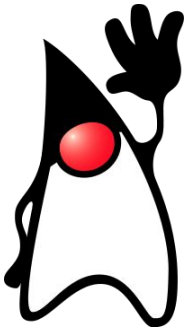
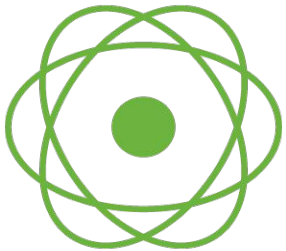
Servlet vs Reactive stacks

in 5 use cases



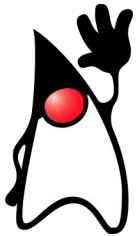


Rossen Stoyanchev

Pivotal

Servlet Stack

- Servlet container
- Servlet API
- Spring MVC



Reactive Stack

- Netty, Servlet 3.1+, Undertow
- Reactive Streams
- Spring **WebFlux**

Reactive Spring

Reactive starters in **Spring Boot 2.0**

Spring Framework 5 WebFlux endpoints + reactive WebClient

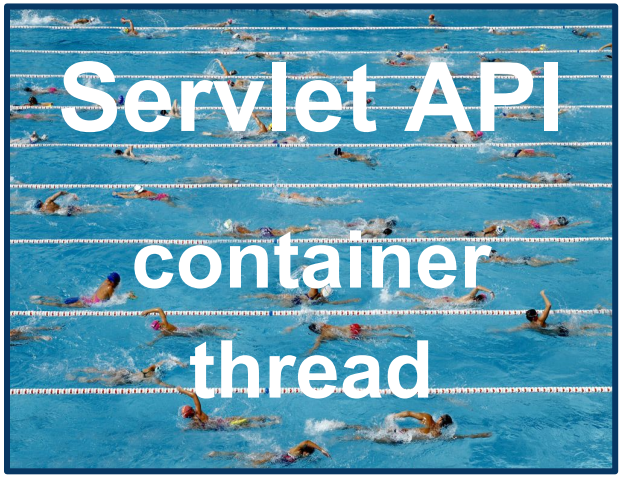
Reactive **Spring Data Kay** repositories

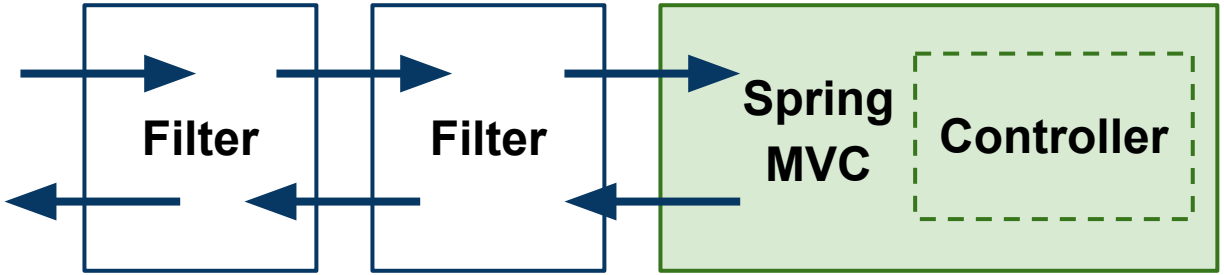
Spring Security

and more…


Servlet
Stack

SERVLET STACK





SERVLET STACK

Synchronous API

`Filter`, `Servlet` ... **`void`**

SERVLET STACK

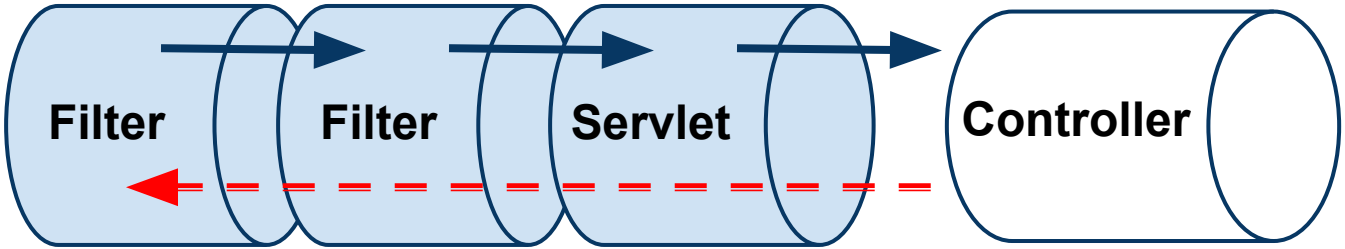
Blocking I/O

`InputStream`, `OutputStream`

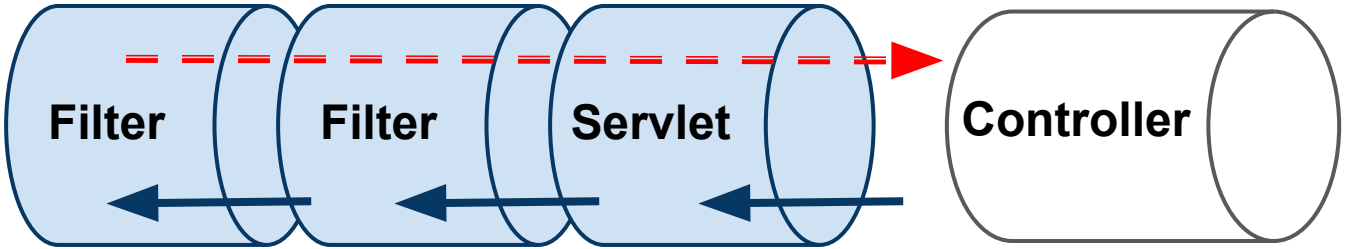
SERVLET STACK

```
servletRequest.startAsync()
```

SERVLET STACK

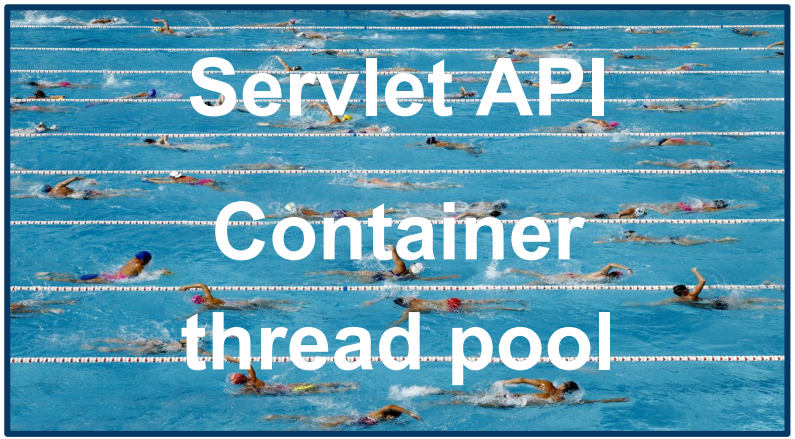


… do work or receive event + `dispatch()` *…*



SERVLET STACK

`startAsync()`



`Input & OutputStream`

Controller

can use
reactive clients


Concurrency models

Synchronous APIs

100s, 1000s
waiting blocked threads

Non-blocking code

“parallel”
thread pool

~ per CPU core
busy worker threads

What does it take to not block ?

event loop at the core

event driven architecture

message passing

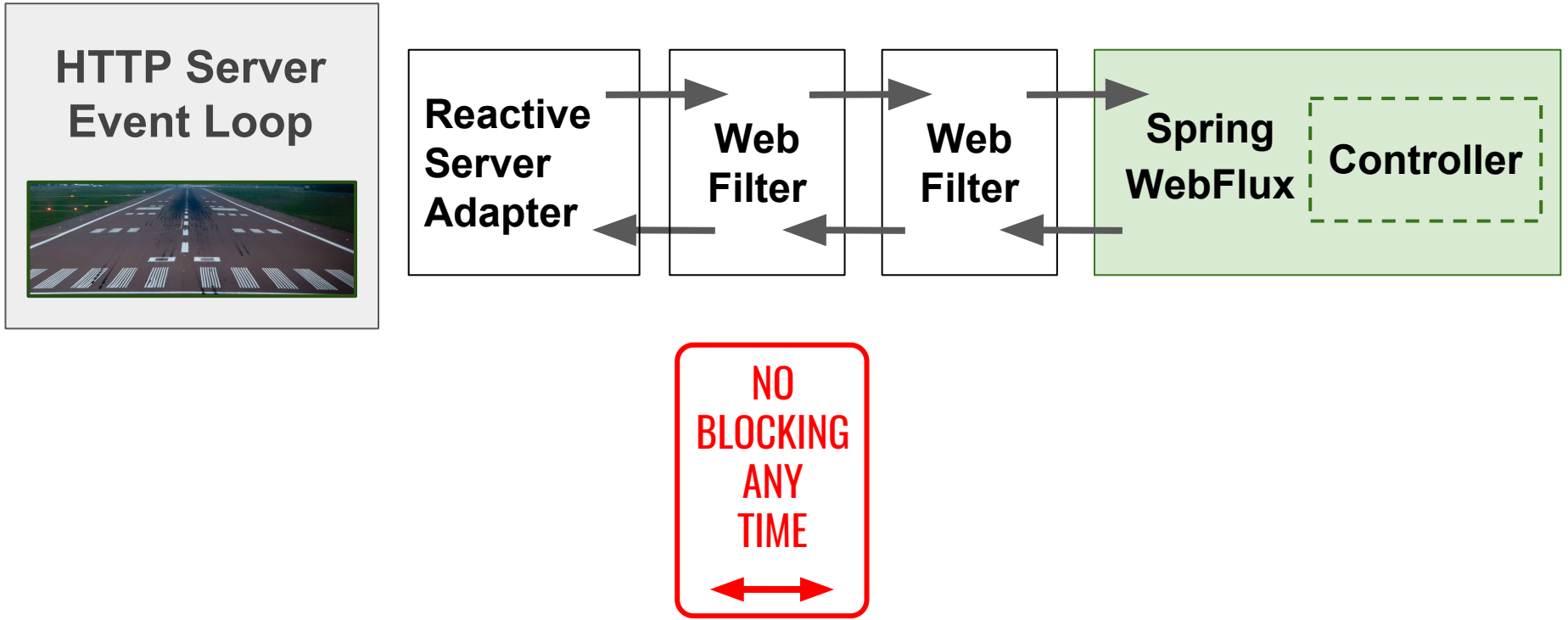
means to compose async logic

bonus:

back pressure (a.k.a flow control)


Reactive
Stack

REACTIVE STACK



REACTIVE STACK

Asynchronous API

`WebFilter`, `WebHandler`...

`Mono<Void>`

REACTIVE STACK

Reactor **Mono**

Reactive Streams `Publisher`

0..1 elements

REACTIVE STACK

Non-blocking **read**:

```
Flux<DataBuffer> getBody()
```

REACTIVE STACK

Non-blocking **write**:

```
writeWith(Flux<DataBuffer>)
```

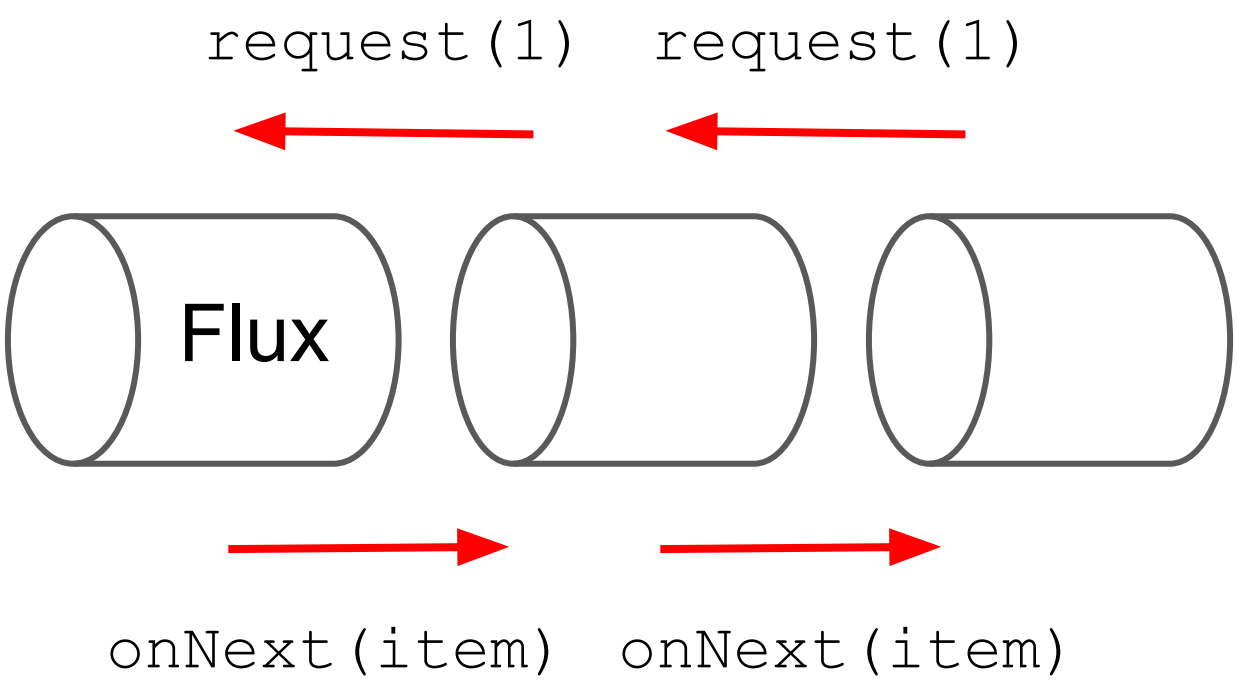
REACTIVE STACK

Reactor **`Flux`**

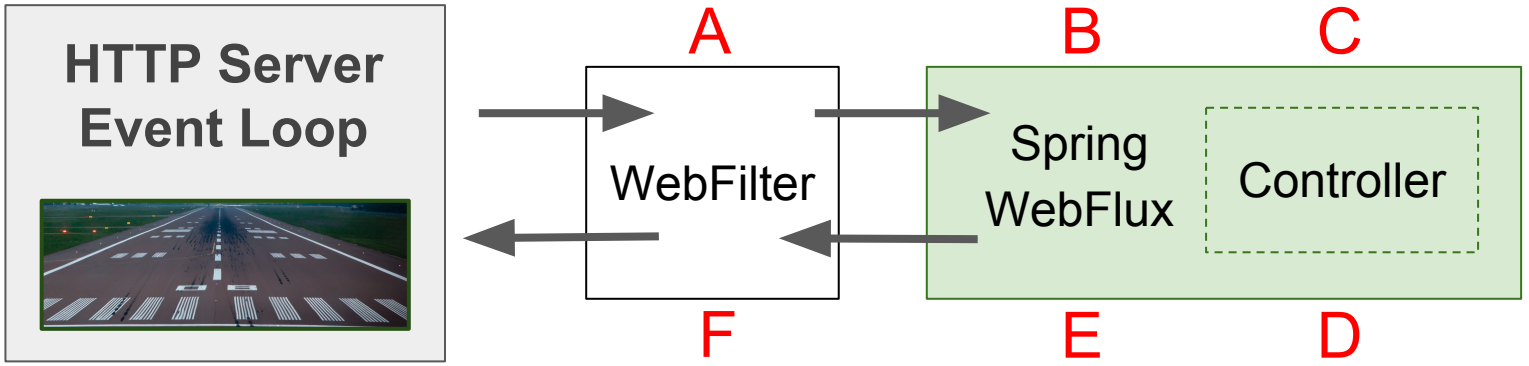
Reactive Streams `Publisher`

0..N elements

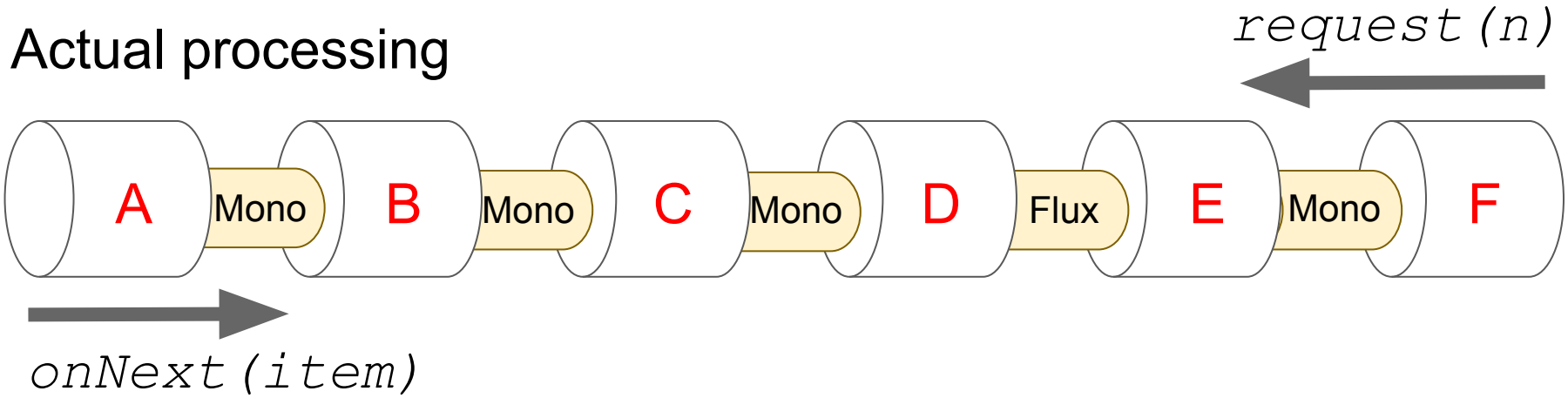
Reactive Streams back pressure



Composition of async logic



Actual processing



Use Case #1

Reactive data repository

Demo

HTTP GET with reactive data repository

Designed to work on both Spring MVC **and** Spring WebFlux

Simply return reactive type (**`Flux`**, **`Observable`**) from `@Controller`

```
@GetMapping("/cars")
@ResponseBody
public Flux<Car> getCars() {
    return this.repository.findAll();
}
```

`Flux<T>`:

finite collection or *infinite* stream?

Use media type to decide

“application/json”

finite collection (JSON array)

No back pressure:

`Flux#collectToList`

(*request all* + *buffer*)

Use Case #2

Response stream with back pressure

“text/event-stream”,

“application/stream+json”

infinite stream

Back pressure:

request(n),
write, flush,
repeat

HTTP GET with streaming response

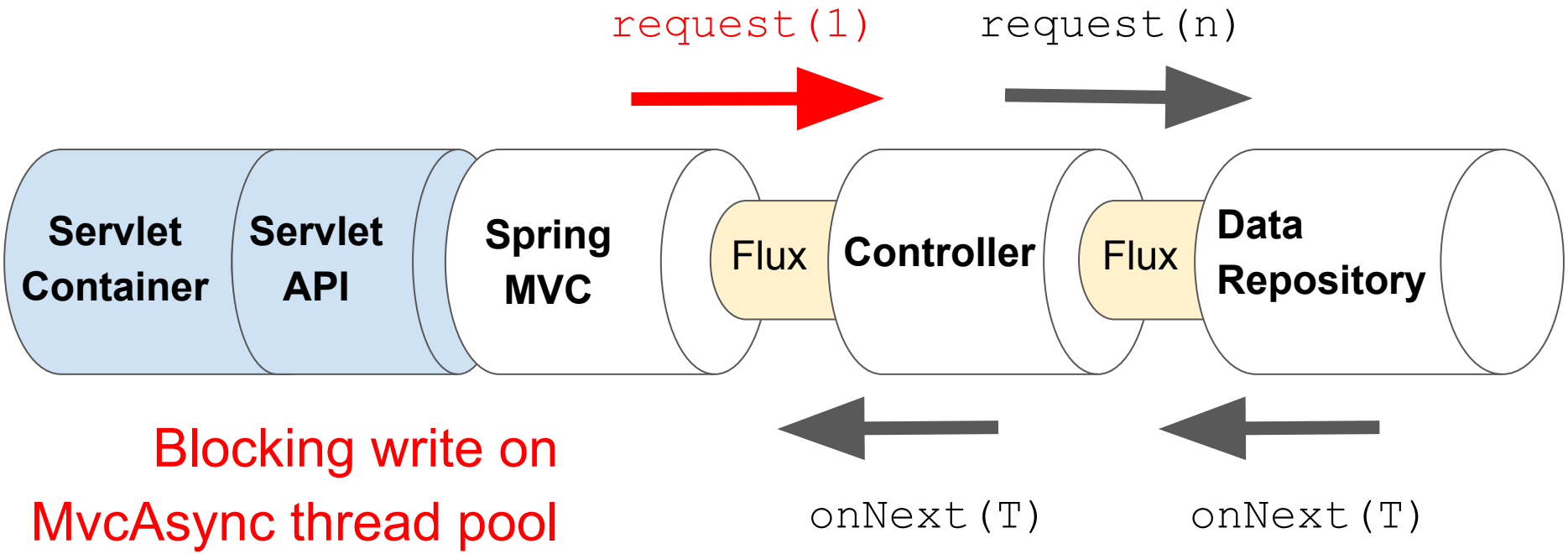
Simply return reactive type (**`Flux`**, **`Observable`**) from `@Controller`

Back pressure on Spring MVC and WebFlux

```
@GetMapping(path="/cars", produces="text/event-stream")
public Flux<Car> getCars() {
    return this.repository.findCarsBy();
}
```

SERVLET STACK …

Back pressure against blocking `OutputStream`



Blocking write on MvcAsync thread pool

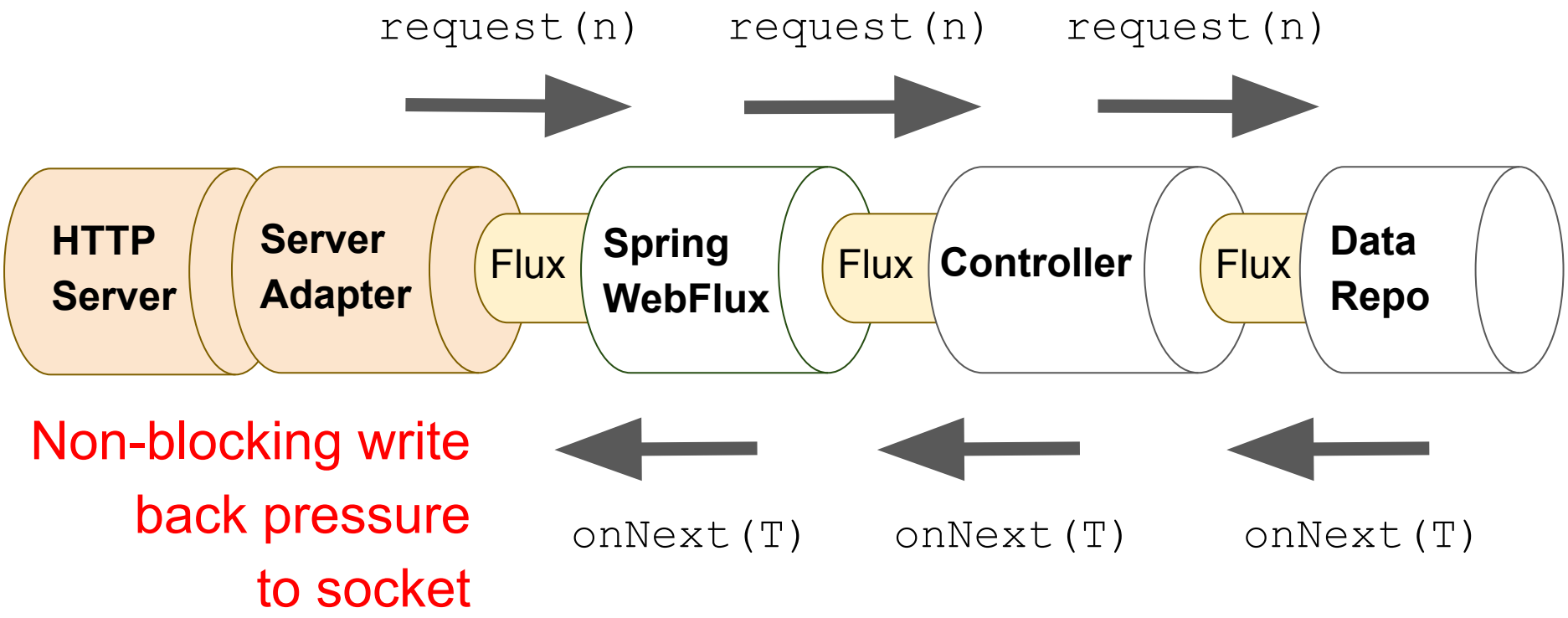
Servlet 3.1 non-blocking I/O ?

Unlike Servlet 3.0 async, Servlet 3.1 non-blocking is hard to retrofit

Requires deeper change

Mutually exclusive with rest of the Servlet API

Response streaming on **reactive** stack



Demo

Use Case #3

Reactive remote service orchestration

使协调地结合在一起； 精心安排

Demo

Reactive `WebClient`

Orchestrate non-blocking, nested remote service calls with ease

Similar to reactive data access

Spring MVC and Spring WebFlux

```
@PostMapping("/booking")
public Mono<ResponseEntity<Void>> book() {

    return locationClient.get()
            .uri("/cars")
            .retrieve()
            .bodyToFlux(Car.class)
            .take(5)
            .flatMap(car -> bookingClient.post()
                    .uri("/cars/{id}/booking", car.getId())
                    .exchange()
                    .map(this::toBookingResponseEntity))
            .next();
}
```

Use Case #4

Reactive request input

Back pressure to socket

No reading until **reactive demand** signalled from upstream

Non-blocking

Reactive stack only territory !

HTTP POST with data

`@RequestBody` argument with reactive type (`Mono`, `Single`)

Reactive type is not required

```
@PostMapping("/cars")
@ResponseStatus(HttpStatus.CREATED)
public Mono<Void> loadCars(@RequestBody Mono<Car> car) {
    return this.repository.insert(car).then();
}
```

Use Case #5

Data Ingestion with back pressure

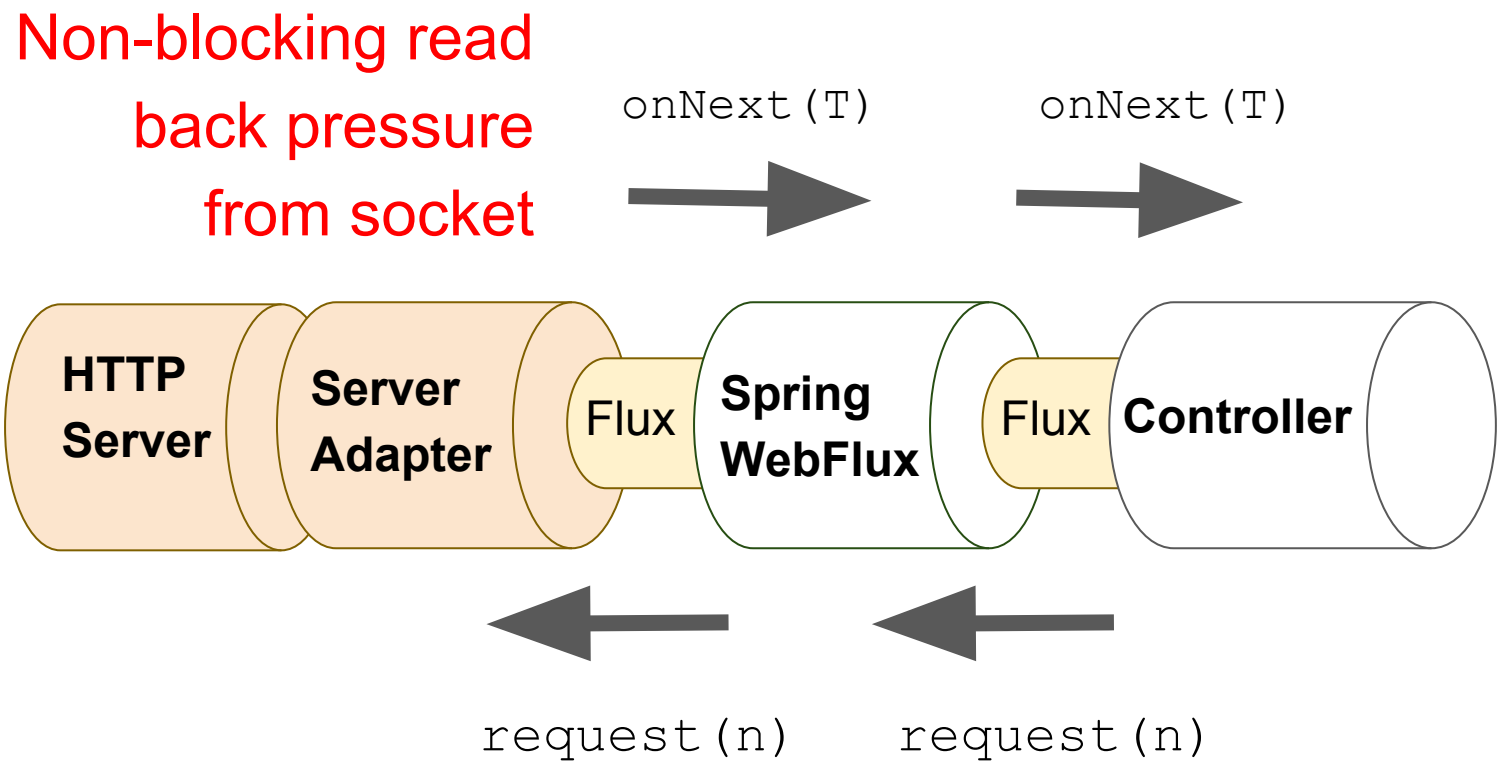
HTTP POST with stream of data

Media type indicates **infinite** stream is expected

Non-blocking streaming + back pressure

```
@PostMapping(path="/cars", consumes="application/stream+json")
public Mono<Void> loadCars(@RequestBody Flux<Car> cars) {
    return this.repository.insert(cars).then();
}
```

Data ingestion on reactive stack



Servlet stack summary


Reactive data repository


Streaming to the response with back pressure


Reactive orchestration of remote services


Reactive request input


Data ingestion with back pressure

Reactive stack summary

- ✓ Reactive data repository
- ✓ Streaming to the response with back pressure
- ✓ Reactive orchestration of remote services
- ✓ Reactive request input
- ✓ Data ingestion with back pressure

Q & A

@rstoya05