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Microservices Technology Enabler from Oracle

iJUG / Oracle Roadshow 2015

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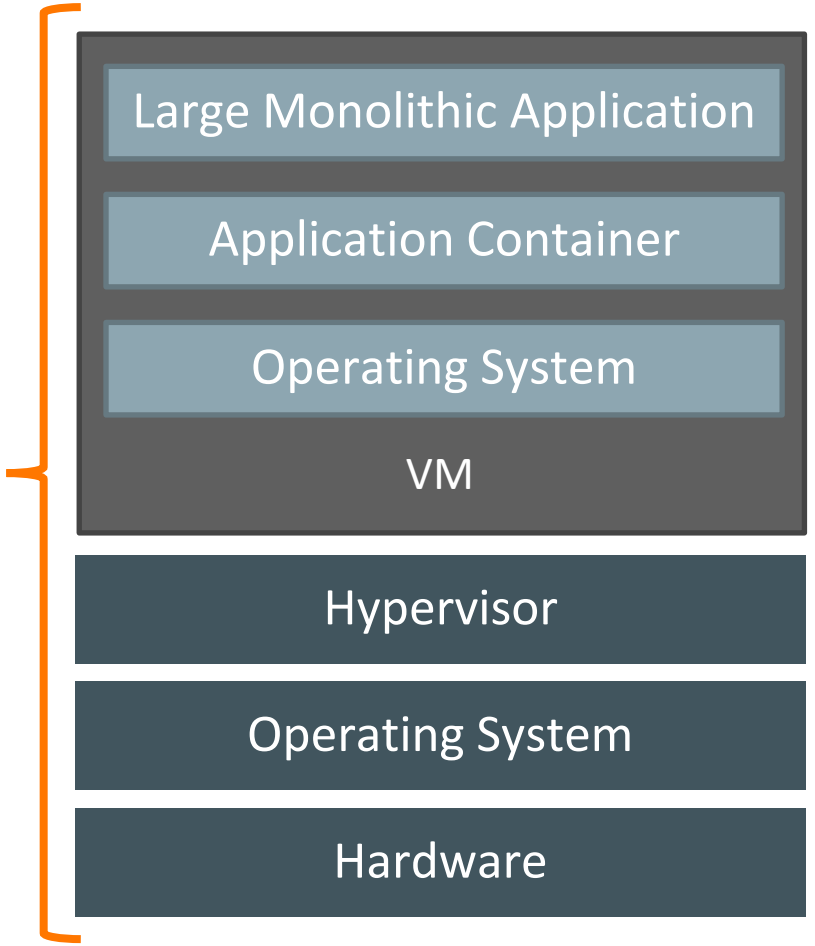
Agenda

- **Microservices**
- Jersey features for microservices
- Demos

Characteristics of Existing Monolith Architecture

The status quo has served us well but there are new alternatives

- Three tiers
- Scale by cloning behind load balancer (X-axis scaling)
- One programming language
- Everything centralized – messaging, storage, database, etc



One large archive, including UI(s) and application code

Feature-rich – support large, complicated applications, many use cases

Provide 100% isolation between tenants

Procured and manually set up

Existing Monolith Architecture Has its Limits

Too Complex

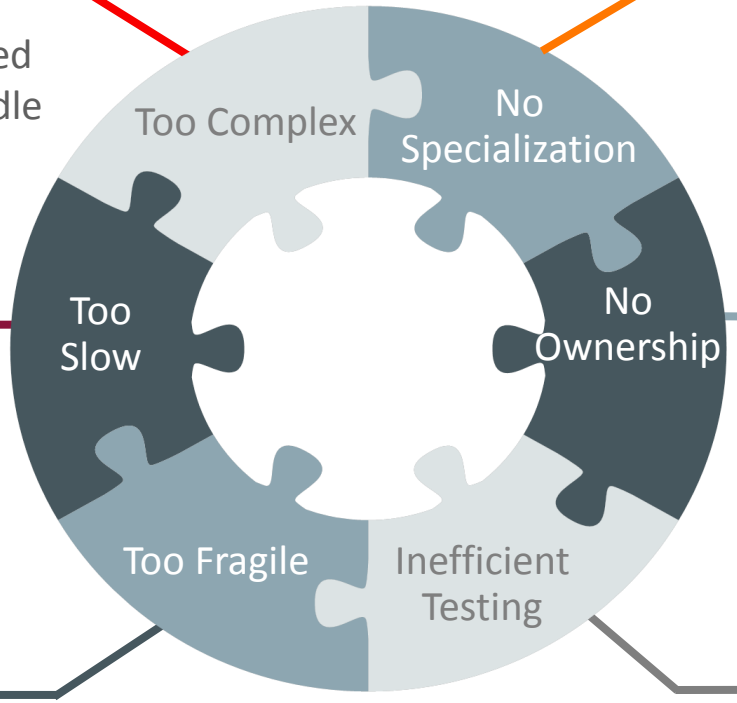
Apps get too big and complicated for a developer to understand over time. Shared layers (ORM, messaging, etc) have to handle 100% of use cases – no point solutions

Too Slow

Teams split up by function – UI, application, middleware, database, etc. Takes forever to get anything done due to cross-ticketing

Too Fragile

A bug will quickly bring down an entire application. Little resiliency



No Specialization

Different parts of applications have different needs – more CPU, more memory, faster network, etc..
Can not evolve at a different pace

No Ownership

Code falls victim to “tragedy of the commons” – when there’s little ownership, you see neglect

Inefficient Testing

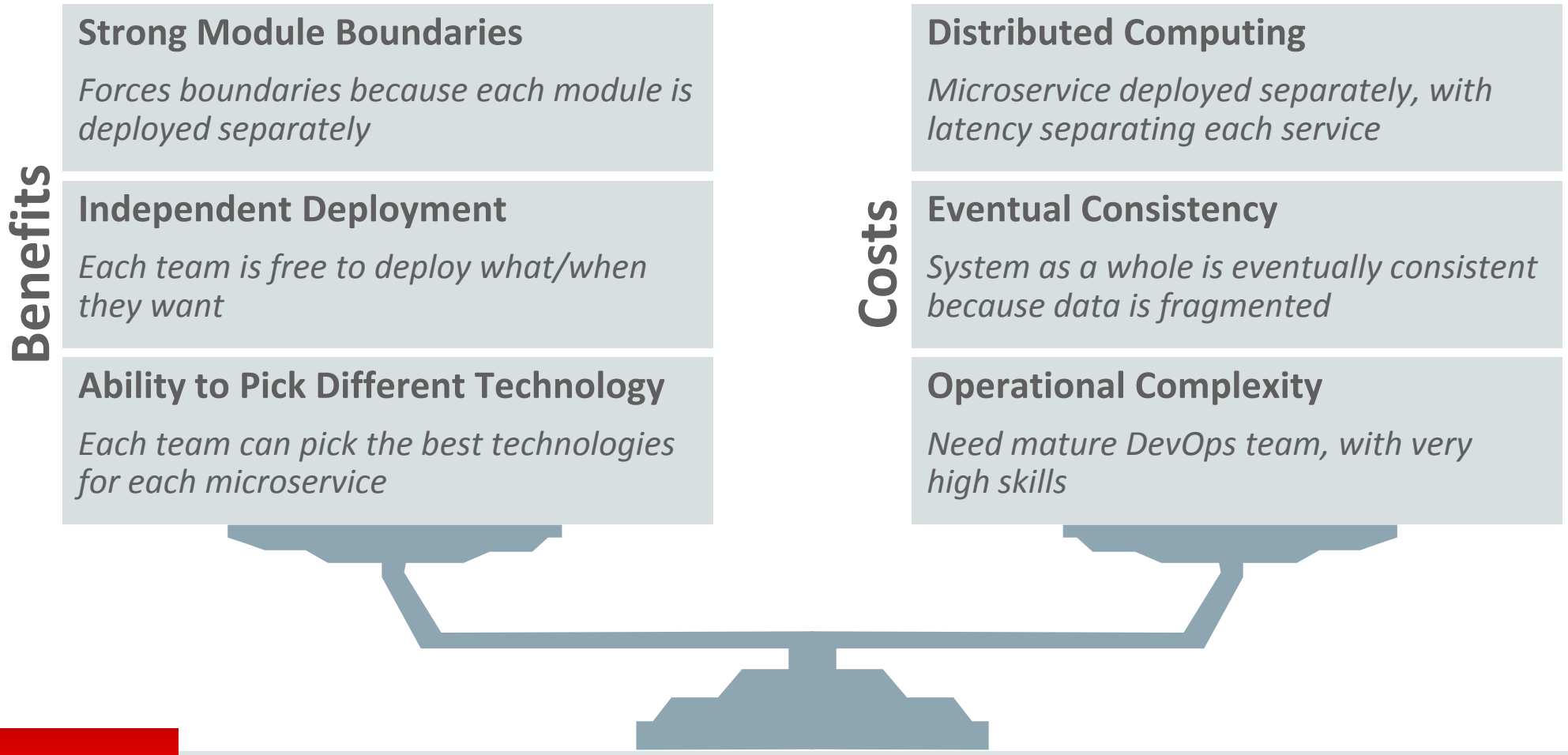
Each time you touch the application, you have to re-test the whole thing. Hard to support continuous delivery

What Are Microservices?

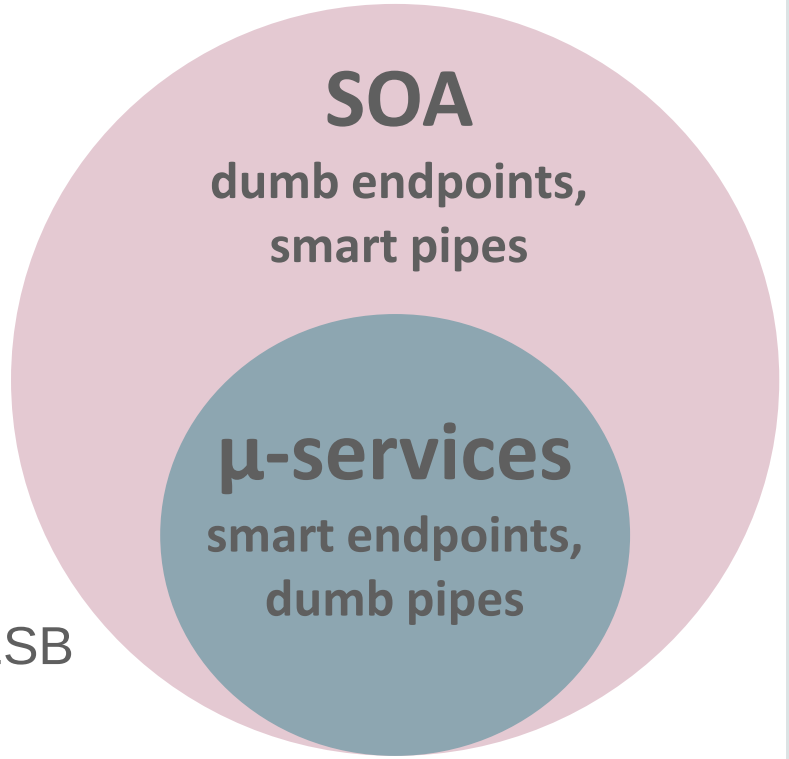
Minimal function services that are deployed separately but can interact together to achieve a broader use-case

Status Quo	Microservices
Single, Monolithic App	Many, Smaller Minimal Function Microservices
Must Test/Deploy/Scale Entire App	Can Test/Deploy/Scale Each Microservice Independently
One Database for Entire App	Each Microservice Has Its Own Datastore
In-process Calls Locally, SOAP Externally	REST Calls Over HTTP, Messaging, or Binary
Organized Around Technology Layers	Organized Around Business Capabilities
One Technology Stack for Entire App	Choice of Technology for Each Microservice
Developers Don’t Do Ops	Developers + Ops Support Production in Perpetuity

Benefits of Microservices Come With Costs



Microservices: Reality Check



- The name “Microservices” is incredibly vague
  - Big hurdle to practical adoption by average Joe developer
  - Already hijacked and overloaded by commercial interests
- Simple concept with a long history
  - UNIX, CORBA, Jini, RMI, EJB 1/2, COM/DCOM, OSGi, SOAP/ESB
  - A SOA with some special characteristics
- Decomposing larger systems into smaller independently deployable parts
  - Purists distance themselves from SOAP, ESB
  - Purists embrace mostly REST and messaging
  - Purists take for granted testing, DevOps, continuous delivery
  - Purists focus on (ridiculously) fine grained services
  - Purists consider the implementation of non-functional requirements to be part of the service

Microservices: The Bottom Line

- Majority of systems just fine as “monoliths”
- Majority of systems needing microservices could evolve into “hybrids”
- Few practical enterprise systems can or need to achieve microservices nirvana

… don’t even consider microservices unless you have a system that’s too complex to manage as a monolith.
The majority of software systems should be built as a single monolithic application.
Do pay attention to good modularity within that monolith, but don’t try to separate it into separate services

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

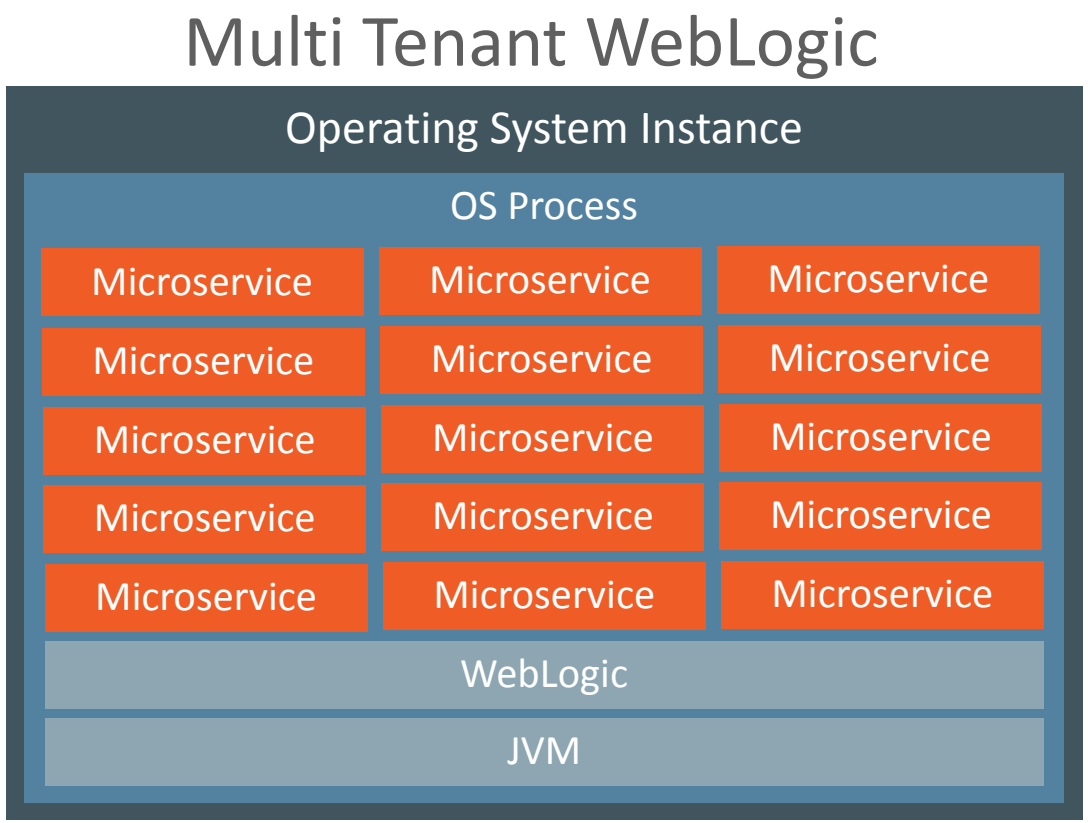
Microservices Related Technologies

- Frameworks: fat jars, “containerless”
  - Vert.x, Spring Boot, Dropwizard
  - WildFly Swarm, Payara Micro/Embedded GlassFish, TomEE Embedded
  - Grizzly(HTTP) + Jersey(JAX-RS) + Tyrus(WebSocket) + ...
- Java libraries for reactive programming
  - RxJava, Hystrix
- Virtualization
  - Docker, Rocket
- Cloud
  - IaaS, PaaS

WebLogic Multitenant Microcontainer for Microservices

Similar to Oracle Database pluggable/container databases

- Each microservice instance can have its own light-weight WebLogic container-like partition
- Partition isolation inside the JVM
- Easily move partitions between WebLogic hosts
- Each partition is exceptionally light
- Each WebLogic host can support hundreds of partitions



JAX-RS/Jersey primer

- JAX-RS 2.0
  - part of Java EE 7 (2013)
  - defines a standard API for
    - Implementing RESTful web services in Java
    - REST client API
- Jersey 2.0
  - provides production ready JAX-RS 2.0 reference implementation
  - brings several non-standard features
  - Current version is 2.22.1

Agenda

- Microservices
- **Jersey features for microservices**
- Demos

Jersey for Microservices

- Integration with various HTTP containers and client transports
- Reactive/Async Client
- Test Framework, Monitoring and Tracing
- Support for SSE
- Dynamic reloading
- Various data bindings
- Security
- MVC view templates
- Weld (CDI) support

Supported server containers

- Grizzly HTTP server
- Jetty HTTP Container (Jetty Server Handler)
- Servlet 2.4-3.1
- Java SE HTTP Server (HttpHandler)
- Other containers could be plugged in via ContainerProvider SPI

Grizzly Lightweight HTTP Server: High Performance I/O

Great for inter-process communication

- Oracle sponsored open source
- Brings non-blocking sockets to the protocol processing layer
  - Support for non-blocking I/O and HTTP processing
- HTTP/2, WebSocket, Comet Support
- Serves static resources
- Endless configuration possibilities

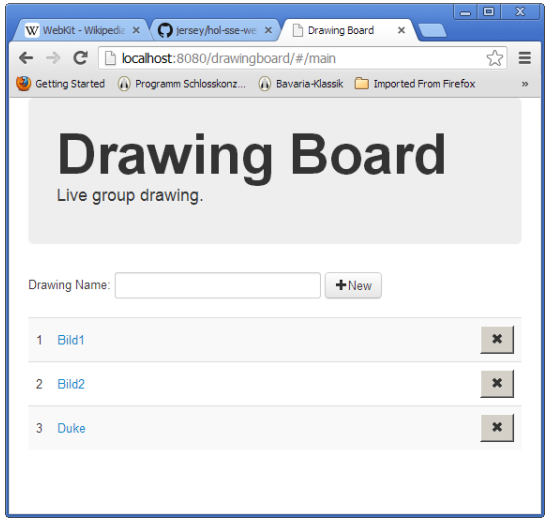
Grizzly HTTP server support and configuration

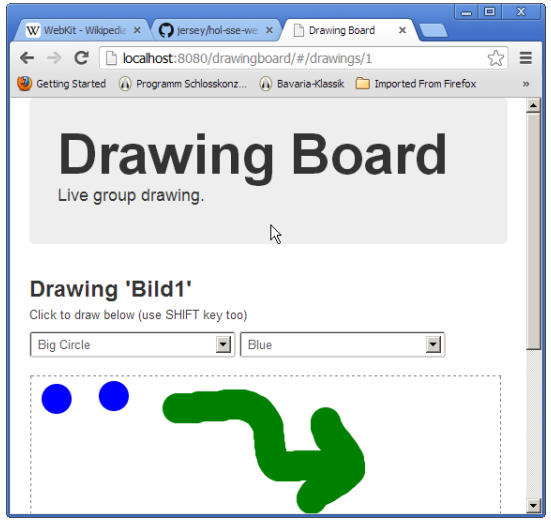
```
HttpServer httpServer =
        GrizzlyHttpServerFactory.createHttpServer(AppURI, new JaxRsApplication(), false);
httpServer.getServerConfiguration().setSessionTimeoutSeconds( . . .);
NetworkListener grizzlyListener = httpServer.getListener("grizzly");
grizzlyListener.getTransport().setSelectorRunnersCount(4);
grizzlyListener.getTransport().setWorkerThreadPoolConfig(
        ThreadPoolConfig.defaultConfig().setCorePoolSize(16).setMaxPoolSize(16));
listener.setDefaultErrorPageGenerator(. . .);
listener.getFileCache().setMaxCacheEntries(. . .);
listener.getCompressionConfig().setCompressionMode( . . .);
httpServer.start();
```

HTML5 App with Jersey+Tyrus+Grizzly: Drawing Board Demo

https://github.com/doschkinow/ijug-roadshow-2015/tree/master/drawingboard-light

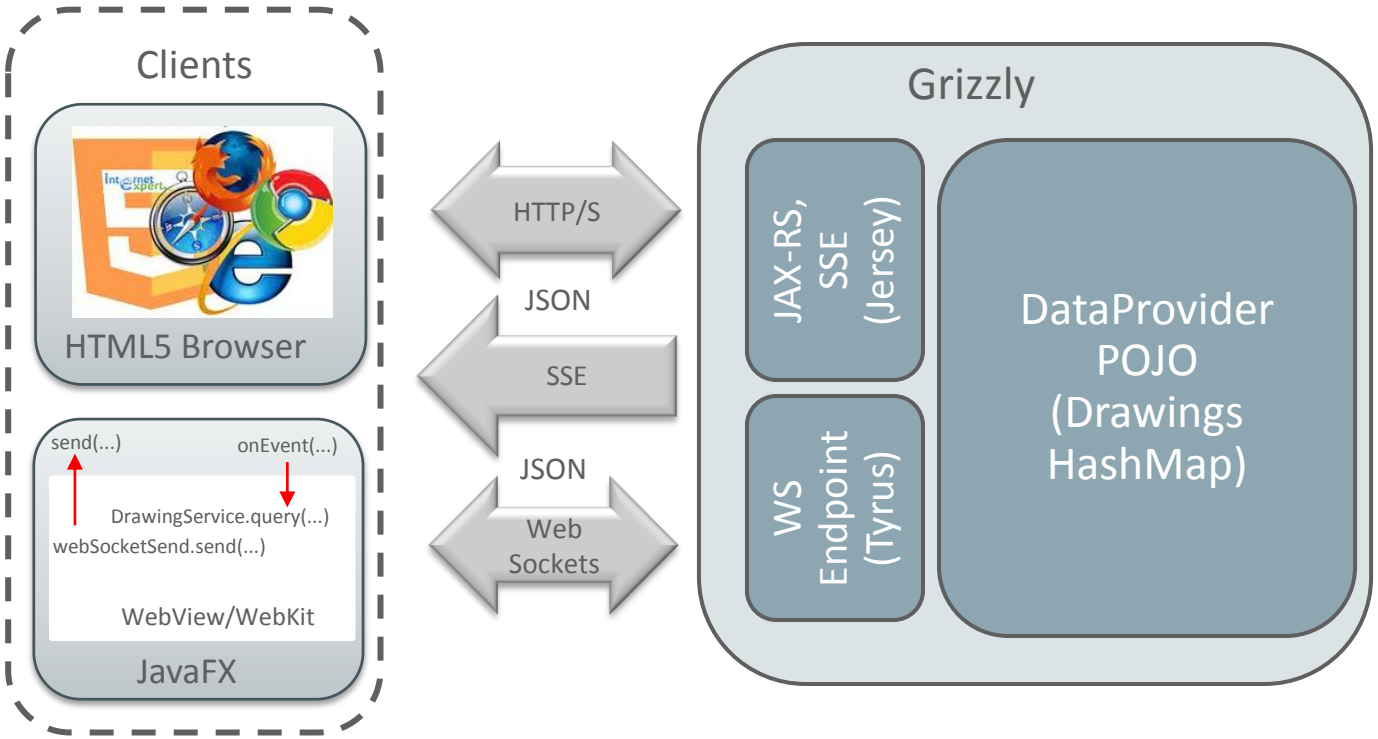
- Collaborative drawing
- Two-page application
  - List of drawings
  - Drawing
- Demonstrating
  - Server-side
    - Java EE 7: JAX-RS, JSON, WebSocket
    - Jersey specific: SSE, JSON-B
    - Lightweight integration Jersey+Tyrus+Grizzly – only 10 MB footprint!
  - Client-side: AngularJS or JavaFX





Drawing Board Demo

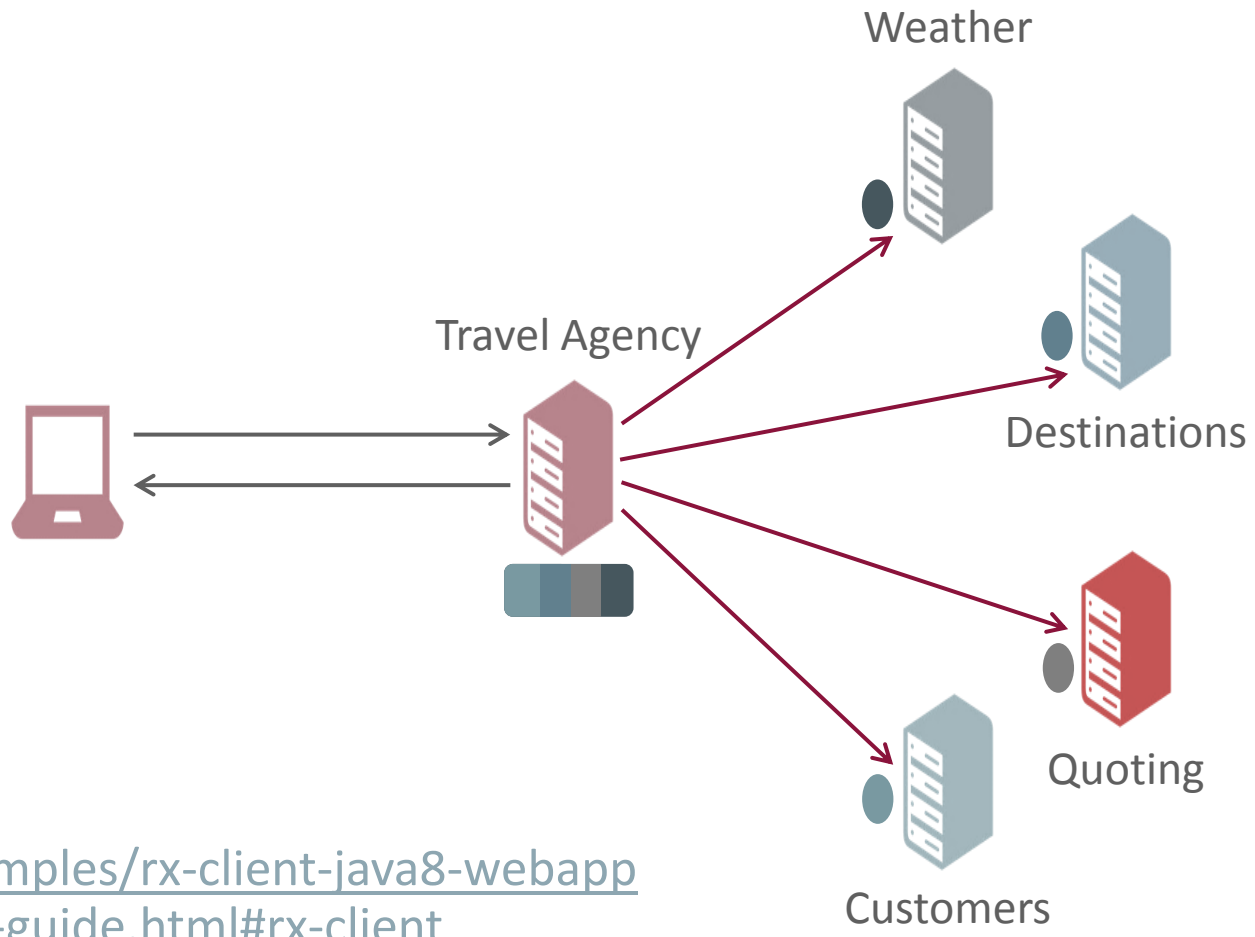
Thin Server Architecture



JAX-RS based Microservices Orchestration

Travel Agency Demo Application

- Remote
  - Destinations, weather, quoting
  - application/json, application/xml
  - Delays are simulated
- Travel agency client
  - application/json
  - Dependent calls



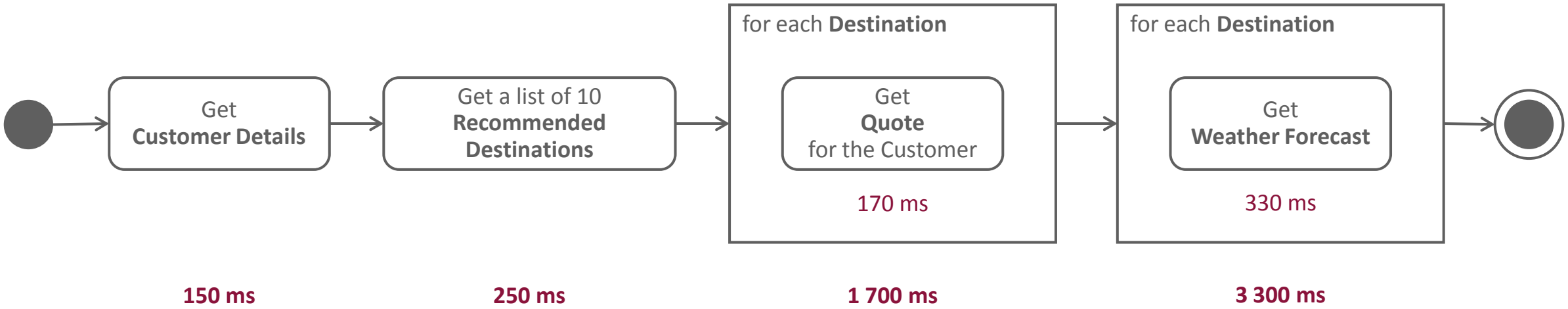
https://github.com/jersey/jersey/tree/master/examples/rx-client-java8-webapp
https://jersey.java.net/documentation/latest/user-guide.html#rx-client

Orchestration Layer Benefits

- 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

Implementing the Service

A Naïve Approach



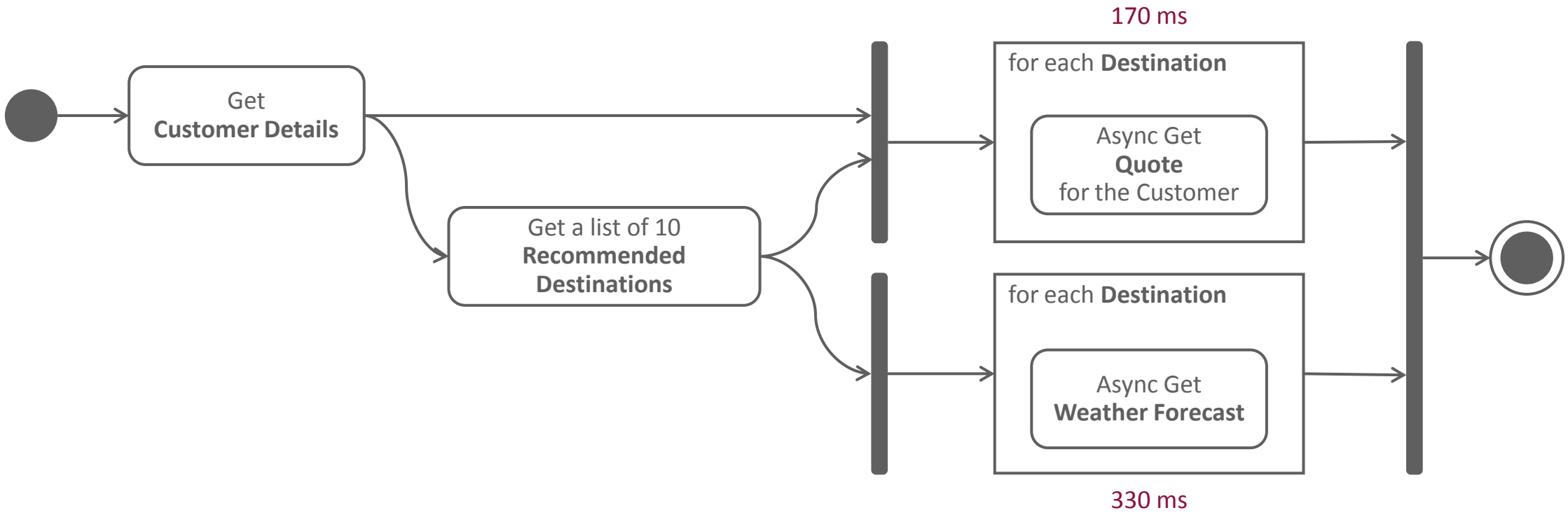
5 400 ms

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



Client – Asynchronous Approach

Futures

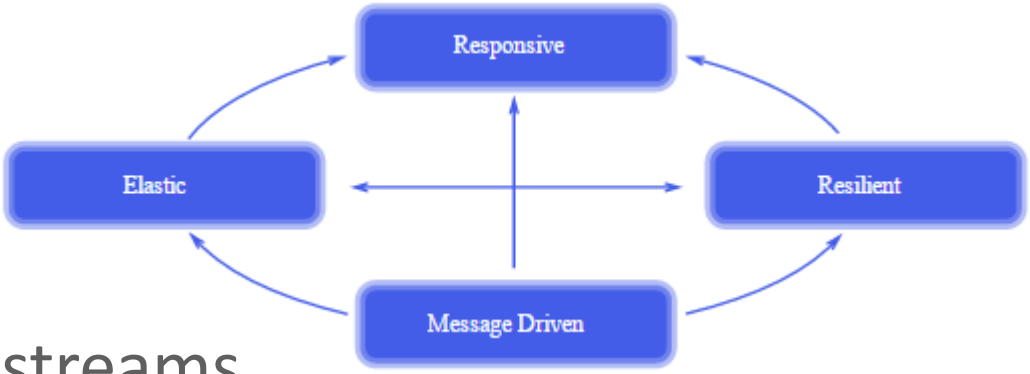
- Returns immediately after submitting a request
  - Future
- Harder to read, understand and debug
  - Especially when dealing with multiple futures and composed, dependent calls
- Need to find out when all Async requests finished
  - Relevant only for 2 or more requests (CountDownLatch)
- Fast
  - Each request can run on a separate thread
- Suitable for many independent calls

Jersey Client Features

- Fluent API for sync and async calls
- Reactive extensions
- Many connectors (Grizzly, Jetty, Apache, …)
  - Alternatives to the Jersey default transport, based on HttpUrlConnection
- Secure (SSL, Digest, Basic, OAuth, …)
- Various data bindings
- Filters

Reactive Jersey Client API

Reactive programming model



- Easier programming for asynchronous data streams
- Data flow
  - execution model propagates changes through the flow
- Event based
  - notify observers about new events, completion or error
- Composable
  - compose/ transform streams into a resulting stream
- Reactive client API to be introduced in JAX-RS 2.1

https://github.com/jersey/jersey/tree/master/ext/rx

Reactive Jersey Client API

Abstraction over different reactive libraries

- Java 8: CompletionStage, 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
- RXJava: Observable
  - Currently most advanced reactive API in Java
  - Contributed by Netflix – hardened & tested in production
- Guava: ListenableFuture, Futures
  - Similar to Java SE 8

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> {
// for now T can be
// CompletionStage/Java8, Observable/RxJava, CompletableFuture/jsr166, ListenebleFuture/Guava

    T get();

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

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

    // ...
}

public interface RxCompletionStageInvoker extends RxInvoker<CompletionStage> {

    CompletionStage<Response> get();

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

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

    // ...
}
```

Sync Client Example

SyncInvoker used

```
private WebTarget destination;
List<Destination> recommended = Collections.emptyList();
...
recommended = destination.path("recommended").request()
                // Identify the user.
                .header("Rx-User", "Sync")
                // Return a list of destinations.
                .get(new GenericType<List<Destination>>() {});

...
```

Async Client Example

AsyncInvoker used

```
private WebTarget destination;
List<Destination> recommended = Collections.emptyList();
...
recommended = destination.path("recommended").request()
                // Identify the user.
                .header("Rx-User", "Sync")
                // Async invoker.
                .async()
                // Return a list of destinations.
                .get(new InvocationCallback<List<Destination>>() {
                        @Override
                        public void completed(final List<Destination> recommended) {
                          ...
                        }
                        ...
                });
```

Reactive Client Example

RxObservableInvoker used

```
private WebTarget destination;
List<Destination> recommended = Collections.emptyList();
...
final Observable<Destination> recommended = RxObservable.from(destination).path("recommended").request()
            // Identify the user.
             .header("Rx-User", "RxJava")
             // Reactive invoker.
             .rx()
             // Return a list of destinations.
             .get(new GenericType<List<Destination>>() {})
             // Emit destinations one-by-one.
             .flatMap(Observable::from)
             // Remember emitted items for dependant requests.
             .cache();
```

Jersey Test Framework

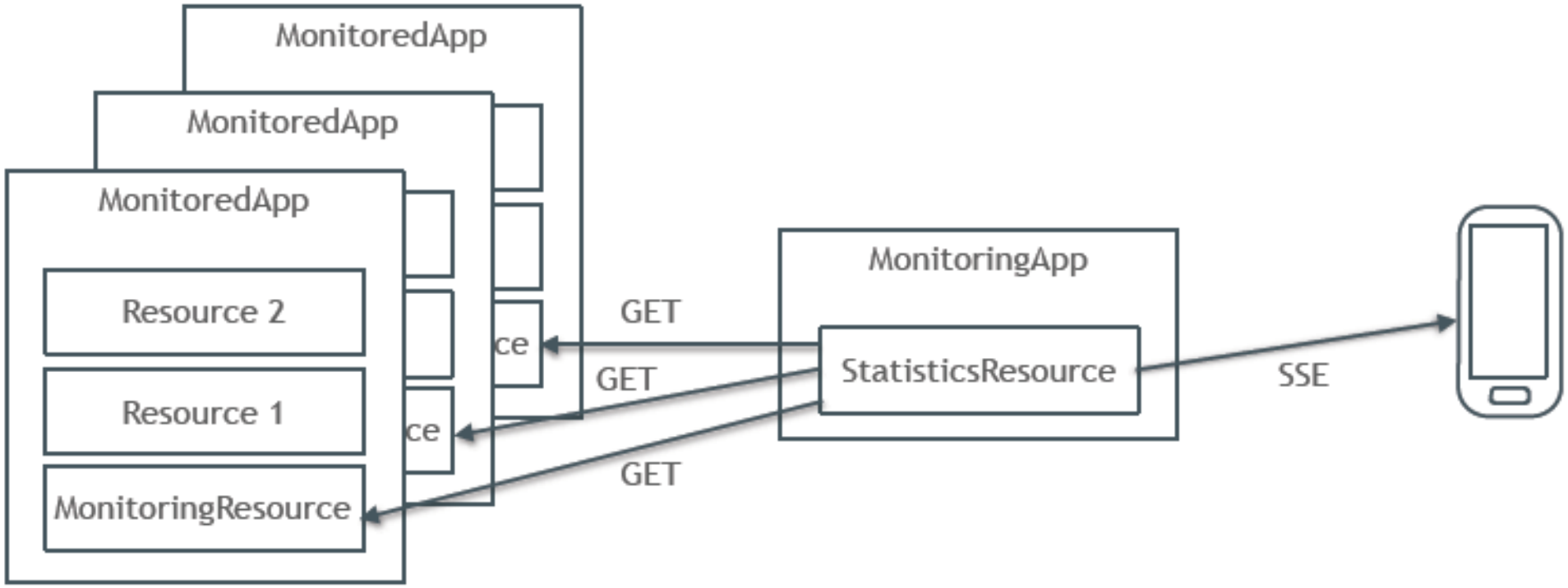
- Based on JUnit
- Support for TestNG available
- Multiple container support
  - Grizzly
  - In memory
  - Java SE Http Server
  - Jetty
  - External container support

Monitoring support

- Powerful monitoring API
  - Basic statistics collected
- Must be explicitly enabled
  - ServerProperties.MONITORING_STATISTICS_ENABLED
  - ServerProperties.MONITORING_STATISTICS_MBEANS_ENABLED
  - Register your own event listeners
- MonitoringStatistics could be injected into any resource and reused:
  - @Inject private Provider<MonitoringStatistics> statistics;

Grizzly and Jersey Monitoring Demo

https://github.com/PetrJanouch/JavaOne2015-Monitoring-Demo



Jersey 3.0

- Jersey 2.x branched off and 3.x on the master
- Based on JAX-RS 2.1
  - Non-blocking IO
  - SSE support
  - Support for reactive programming
- Java 8 friendly
- Backwards compatible with 2.x

Jersey 3.0 Non-Blocking I/O

- Extra performance boost
- Inspired by but not based on Servlet 3.1
- Beneficial for large and streamed entities
- A brand new client connector
  - Getting rid of HttpUrlConnection
  - First version already in incubator
  - Much better performance than HttpUrlConnection even in blocking mode

Summary

- Microservices are a valuable architectural technique, but:
  - not necessarily for everyone
  - not necessary always
  - not necessarily all-at-once
- Building microservises with Jersey is easier
  - Many microservices-related features in Jersey are going to be standardized

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