

Overview of Spring WebFlux

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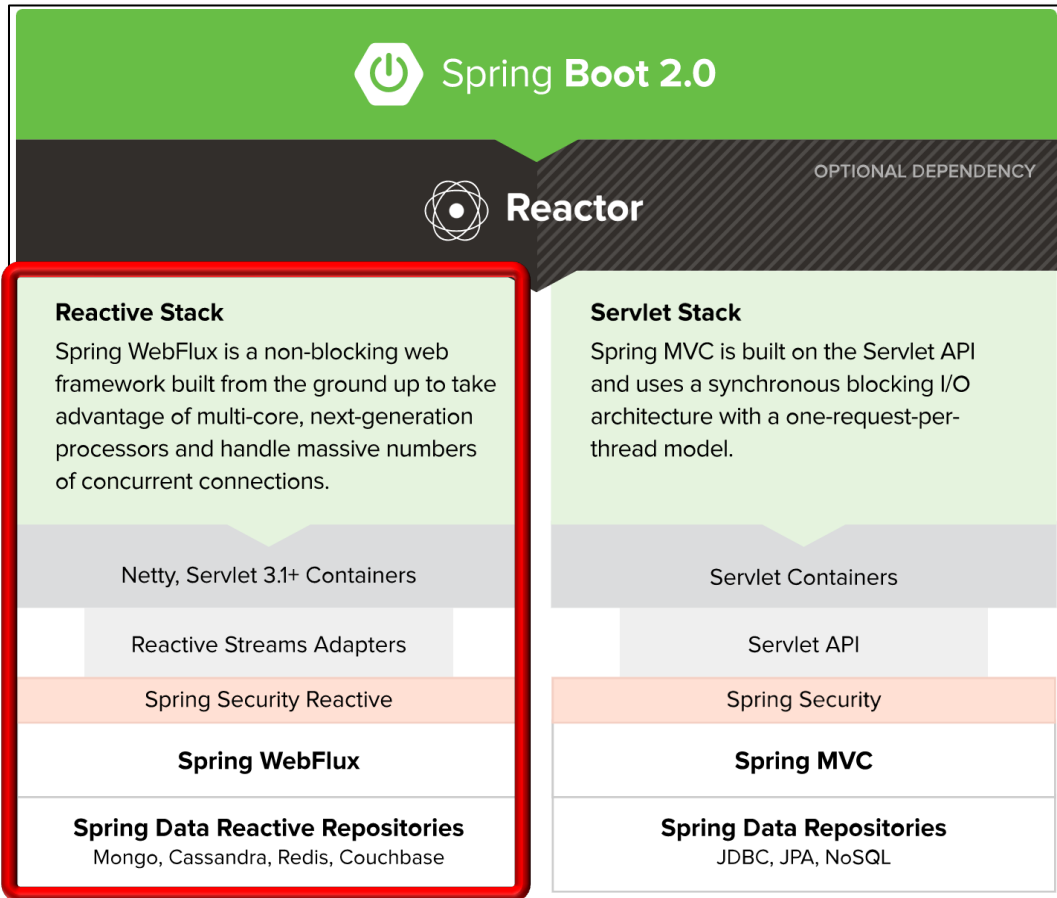
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Integrated Systems**

**Vanderbilt University
Nashville, Tennessee, USA**



Learning Objectives in this Lesson

- Understand the structure & functionality of the Spring WebFlux framework supported by Spring Boot 2.0

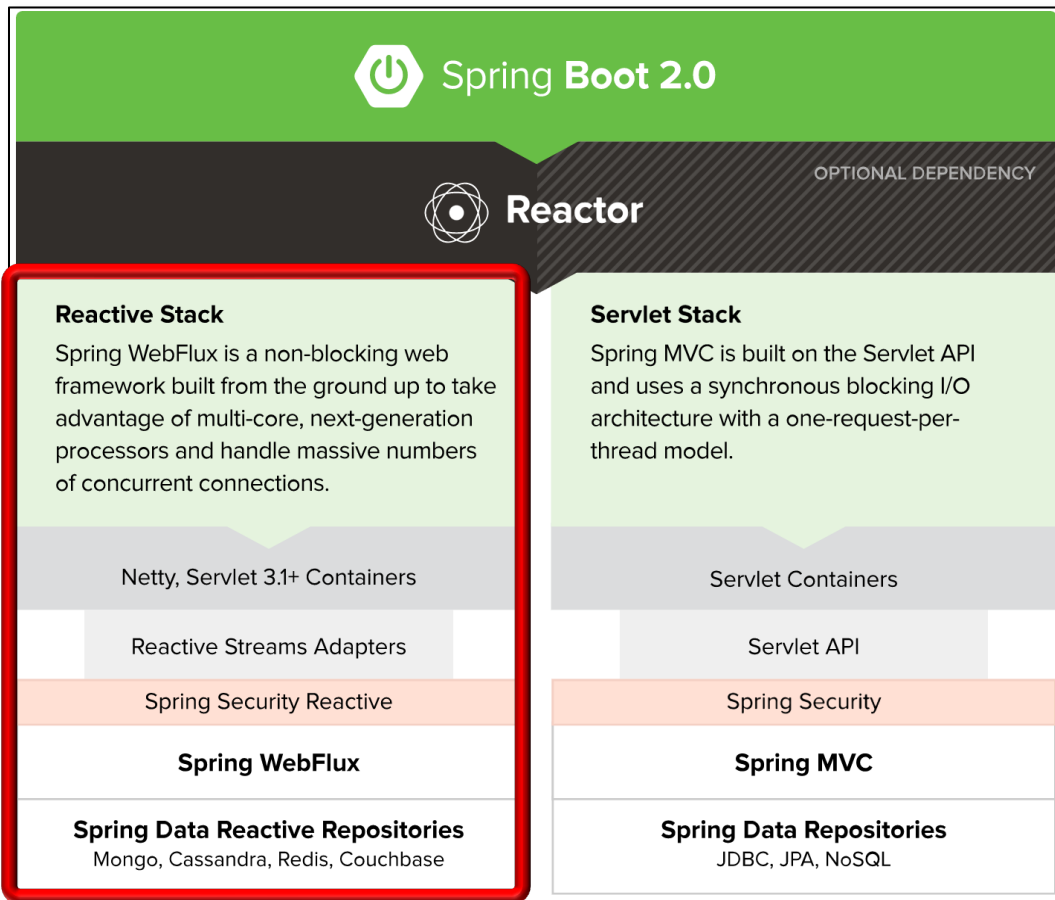


See docs.spring.io/spring-framework/docs/current/reference/html/web-reactive.html#webflux

Overview of Spring WebFlux

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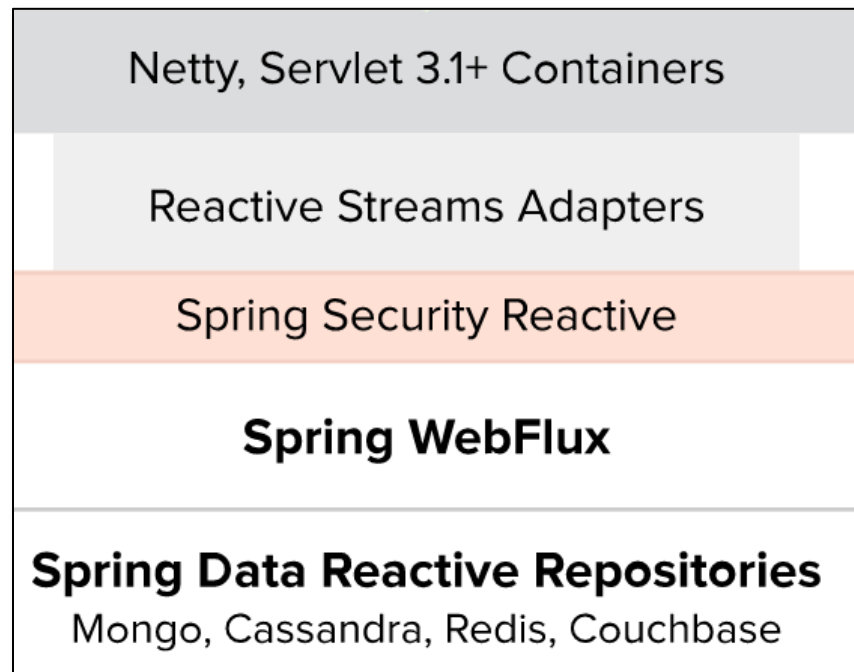
- Spring WebFlux



See docs.spring.io/spring-framework/docs/current/reference/html/web-reactive.html#webflux

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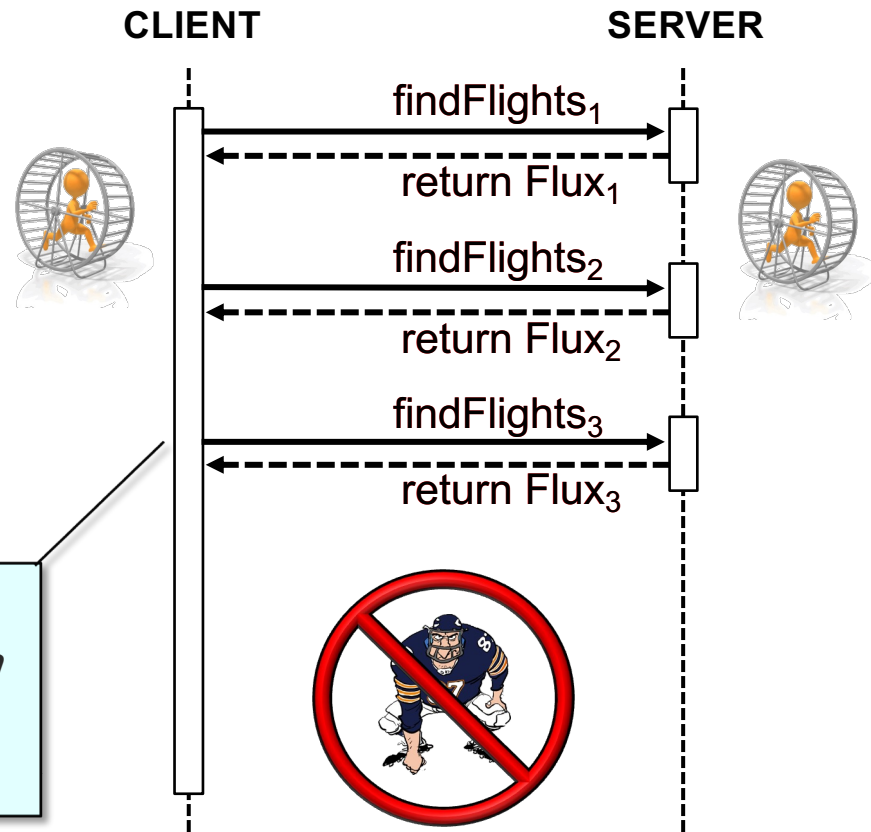
- Spring WebFlux
 - A non-blocking web framework that leverages multiple cores & handles large # of concurrent connections



See en.wikipedia.org/wiki/Non-blocking_algorithm

Overview of Spring WebFlux

- Spring WebFlux
 - A non-blocking web framework that leverages multiple cores & handles large # of concurrent connections
 - Requests are handled in an entirely asynchronous (& "lazy") manner



A request to a list of flights from a database over the network might take a few seconds, but the threads servicing requests & responses don't block

See [en.wikipedia.org/wiki/Asynchrony_\(computer_programming\)](https://en.wikipedia.org/wiki/Asynchrony_(computer_programming))

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 - A small # of threads are thus required



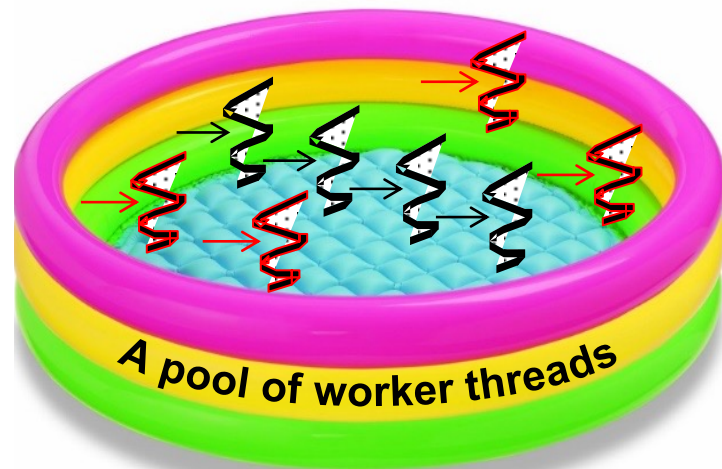
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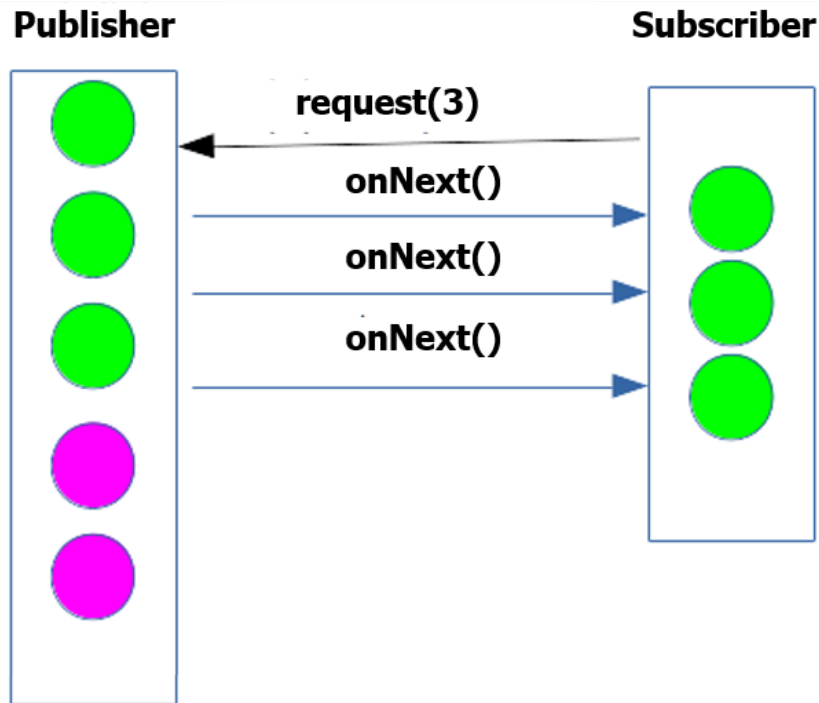
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 - Typically based on # of processor cores
 - I/O-bound operations may require adaptively increasing the # of threads



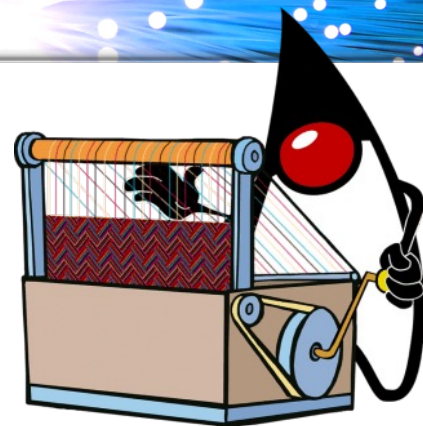
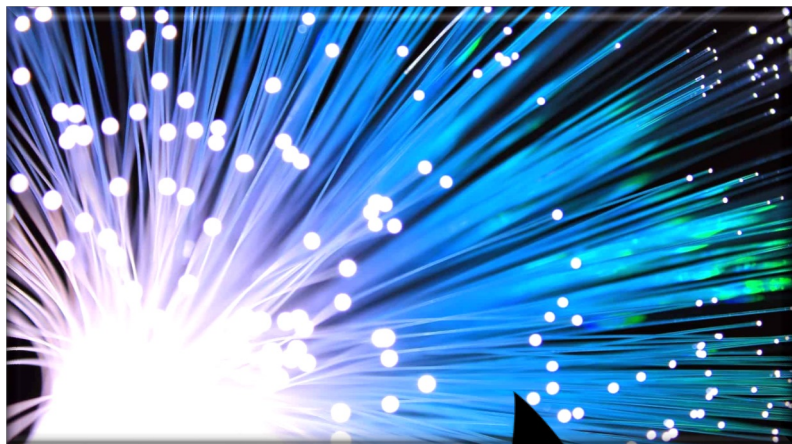
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 - However, there's often a need for non-blocking backpressure
 - i.e., control event rate so a fast publisher does not overwhelm a slower subscriber



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 - Java 19’s “virtual threads” provide scalability without non-blocking clients & servers

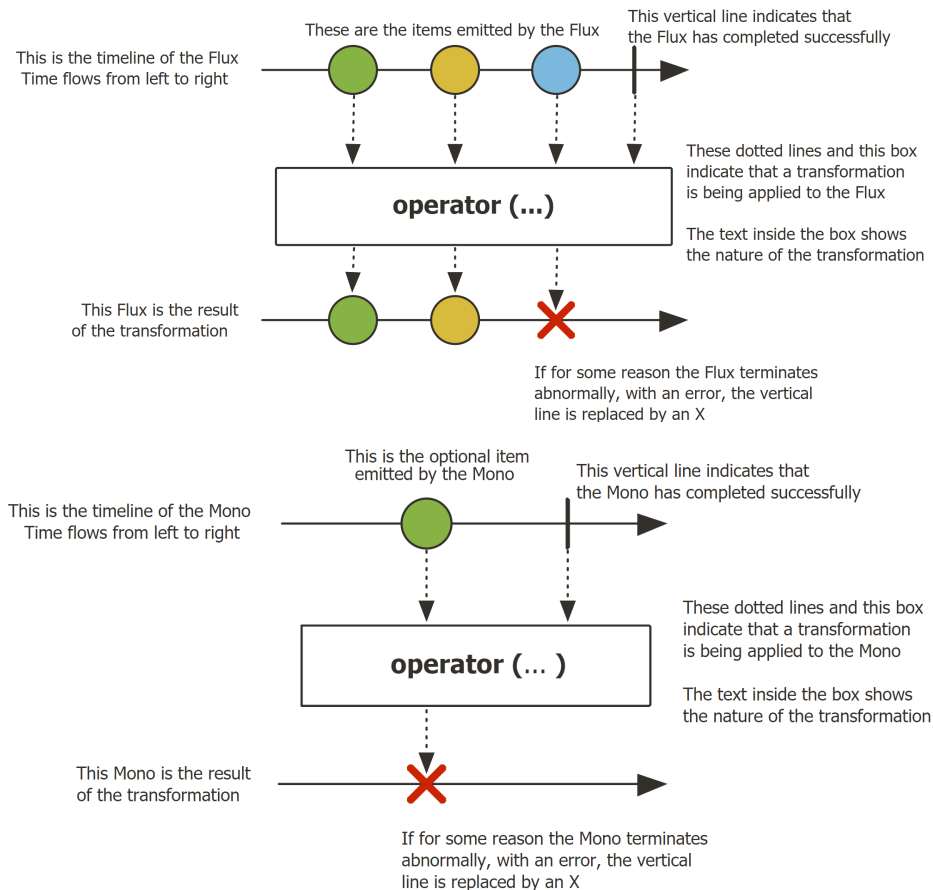


Project Loom

See fabiangotzen.net/2023/01/19/java-project-loom

Overview of Spring WebFlux

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 - Network communication uses Project Reactor reactive types



See spring.io/blog/2016/04/19/understanding-reactive-types

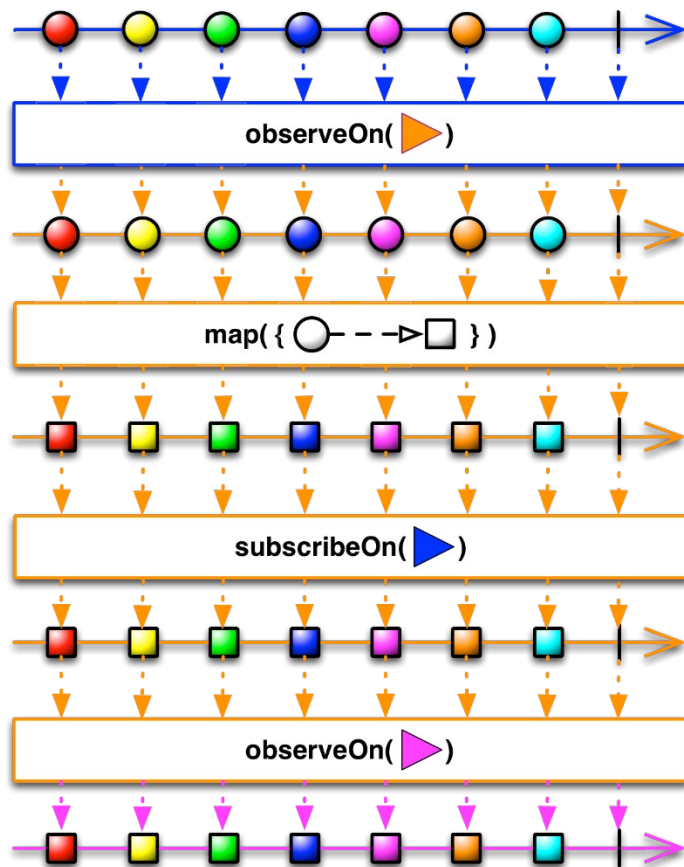
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 - Work on data sequences of 0..1 (Mono) and 0..N (Flux)

```
public class FlightController {  
    ...  
    @GetMapping(FLIGHT_DATES)  
    Flux<LocalDate>  
        findDepartureDates  
        (@RequestParam String  
         departureAirport,  
         @RequestParam String  
         arrivalAirport) {...}  
    ...  
    @GetMapping(EXCHANGE)  
    Mono<ExchangeRate> getRate  
        (@RequestParam String from,  
         @RequestParam String to)  
        {...}
```

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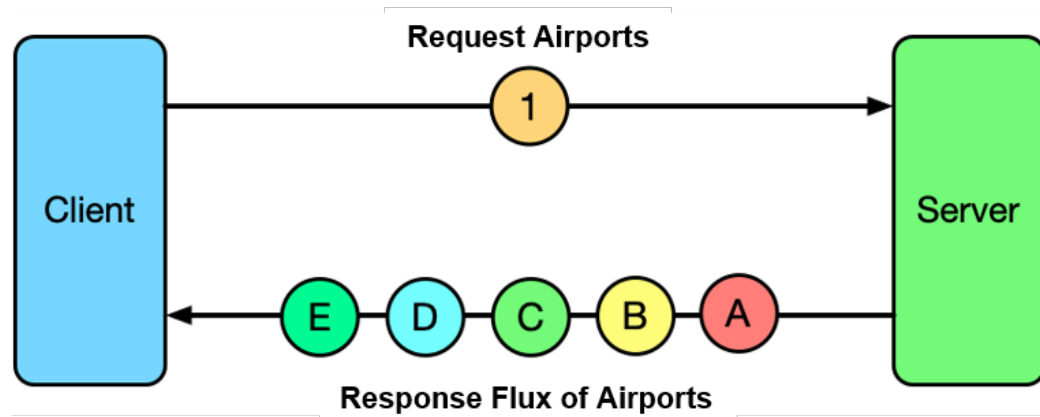
- Spring WebFlux
 - A non-blocking web framework that leverages multiple cores & handles large # of concurrent connections
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 - Work on data sequences of 0..1 (Mono) and 0..N (Flux)
 - Provides a rich set of operators aligned with the ReactiveX vocabulary of operators



See reactivex.io/documentation/operators.html

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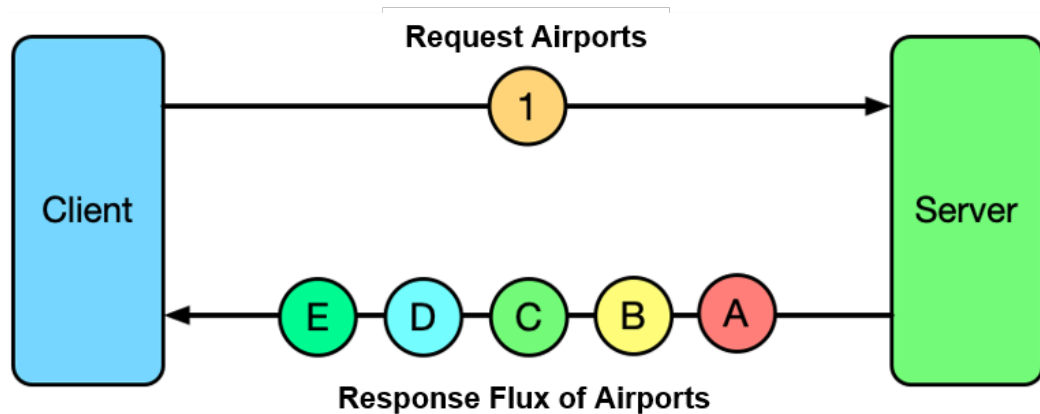
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 - Reactive Flux types can be streamed element-by-element



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- Reactive Flux types can be streamed element-by-element
 - Clients can thus be more responsive

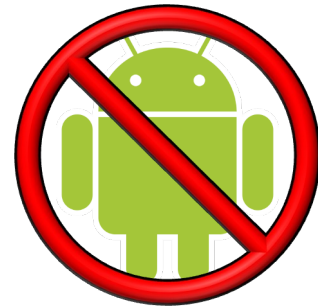
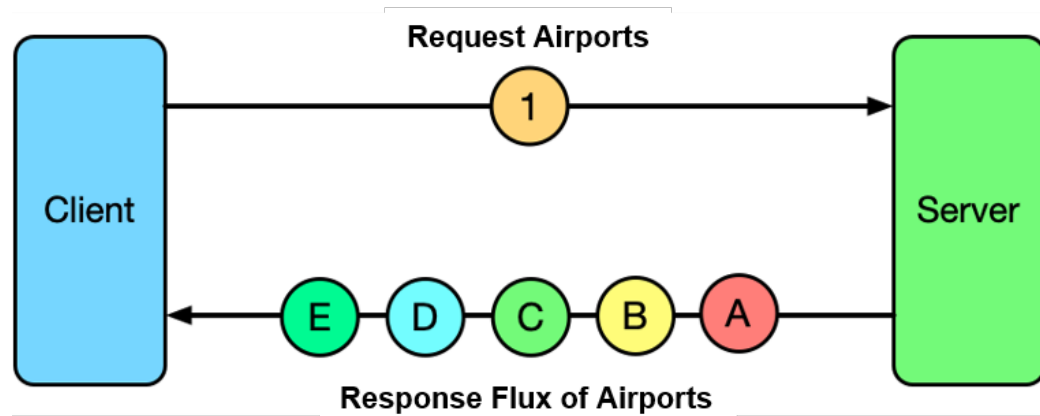


See en.wikipedia.org/wiki/Responsiveness

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 - Android retrofit doesn't support WebFlux reactive clients..



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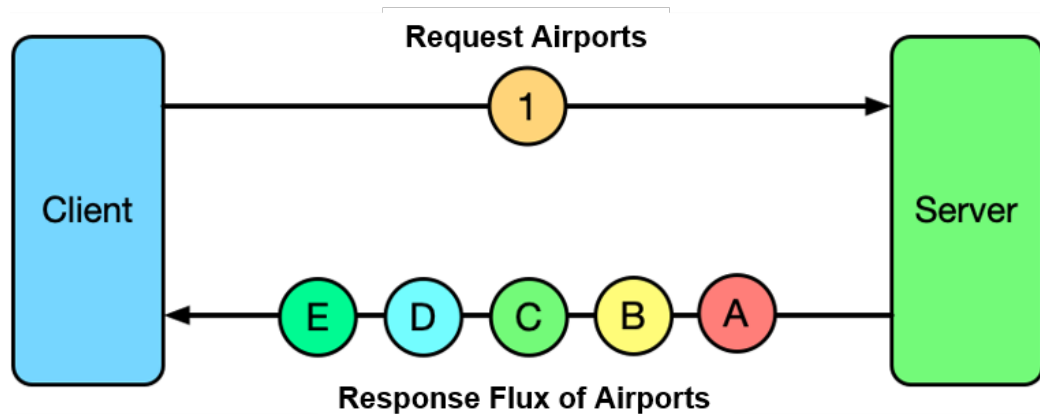
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- Reactive Flux types can be streamed element-by-element

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- Android retrofit doesn't support WebFlux reactive clients..

- Spring 6 HTTP interface also doesn't work on Android



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 - Clients can thus be more responsive
 - The stream can be kept “live” via Spring server-sent-events

```
public class FlightController {  
    ...  
    @GetMapping(RATES,  
                produces = MediaType.  
                    TEXT_EVENT_STREAM_VALUE) {  
        Flux<ExchangeRate>  
            getRates (@RequestParam  
                    String toCurrency)  
                {...}  
    ...  
}
```

See www.baeldung.com/spring-server-sent-events

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STATISTICS Servlet Stack			
Executions			
	Total	OK	KO
	40000	39994	6
Mean req/s	784.314	784.196	0.118
Response Time (ms)			
	Total	OK	KO
Min	202	202	2443
50th percentile	2093	2093	3151
75th percentile	3017	3017	3763
95th percentile	4547	4547	4104
99th percentile	5061	5061	4154
Max	5356	5356	4166
Mean	2102	2101	3216
Std Deviation	1304	1304	660

STATISTICS Reactive Stack			
Executions			
	Total	OK	KO
	40000	40000	0
Mean req/s	975.61	975.61	-
Response Time (ms)			
	Total	OK	KO
Min	201	201	-
50th percentile	315	315	-
75th percentile	422	422	-
95th percentile	865	865	-
99th percentile	1392	1392	-
Max	1883	1883	-
Mean	390	390	-
Std Deviation	232	232	-

The reactive stack can have better response time & the # of request per second

See [springboot-2-performance-servlet-stack-vs-webflux-reactive-stack-528ad5e9dad](https://spring.io/blog/2017/01/26/springboot-2-performance-servlet-stack-vs-webflux-reactive-stack-528ad5e9dad)

End of Overview of Spring WebFlux