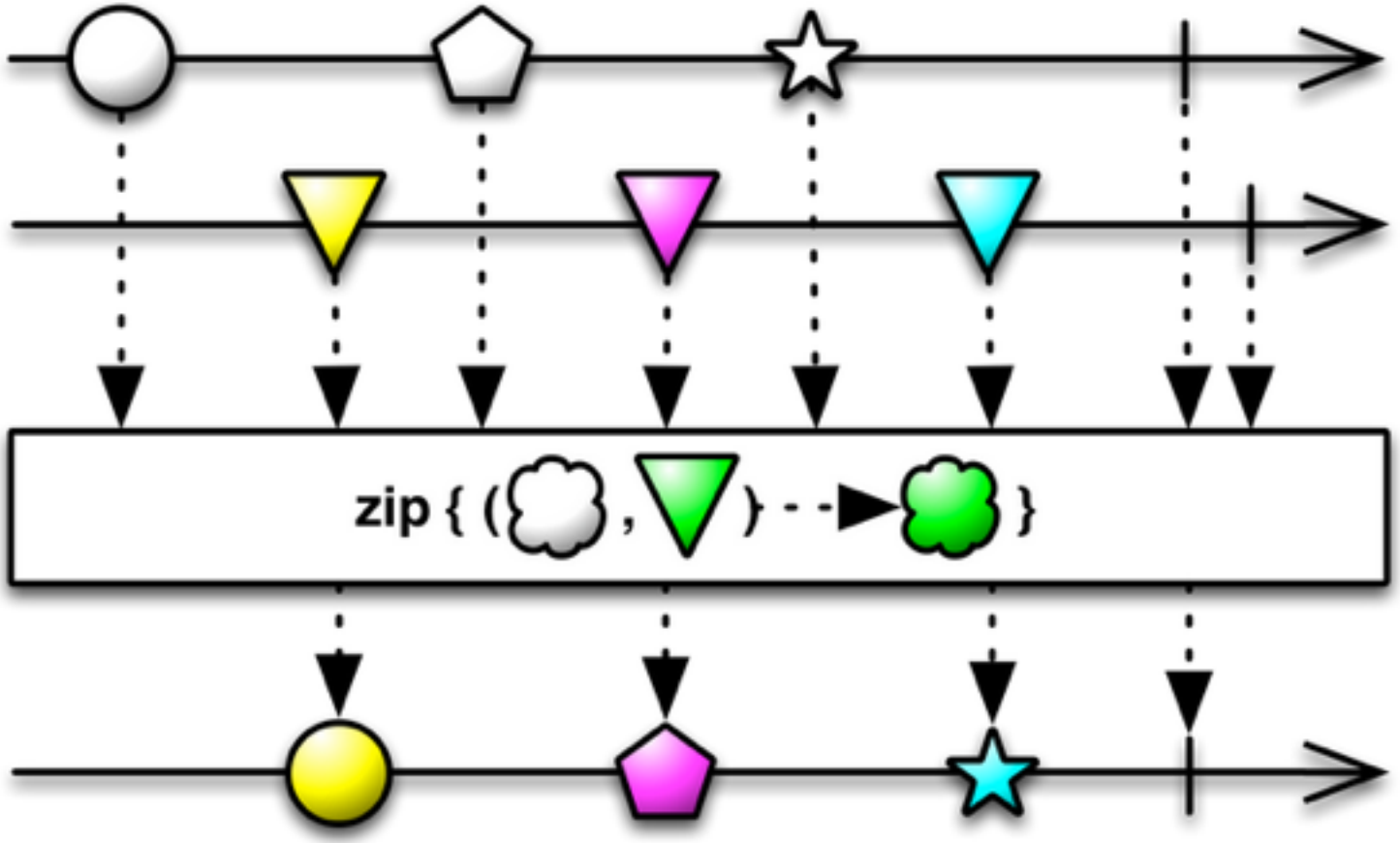
Combining streams with zip



http://reactivex.io/RxJava/javadoc/rx/Observable.html

flatMap and zip in action

```
public Observable<SearchResult> findInternalProducts(String query) {

    Observable<Long> productIndexObservable =
            productIndex.findProducts(query);

    return productIndexObservable.flatMap(productId -> {

        Observable<Product> productObservable =
                retrieveProductFromProductSystem(productId);

        Observable<Long> quantityObservable =
                retrieveQuantityFromInventoryService(productId);

        return Observable.zip(productObservable,
                quantityObservable, SearchResult::new);
    });
}
```

Blocking streams

```
public List<SearchResult> getSearchResults(String query) {
    Observable<SearchResult> searchResults =
        searchService.findInternalProducts(query)
            .mergeWith(searchService.findExternalProducts2(query));

    Iterator<SearchResult> searchResultIterator
            = searchResults.toBlocking().getIterator();

    return Lists.newArrayList(searchResultIterator);
}
```

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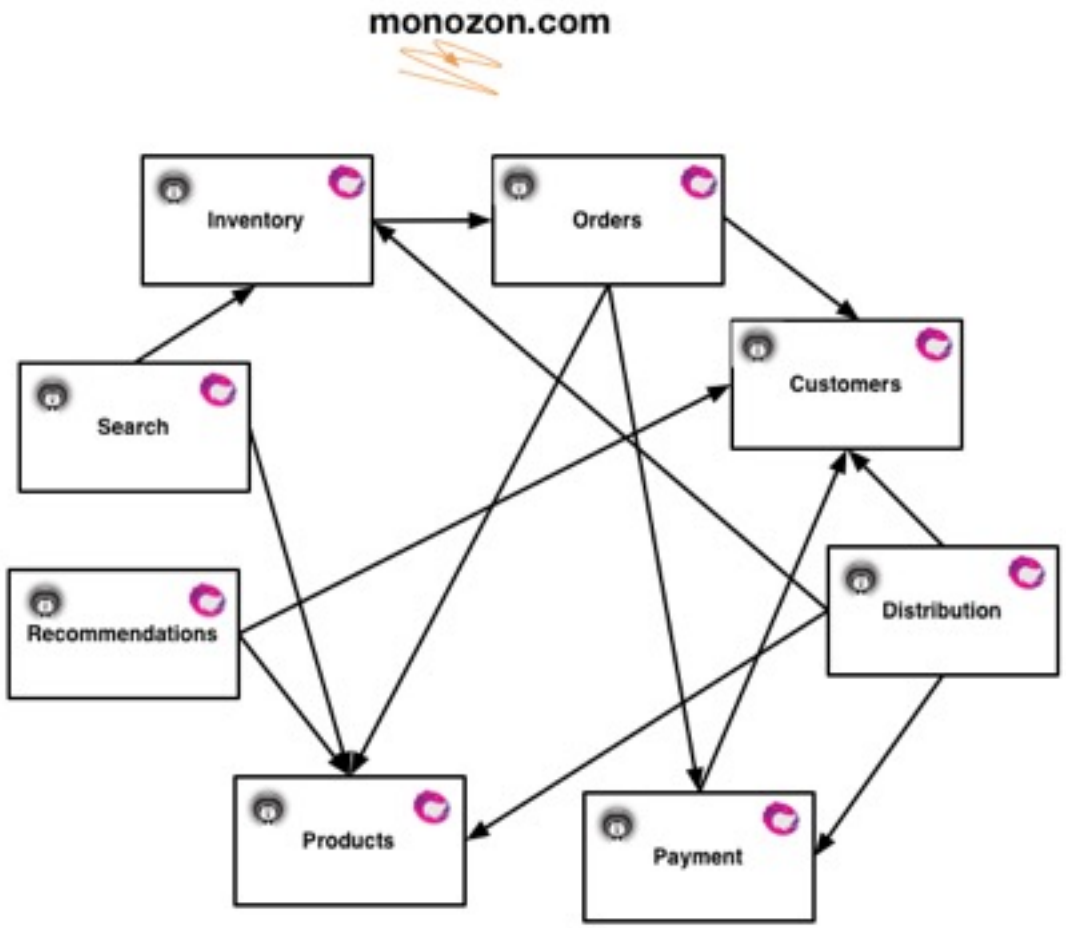
Systems connected



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Our goal was to make you curious!

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Find your own way!

Summary

- Use Hystrix to stabilize your system!
- Use RxJava to increase the amount of async/parallel processes in an easy way!
- Introduce Microservices to get control over your system again!
- Have fun :)

Thank you!

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