Vert.X

high performance polyglot application toolkit

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Architecte chez @cmarkea

CTO chez @qaobee

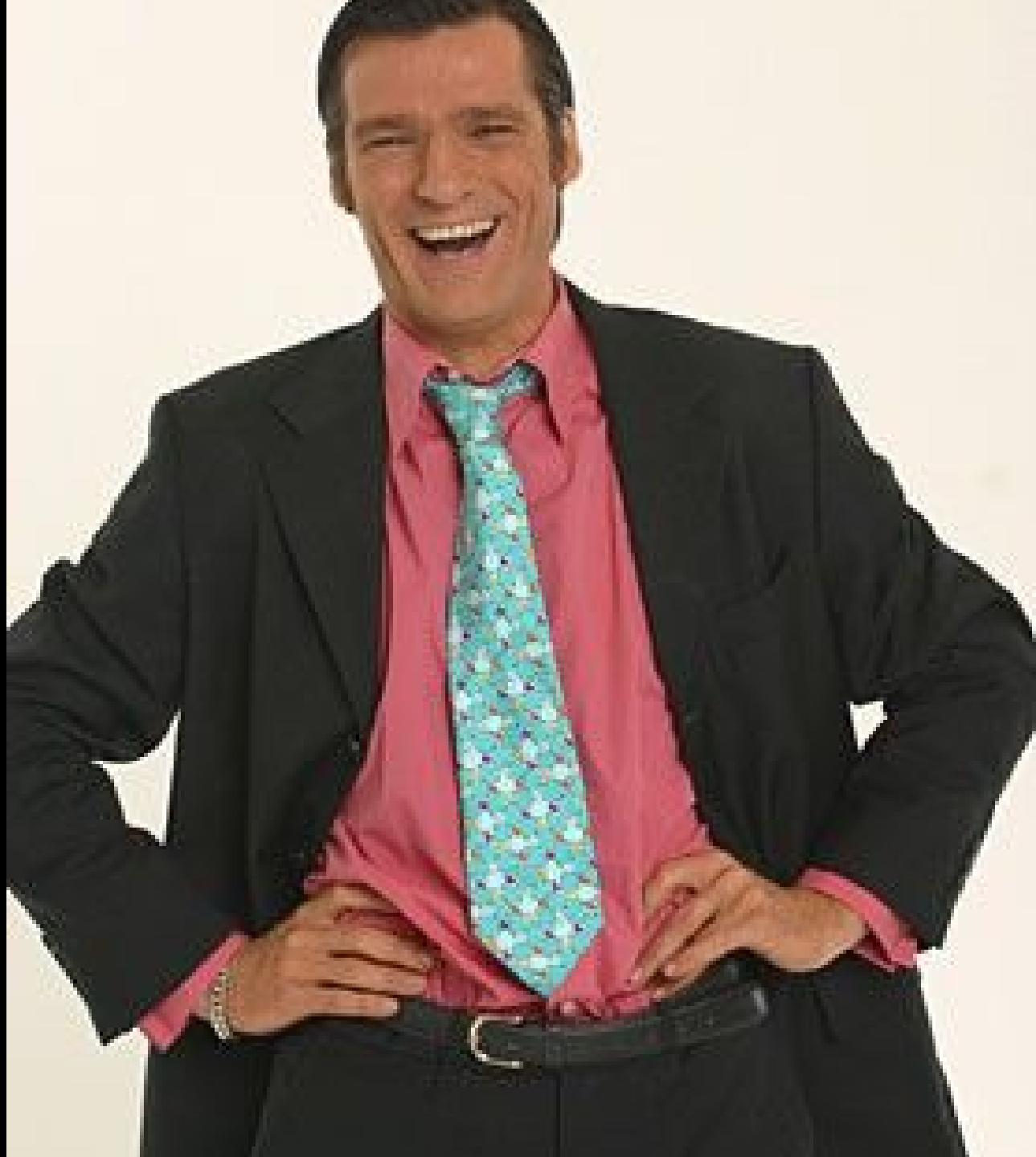
Petite histoire

- Créé par Tim Fox @timfox
- en 2011 chez VMWare
- sous le nom de Node.x
- 2012 : devient Vert.X
- 2013 : passe dans la fondation Eclipse
- 24/06/2015 sortie de la v3
- environ 180 contributeurs

https://www.parleys.com/search/vert.x/PRESENTATIONS

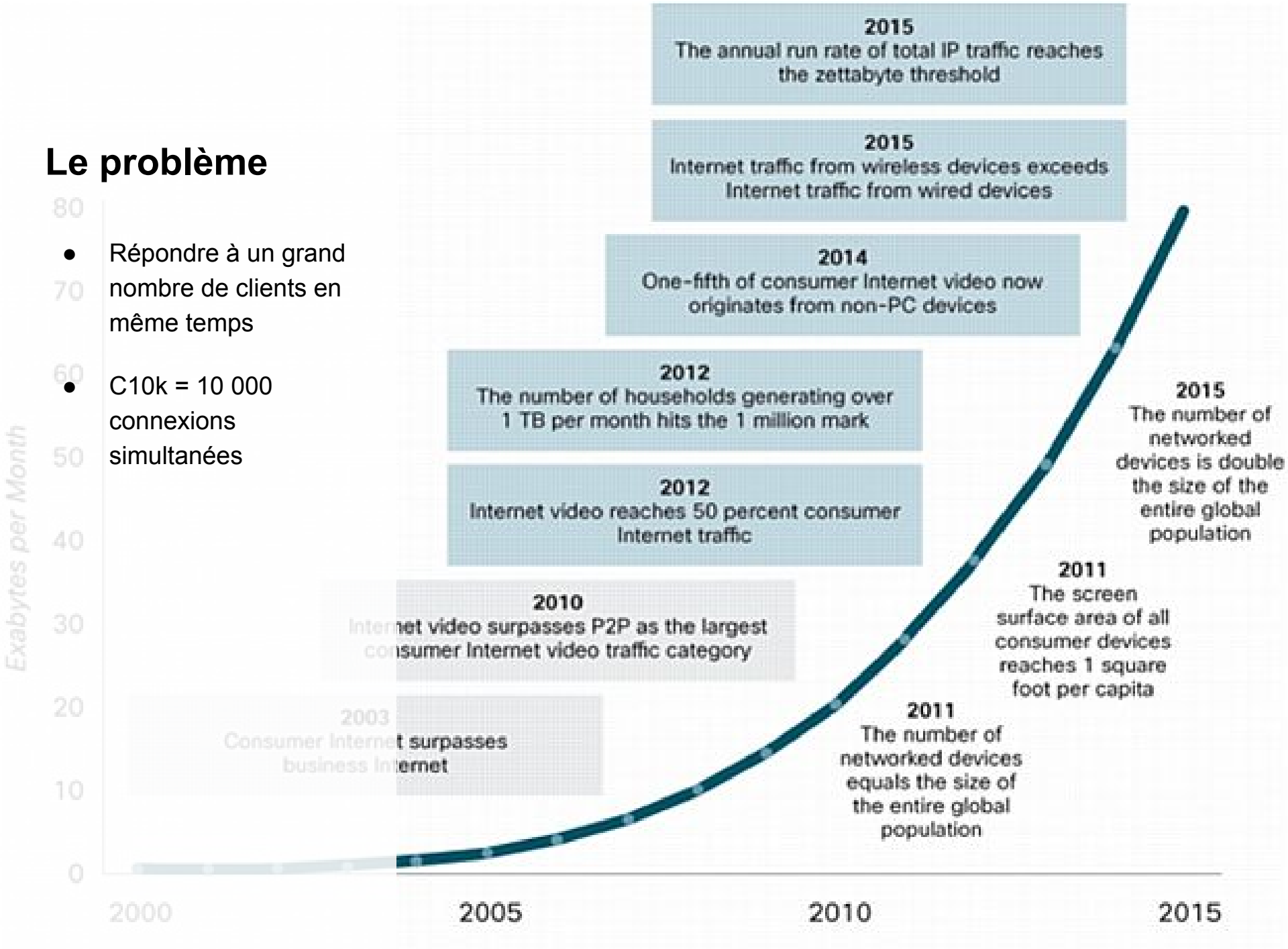
Vocabulaire pour commerciaux

Simple threadSafe concurrent asynchronous eventDriven reactive eventBus over a scalable polyglot embeddable toolkit plateform

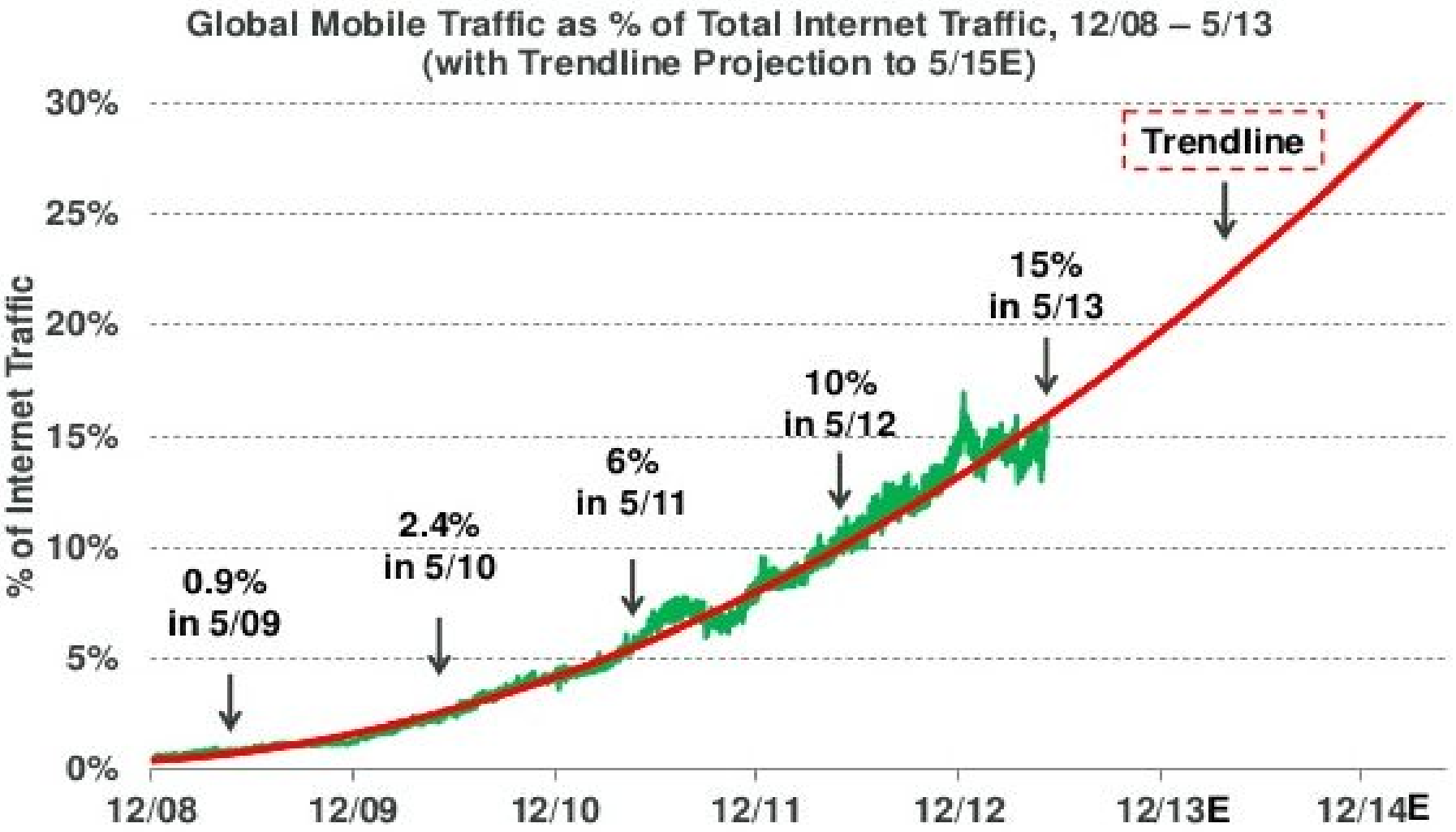


Le problème

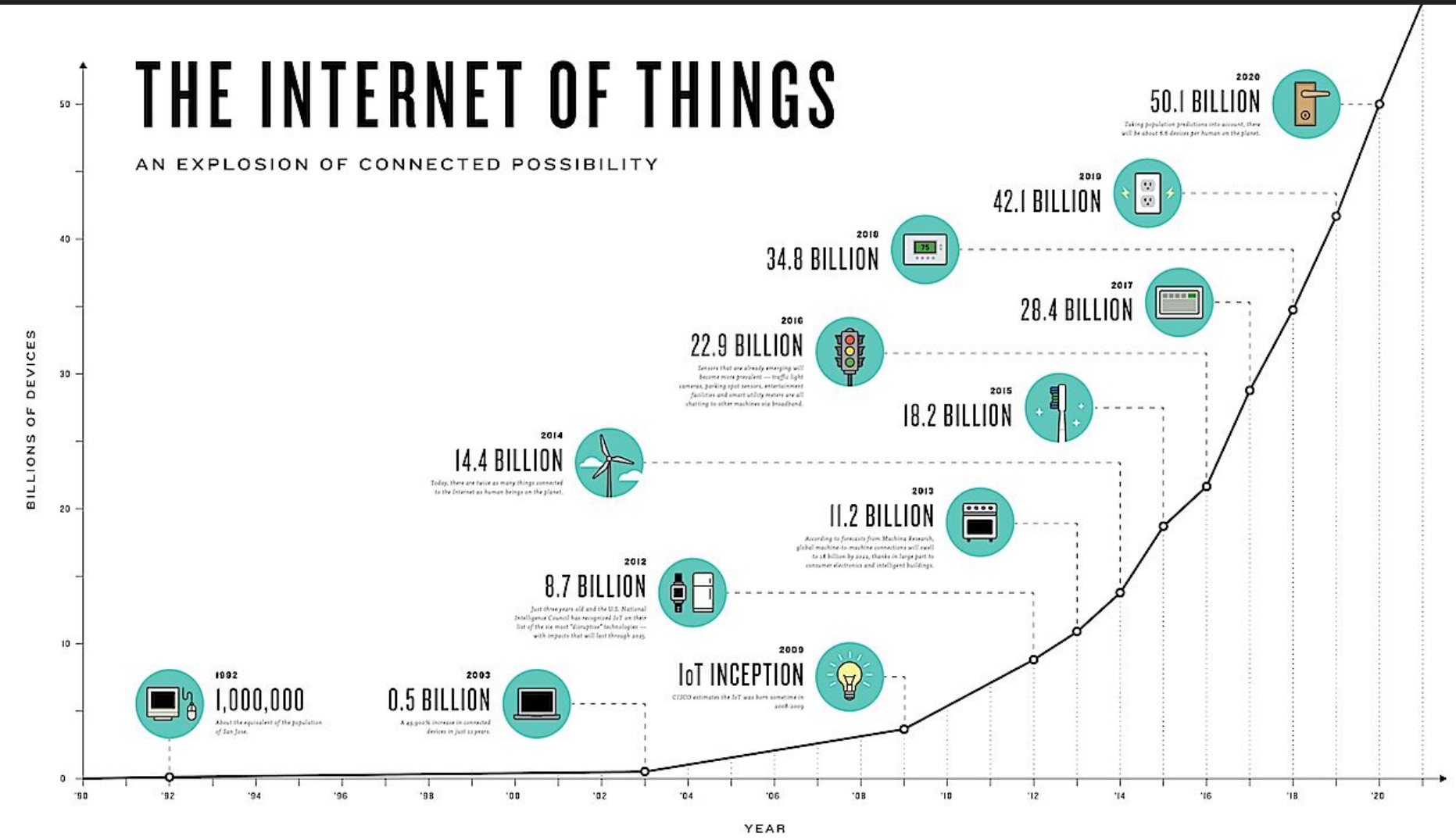
- Répondre à un grand nombre de clients en même temps
- C10k = 10 000 connexions simultanées



C10k


Global Mobile Traffic as % of Total Internet Traffic, 12/08 – 5/13
(with Trendline Projection to 5/15E)
% of Internet Traffic
30%
25%
20%
15%
10%
5%
0%
Trendline
15%
in 5/13
10%
in 5/12
6%
in 5/11
2.4%
in 5/10
0.9%
in 5/09
12/08
12/09
12/10
12/11
12/12
12/13E
12/14E

C10k


THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY
1992
1,000,000
About the equivalent of the population of San Jose.
2003
0.5 BILLION
A 49,900% increase in connected devices in just 13 years.
2009
IoT INCEPTION
CISCO estimates the IoT was born sometime in 2008-2009.
2012
8.7 BILLION
Just three years old and the U.S. National Intelligence Council has recognized IoT on their list of the six most "disruptive" technologies — with impacts that will last through 2025.
2013
11.2 BILLION
According to forecasts from Machina Research, global machine-to-machine connections will swell to 18 billion by 2022, thanks in large part to consumer electronics and intelligent buildings.
2014
14.4 BILLION
Today, there are twice as many things connected to the Internet as human beings on the planet.
2015
18.2 BILLION
2016
22.9 BILLION
Sensors that are already emerging will become more prevalent — traffic light cameras, parking spot sensors, entertainment facilities and smart utility meters are all chatting to other machines via broadband.
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION
Taking population predictions into account, there will be about 6.6 devices per human on the planet.
BILLIONS OF DEVICES
0
10
20
30
40
50
'90
'92
'94
'96
'98
'00
'02
'04
'06
'08
'10
'12
'14
'16
'18
'20
YEAR

Système réactif vs programmation réactive

The Reactive Manifesto

Published on September 16 2014. (v2.0)

Organisations working in disparate domains are independently discovering patterns for building software that look the same. These systems are more robust, more resilient, more flexible and better positioned to meet modern demands.

These changes are happening because application requirements have changed dramatically in recent years. Only a few years ago a large application had tens of servers, seconds of response time, hours of offline maintenance and gigabytes of data. Today applications are deployed on everything from mobile devices to cloud-based clusters running thousands of multi-core processors. Users expect millisecond response times and 100% uptime. Data is measured in Petabytes. Today's demands are simply not met by yesterday's software architectures.

We believe that a coherent approach to systems architecture is needed, and we believe that all necessary aspects are already recognised individually: we want systems that are Responsive, Resilient, Elastic and Message Driven. We call these Reactive Systems.

Systems built as Reactive Systems are more flexible, loosely-coupled and scalable. This makes them easier to develop and amenable to change. They are significantly more tolerant of failure and when failure does occur they meet it with elegance rather than disaster. Reactive Systems are highly responsive, giving users effective interactive feedback.

Reactive Systems are:

Responsive: The system responds in a timely manner if at all possible. Responsiveness is the cornerstone of usability and utility, but more than that, responsiveness means that problems may be detected quickly and dealt with effectively. Responsive systems focus on providing rapid and consistent response times, establishing reliable upper bounds so they deliver a consistent quality of service. This consistent behaviour in turn simplifies error handling, builds end user confidence, and encourages further interaction.

Resilient: The system stays responsive in the face of failure. This applies not only to highly-available, mission critical systems — any system that is not resilient will be unresponsive after a failure. Resilience is achieved by replication, containment, isolation and delegation. Failures are contained within each component, isolating components from each other and thereby ensuring that parts of the system can fail and recover without compromising the system as a whole. Recovery of each component is delegated to another (external) component and high-availability is ensured by replication where necessary. The client of a component is not burdened with handling its failures.

Elastic: The system stays responsive under varying workload. Reactive Systems can react to changes in the input rate by increasing or decreasing the resources allocated to service these inputs. This implies designs that have no contention points or central bottlenecks, resulting in the ability to shard or replicate components and distribute inputs among them. Reactive Systems support predictive, as well as Reactive, scaling algorithms by providing relevant live performance measures. They achieve elasticity in a cost-effective way on commodity hardware and software platforms.

Message Driven: Reactive Systems rely on asynchronous message-passing to establish a boundary between components that ensures loose coupling, isolation, location transparency, and provides the means to delegate errors as messages. Employing explicit message-passing enables load management, elasticity, and flow control by shaping and monitoring the message queues in the system and applying back-pressure when necessary. Location transparent messaging as a means of communication makes it possible for the management of failure to work with the same constructs and semantics across a cluster or within a single host. Non-blocking communication allows recipients to only consume resources while active, leading to less system overhead.

http://www.reactivemanifesto.org

Les applications modernes font face à de nouveaux défis, bla bla bla

Responsive : répond sur un laps de temps

Résilient : répond même en cas d' échec

Elastique : répond quel que soit la charge

Message-driven : repose sur le la communication événementielle asynchrone

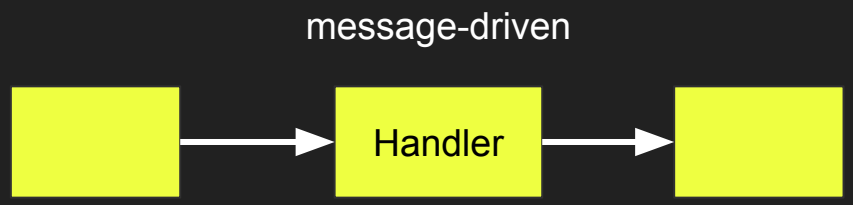
Caractéristiques

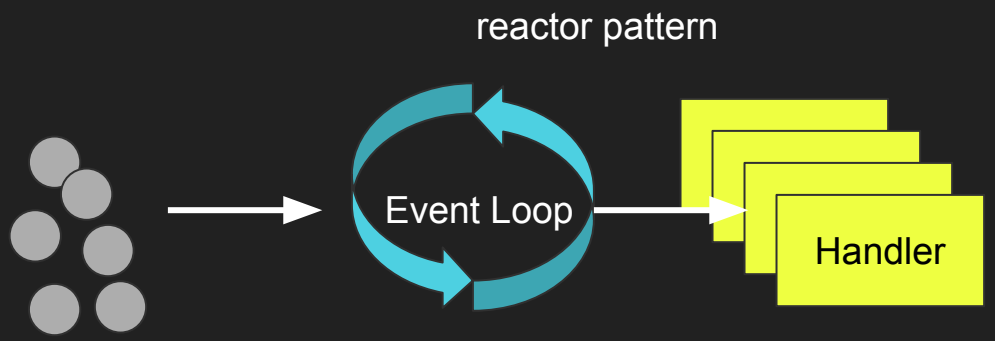
Réactif

- Responsive
  - Tient la charge (scalable)
  - Robuste (resilience)
- Message-driven
  - événementiel asynchrone

Polyglotte

- Pas que en Java
  - Groovy, Ruby, Javascript
- S'exécute sur la VM





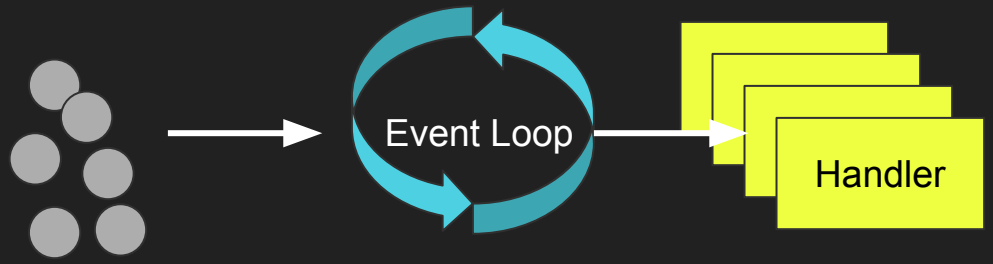
Les handlers sont toujours appelés dans le même thread (event loop)

Les handlers ne bloquent jamais le thread qui les appelle

Qu'est-ce que ● ?

- Un message
- Une notification
- Une requête HTTP
- Une commande, une instruction
- Un fichier
- Un résultat, un rapport, une erreur

```
void operation(param1, param2, Handler< ● > {
   // …
   handler.handle( ● );
  // …
}
```




```
void handle( ● ) {
   // faire un truc avec ●
}
```

Modèle de développement asynchrone

```
vertx.createHttpServer()
        .requestHandler(
                req -> req.response().end("Hello there!")
        )
        .listen(8080,
                ar -> {
                    if (ar.failed()) {
                        System.out.println("The server failed to start");
                    } else {
                        System.out.println("Server started on 8080");
                    }
                }
        );
```

ar : AsyncResult

- status : success ou failed
- result : si success
- cause : si failed

JVM polyglotte

Dois-je coder en java pour exécuter un programme sur la JVM?

Oui, mais pas que, fais-toi plaisir!

JVM polyglotte

On peut programmer en plus de 200 langages

Java, JavaFX, Ceylon, Gosu, Groovy, Clojure, ~~Rhino~~ Nashorn, Mirah, Scala, JRuby, Xtend, JPython, Fantom, Oxygene, Kotlin, …

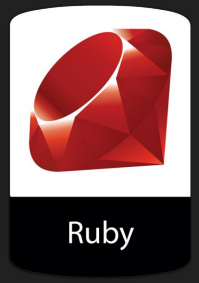
L'intérêt : à chaque problème sa solution

"Quand on n'a qu'un marteau dans la main, les vis ressemblent à des clous"

Polyglotte


```
var vertx = require('vertx-js/vertx');


var server = vertx.createHttpServer();
server.requestHandler(function (request) {
  var response = request.response();
  response.putHeader('content-type', 'text/plain');
  response.end('Hello World!');
});

server.listen(8080);
```

Polyglotte




```
server = vertx.create_http_server()


server.request_handler() { |request|
  response = request.response()
  response.put_header("content-type", "text/plain")
  response.end("Hello World!")
}

server.listen(8080)
```

Polyglotte


```
def server = vertx.createHttpServer()

server.requestHandler({ request ->
  def response = request.response()
  response.putHeader("content-type", "text/plain")
  response.end("Hello World!")
})

server.listen(8080)
```

Polyglotte

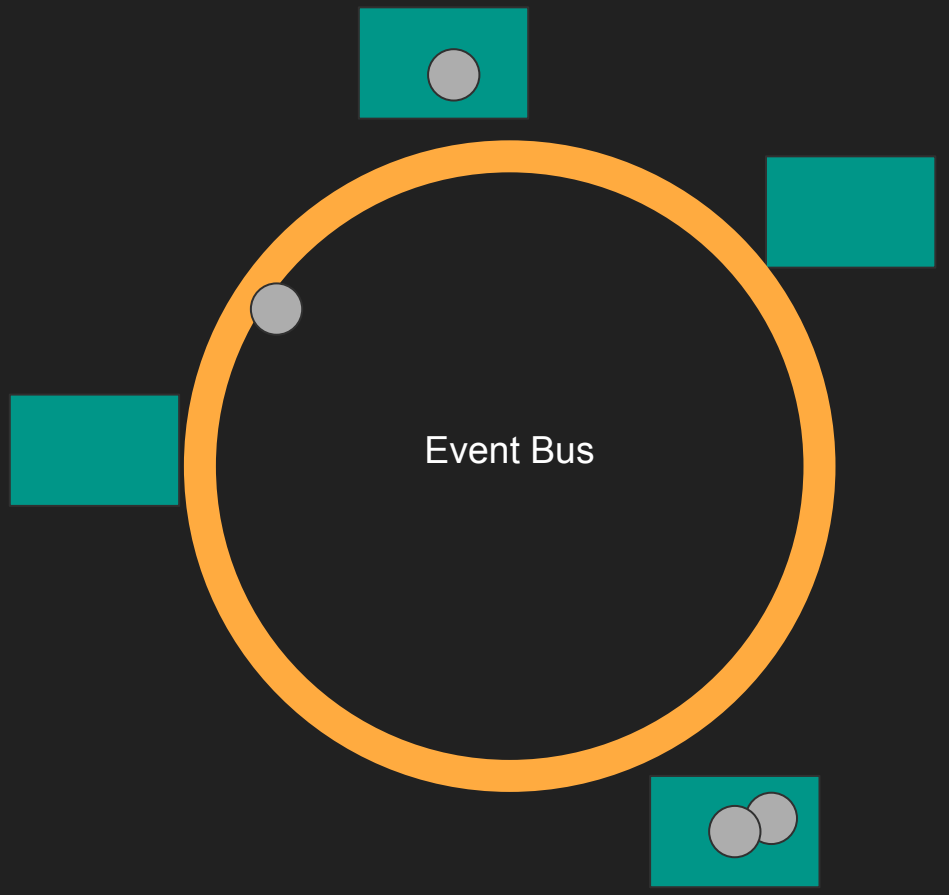

```
public class Main {

  public static void main(String[] args) {

    HttpServer server = vertx.createHttpServer();
    server.requestHandler(request -> {
      HttpServerResponse response = request.response();

      response.putHeader("content-type", "text/plain");
      response.end("Hello World!");
    });
    server.listen(8080);
  }

}
```

L’event bus

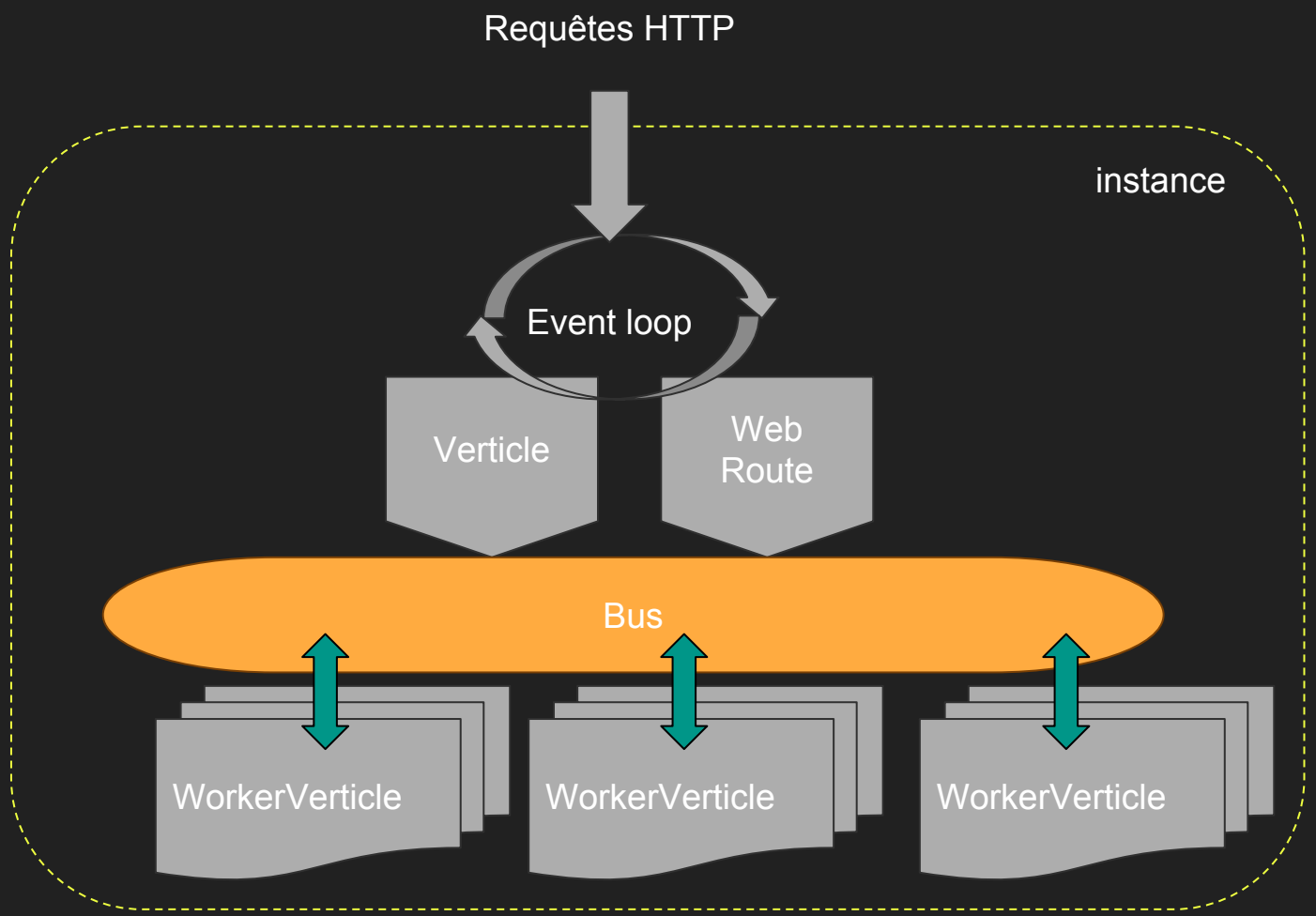
- Point à point
- Publish / Subscribe
- Requête / réponse

Les messages sont reçus par des handlers et déposés en utilisant l’eventLoop

Chaque instance de Vert.X a accès à l’eventBus

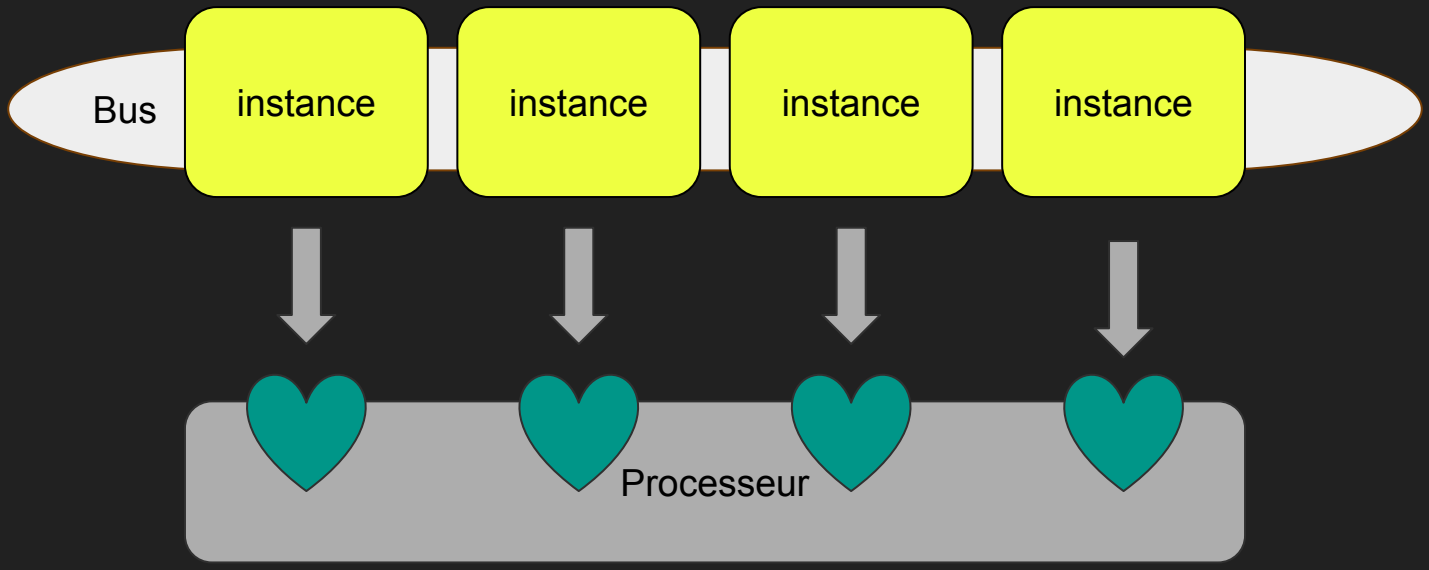


Architecture



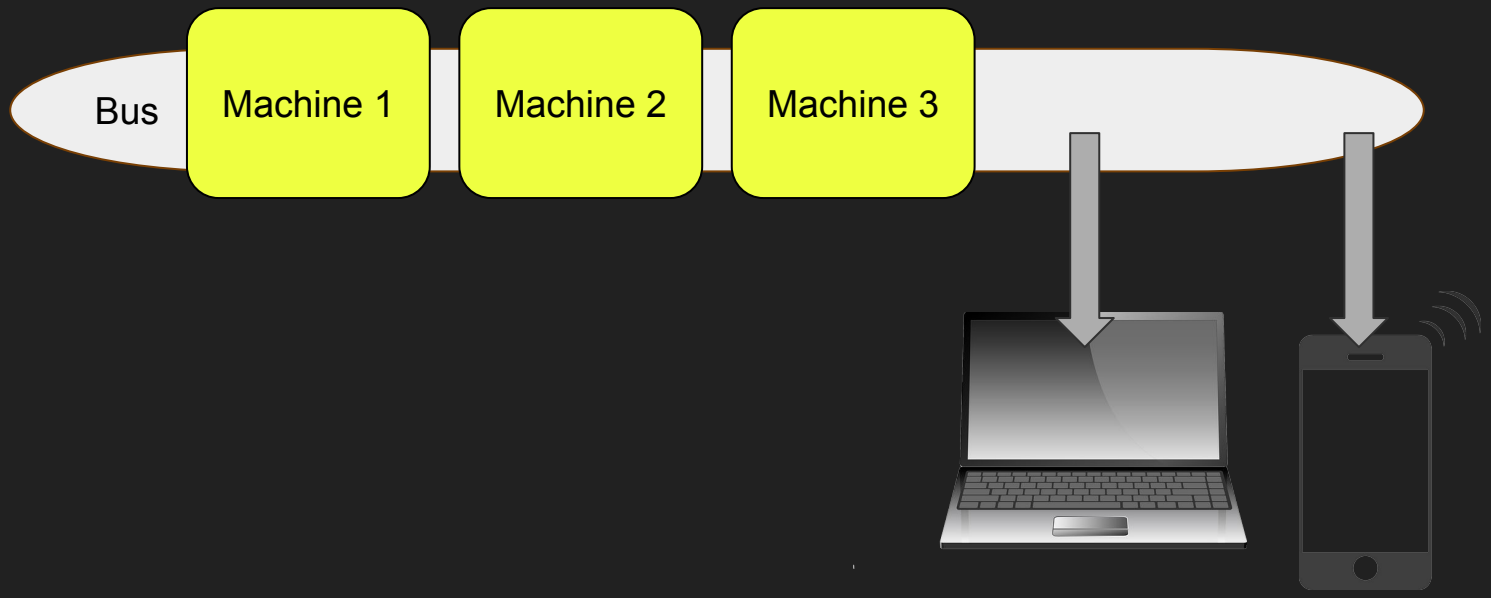
Architecture

Multi-instances



Architecture

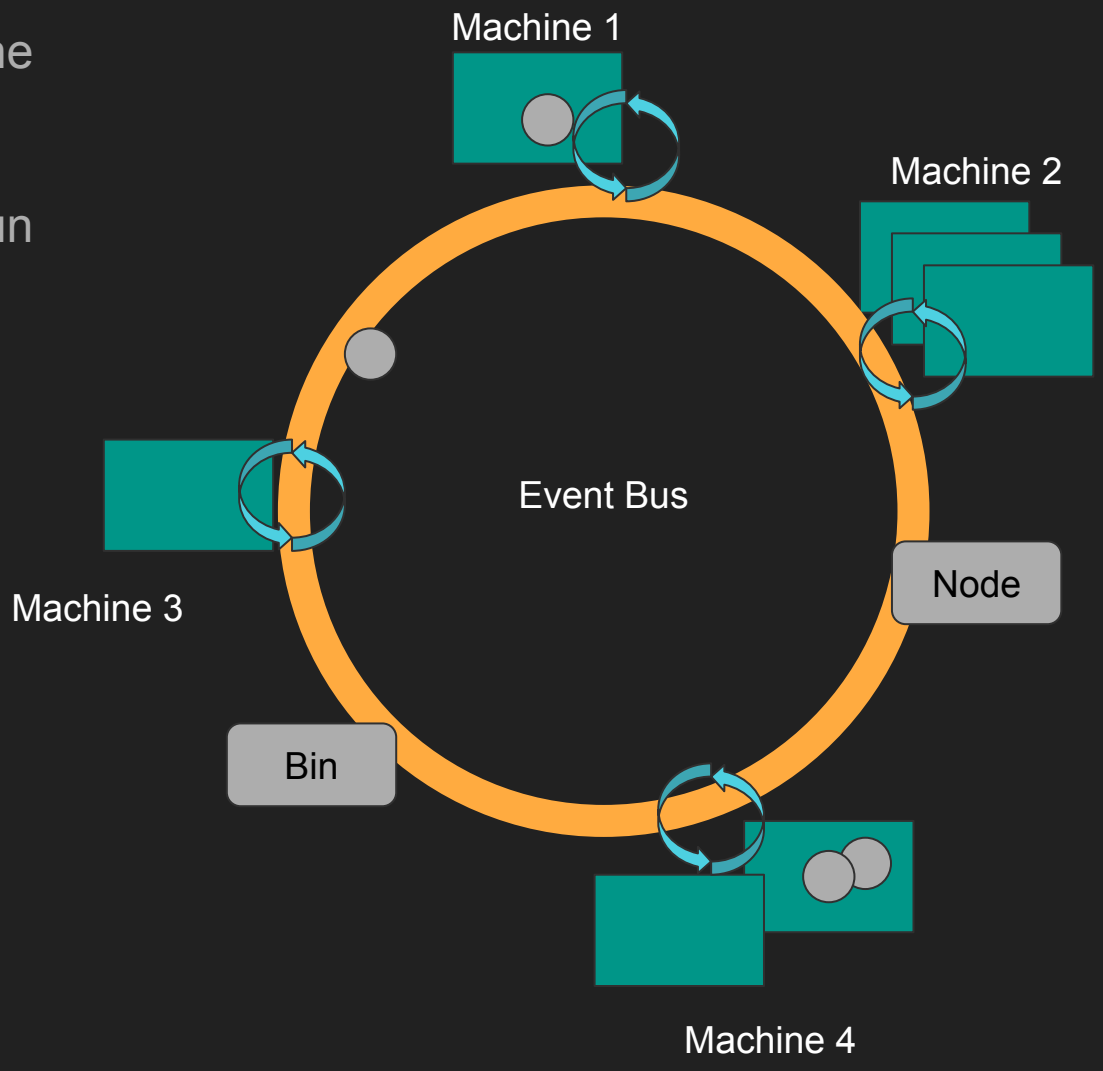
Cluster



L’event bus

L’eventBus permet une communication distribuée.

Presque tout peut publier un message sur le bus.



Event bus

```
EventBus eb = vertx.eventBus();
MessageConsumer<String> consumer = eb.consumer("news.uk.sport", message -> {
   System.out.println("I have received a message: " + message.body());
   message.reply("how interesting!");
}).completionHandler(res -> {
   if (res.succeeded()) {
       System.out.println("Registration has reached all nodes");
   } else {
       System.out.println("Registration failed!");
   }
});

consumer.unregister(res -> {
   if (res.succeeded()) {
       System.out.println("Un-registration has reached all nodes");
   } else {
       System.out.println("Un-registration failed!");
   }
});
```

Event bus

Publish / Subscribe

```
eventBus.publish("news.uk.sport", "You kicked a ball");
```

Point à point

```
eventBus.send("news.uk.sport","You kicked a ball",ar ->{
   if (ar.succeeded()) {
       System.out.println("reply: " + ar.result().body());
   }
});
```

Ajout d'en-tête

```
DeliveryOptions options = new DeliveryOptions();
options.addHeader("some-header", "some-value");
eventBus.send("news.uk.sport", "You kicked a ball", options);
```

Verticles : un modèle “agent” ou presque

Les verticles sont des bouts de code qui sont déployés et exécuté par Vert.X peu importe le langage.

```
vertx.deployVerticle("mon.verticle");
```

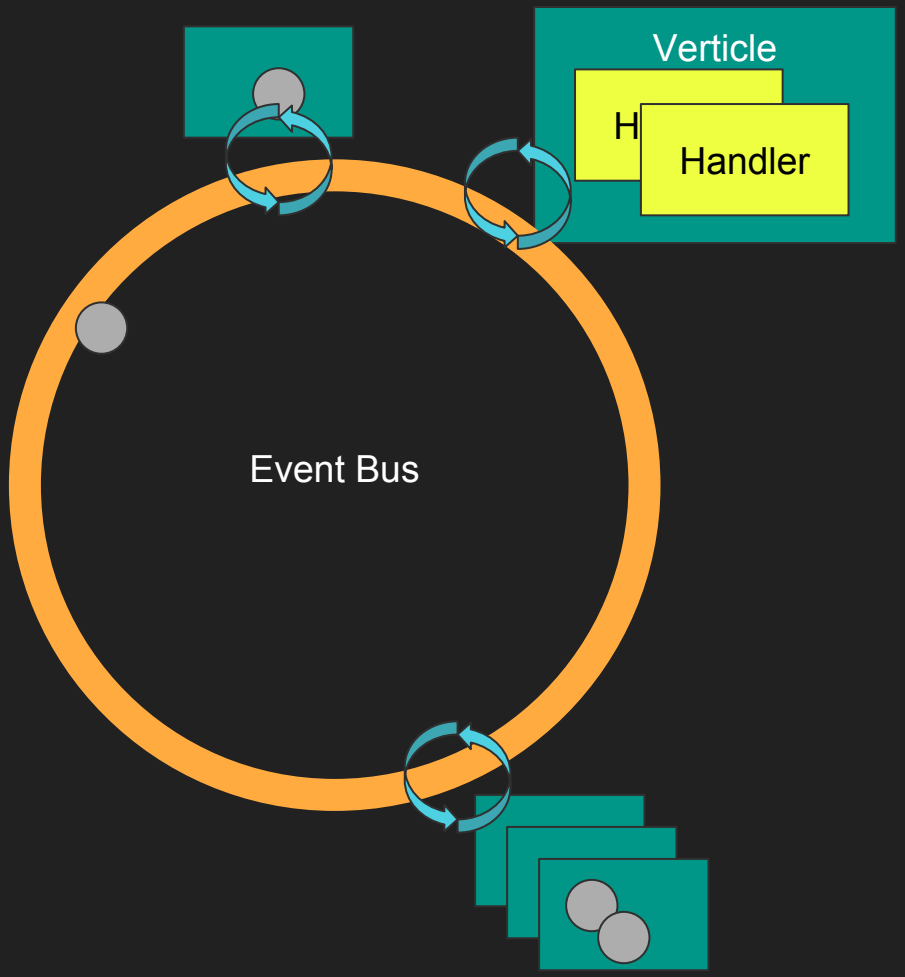
Ils ont un cycle de vie : start et stop.

Ils interagissent en utilisant des événement ou des messages.

Ils peuvent être instanciés plusieurs fois et se respawn en cas d’échec.

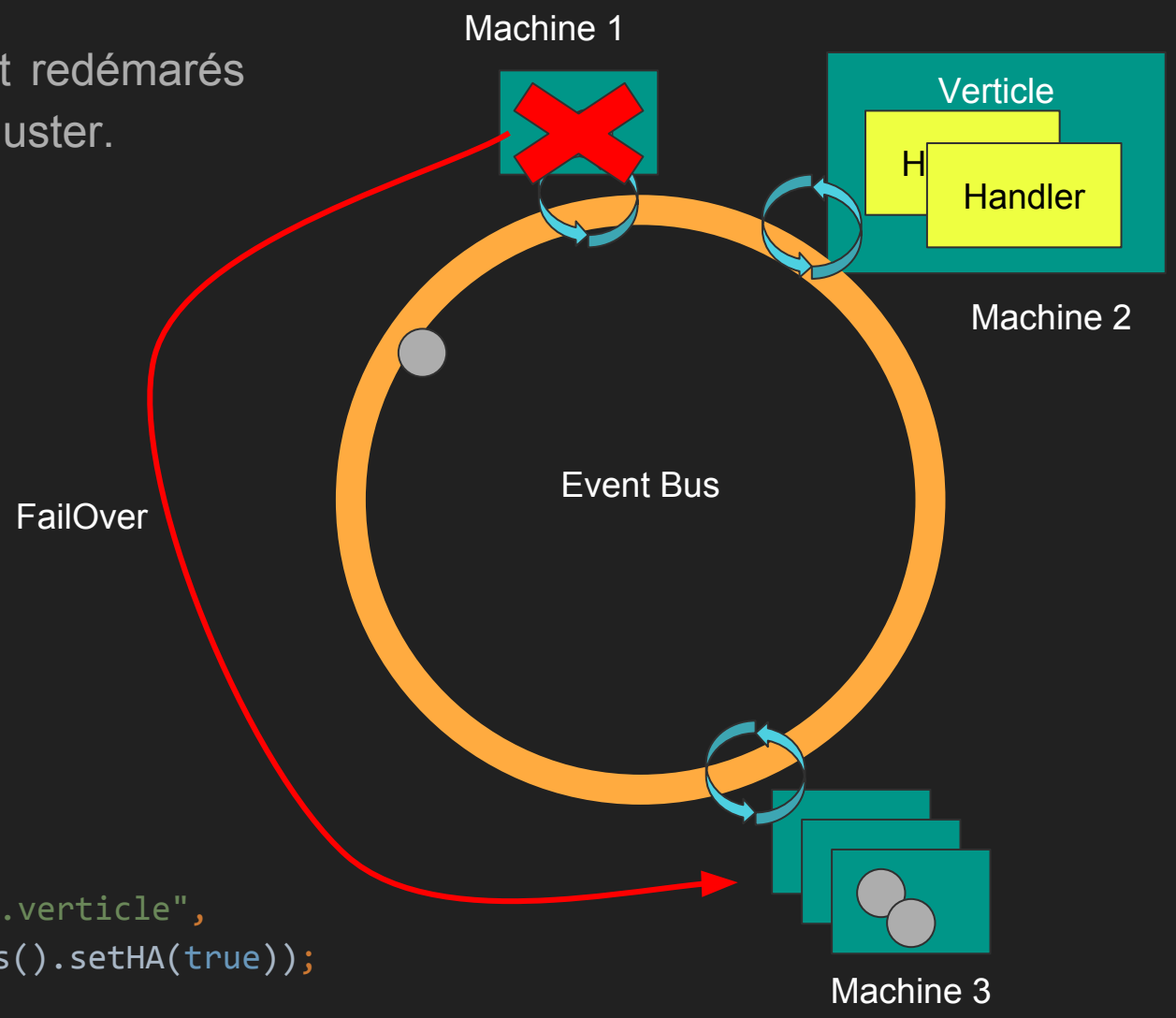
Les workerVerticles traitent le bloquant

```
vertx.deployVerticle("mon.verticle",
    new DeploymentOptions().setInstances(3));
```



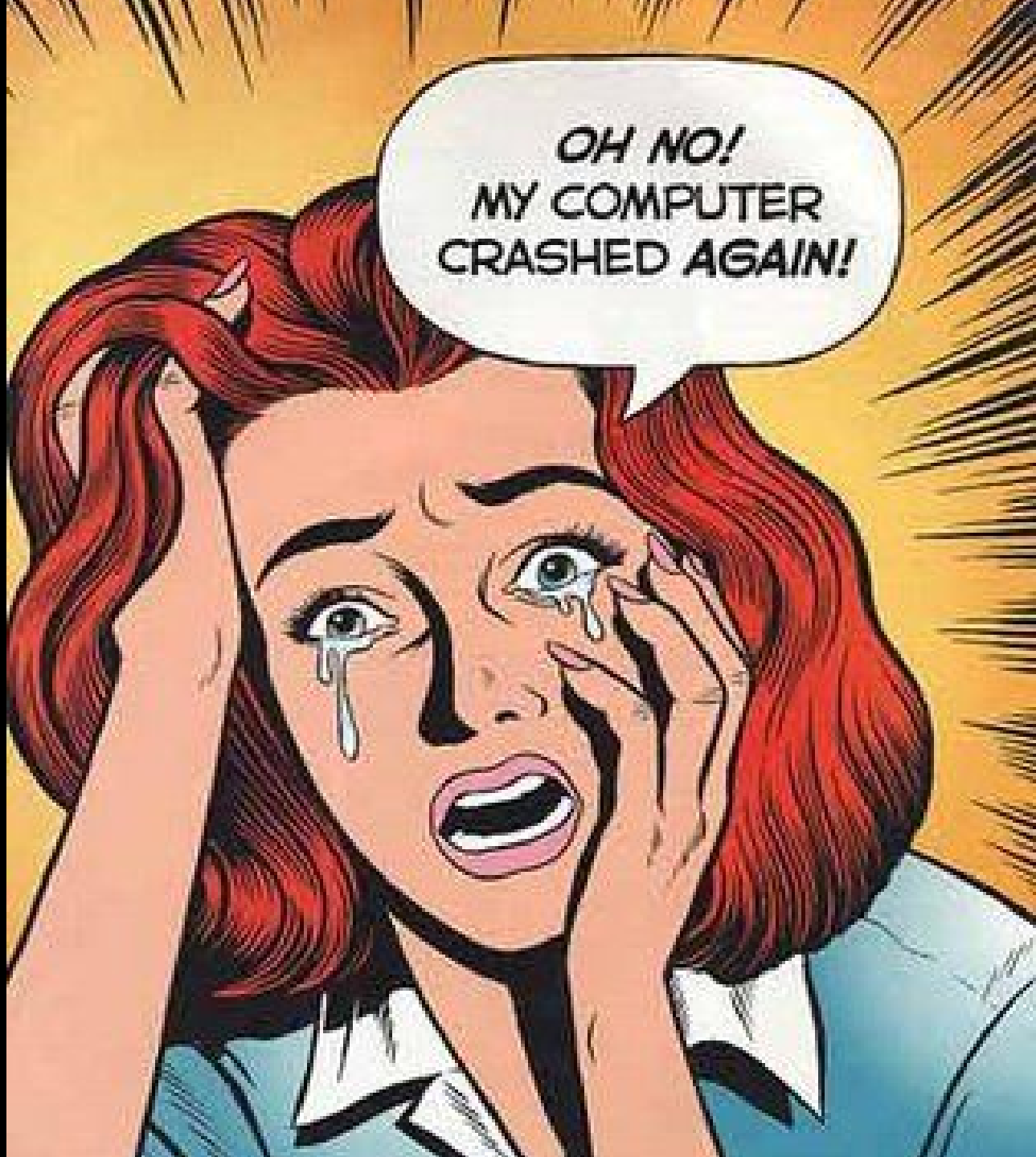
Verticles : un modèle “agent” ou presque

Les verticles morts sont redémarés sur un autre noeud du cluster.



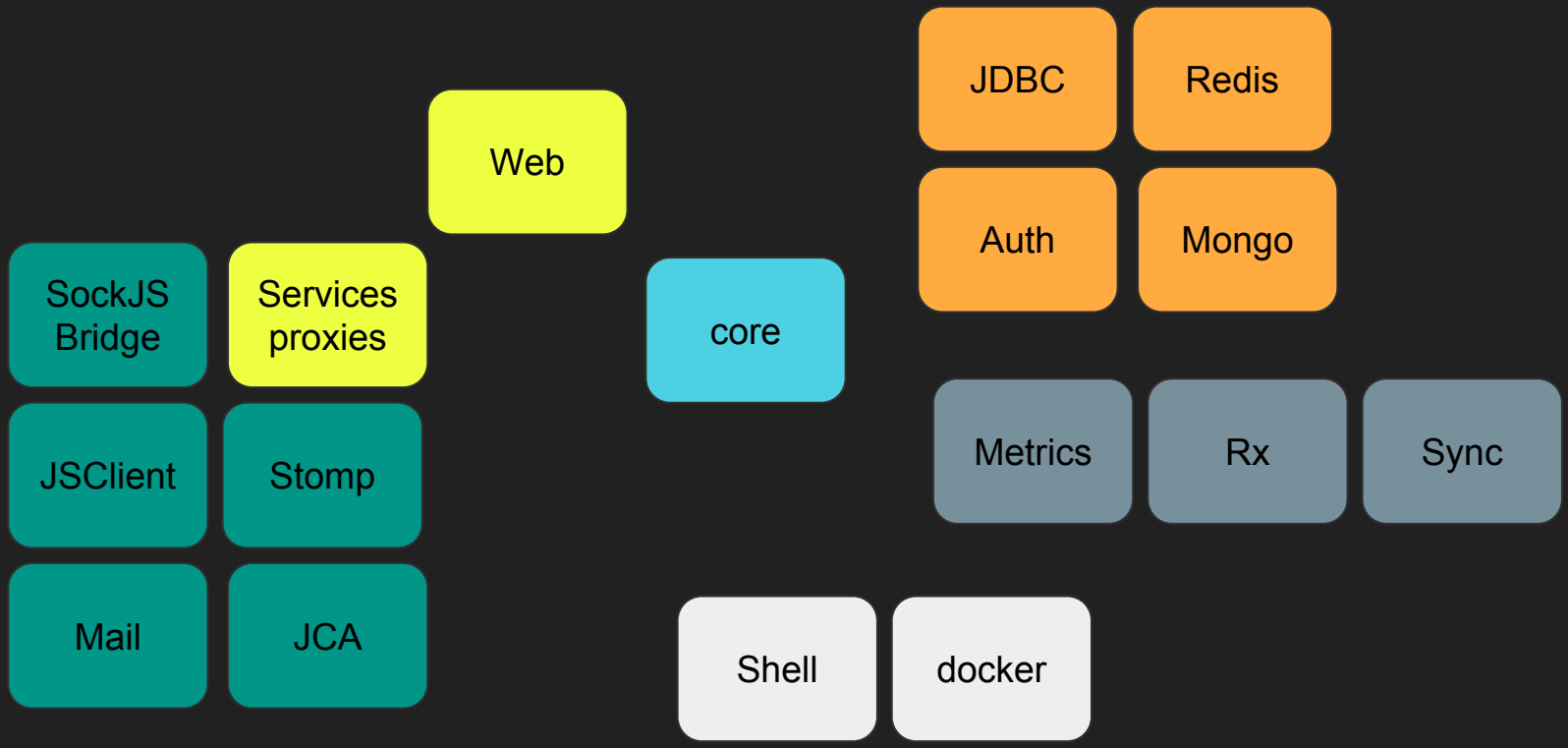

```
vertx.deployVerticle("mon.verticle",
     new DeploymentOptions().setHA(true));
```

Fail-over demo



Stack Vert.X

http://vertx.io/docs/



Stack Vert.X

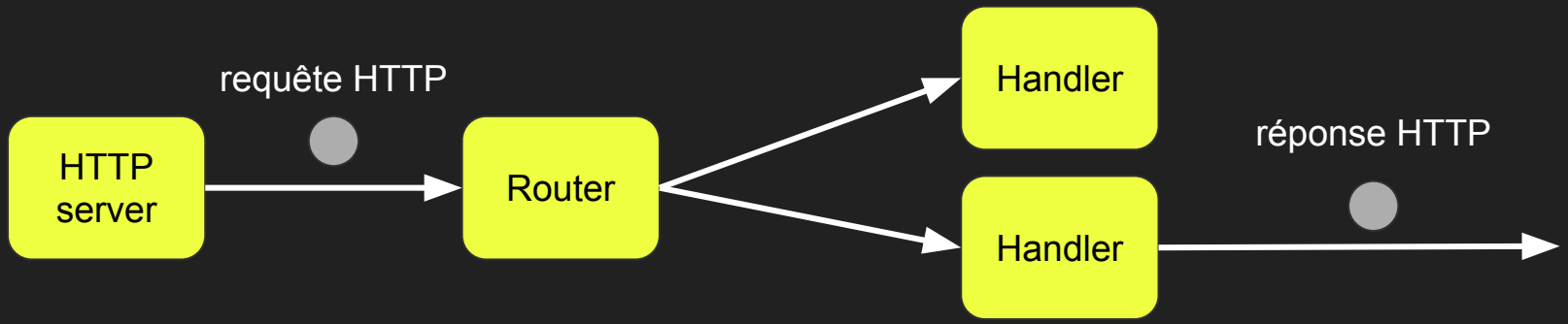
- Vert.x core
- Vert.x Web
  - Routages et sous-routages
  - Sessions
  - Cookies
  - Sécurité (basic auth, shiro, JWT, …)
  - Templates (Handlebars, Jade, MVEL, Thymeleaf)
  - SockJS
  - Static files
  - …
- Accès aux données
  - MongoDB, JDBC, Redis, SQL Common
- Intégration
  - Mail et JCA
- Sécurité
  - basic auth, shiro, JWT, JDBC Auth
- Reactive
  - Vert.X Rx, Reactive streams
- Metrics
- Vert.X unit

Accès aux données de manière asynchrone

```
jdbc.getConnection(ar -> {
    SQLConnection connection  =  ar.result();
    connection.query("SELECT  *  FROM  Beer", resp ->{
        if  (!resp.failed())  {
            List<Beer> beverages  = resp.result()
                .getRows()
                .stream()
                .map(Beer::new)
                .collect(Collectors.toList());
        }
    //…
    });
});
```

Le Web

```
HttpServer server = vertx.createHttpServer();
Router router = Router.router(vertx);
Route route = router.route(HttpMethod.PUT, "myapi/orders")
       .consumes("application/json")
       .produces("application/json");

route.handler(routingContext -> {
   // This would be match for any PUT method to paths starting with
   // "myapi/orders" with a content-type of "application/json"
   // and an accept header matching "application/json"
});

server.requestHandler(router::accept).listen(8080);
```



Le Web

```
Router restAPI = Router.router(vertx);
restAPI.get("/products/:productID").handler(rc -> {
     // TODO Handle the lookup of the product....
     rc.response().write(productJSON);
});

restAPI.put("/products/:productID").handler(rc -> {
     // TODO Add a new product...
     rc.response().end();
});

Router mainRouter = Router.router(vertx);
// Handle static resources
mainRouter.route("/static/*").handler(StaticHandler.create());
mainRouter.route(".*\\.templ").handler(myTemplateHandler);
mainRouter.mountSubRouter("/productsAPI", restAPI);

$curl http://localhost:8080/productsAPI/products/1234
```

Le Web

```
router.route().path("/*")
        .consumes("application/json")
        .handler(routingContext -> {
            HttpServerResponse response = routingContext.response();
            response.putHeader("content-type", "application/json");
            routingContext.next();
        });

router.get("/beers/").handler(routingContext -> {
    JsonObject query = new JsonObject();
    mongoClient.find("beers", query, res -> {
        if (res.succeeded()) {
            JsonArray jar = new JsonArray();
            res.result().forEach(jar::add);
            routingContext.response().end(jar.encodePrettily());
        } else {
            res.cause().printStackTrace();
        }
    });
}
```

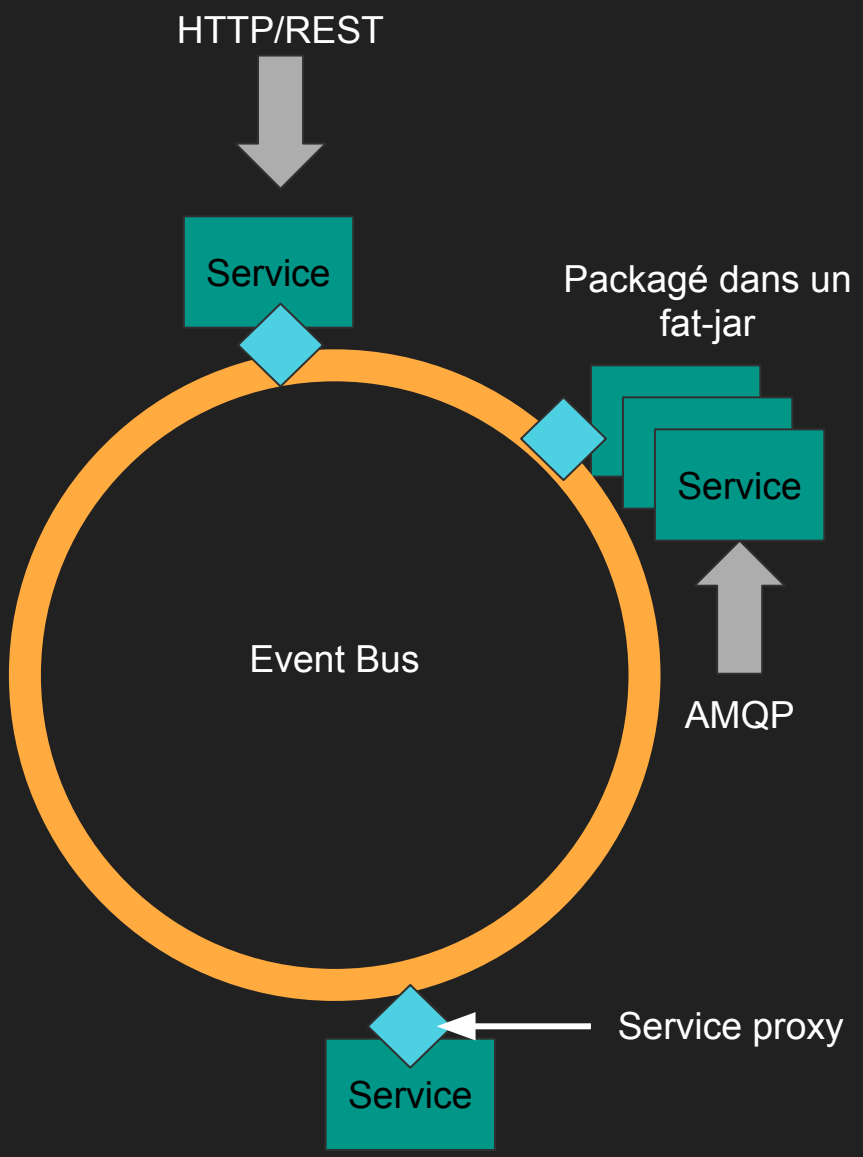
Micro services

Les micro-services interagissent en utilisant l'eventBus ou en utilisant un autre protocole.

Des service-proxies sont générés pour l'eventBus.

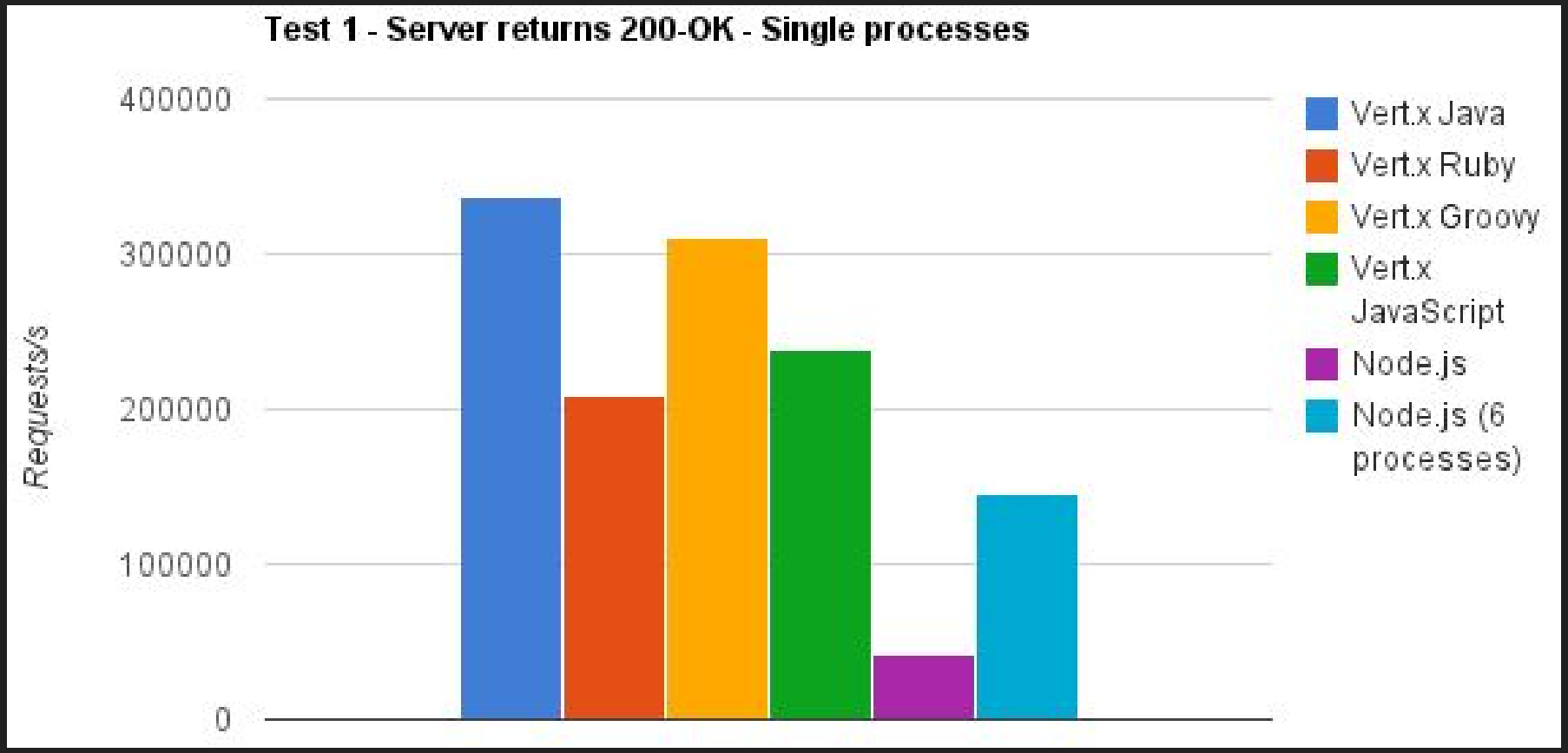
On peut même consommer les services depuis NodeJS, le navigateur, iOS ou Android via l'eventBus.

Chaque service peut se mettre à l' échelle en fonction de la charge et supporte le fail-over.



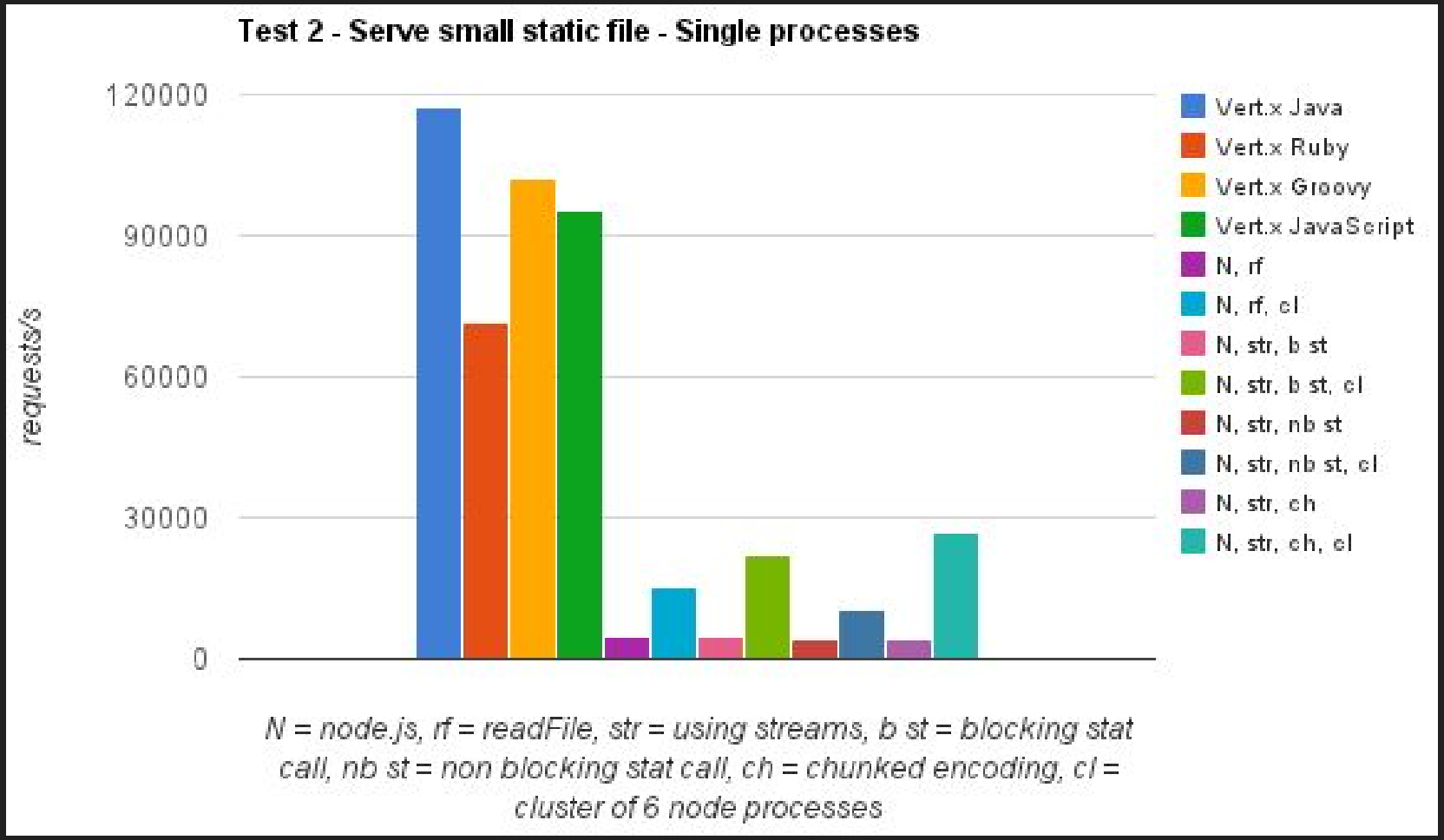
Performances

Source : http://www.cubrid.org



Performances

Source : http://www.cubrid.org



Performances

Source : https://www.techempower.com

JSON serialization

Results

Best (bar chart) | Data table | Latency | Framework overhead

Best JSON responses per second, Dell R720xd dual-Xeon E5 v2 + 10 GbE (7 tests)

Framework	Best performance (higher is better)	Cls	Lng	Plt	FE	Aos	IA	Errors
vertx	1,117,768 100.0% (50.7%)	Plt	Jav	Nty	Non	Lin	Rea	0
servlet	842,458 75.4% (38.2%)	Plt	Jav	Svt	Res	Lin	Rea	0
spark	552,007 49.4% (25.0%)	Mcr	Jav	Svt	Res	Lin	Rea	0
jetty-servlet	304,573 27.2% (13.8%)	Plt	Jav	Jty	Jty	Lin	Rea	0
nodejs	225,507 20.2% (10.2%)	Plt	JS	njs	Non	Lin	Rea	0
spring	136,798 12.2% (6.2%)	Ful	Jav	Svt	Tom	Lin	Rea	0
express	118,838 10.6% (5.4%)	Mcr	JS	njs	Non	Lin	Rea	0

Performances

Source : https://www.techempower.com

Plaintext

Results

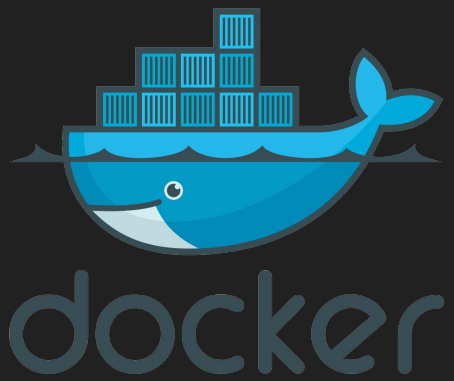
Best (bar chart) | Data table | Latency | Framework overhead

Best plaintext responses per second, Dell R720xd dual-Xeon E5 v2 + 10 GbE (7 tests)

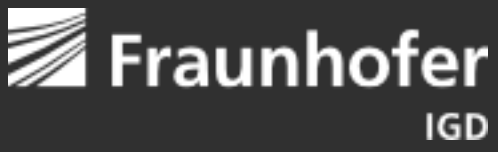
Framework	Best performance (higher is better)	Cls	Lng	Plt	FE	Aos	IA	Errors
vertx	3,387,403 100.0% (47.8%)	Plt	Jav	Nty	Non	Lin	Rea	0
servlet	2,013,647 59.4% (28.4%)	Plt	Jav	Svt	Res	Lin	Rea	0
jetty-servlet	644,391 19.0% (9.1%)	Plt	Jav	Jty	Jty	Lin	Rea	0
nodejs	314,418 9.3% (4.4%)	Plt	JS	njs	Non	Lin	Rea	0
spring	198,397 5.9% (2.8%)	Ful	Jav	Svt	Tom	Lin	Rea	0
express	146,416 4.3% (2.1%)	Mcr	JS	njs	Non	Lin	Rea	0
spark	11,349 0.3% (0.2%)	Mcr	Jav	Svt	Res	Lin	Rea	639

Cloud ready

- Vert.x OpenShift Cartridge
  - https://github.com/vert-x3/vertx-openshift-cartridge
- Vert.x OpenShift Using DIY Cartridge
  - https://github.com/vert-x3/vertx-openshift-diy-quickstart
- Vert.x Docker Images
  - https://github.com/vert-x3/vertx-stack/tree/master/stack-docker



Production ready



The end ...

« Si vous avez compris ce que je viens de vous dire, c'est que je me suis probablement mal exprimé »

A. Greenspan

https://github.com/Giwi/vertx3-angular-beers