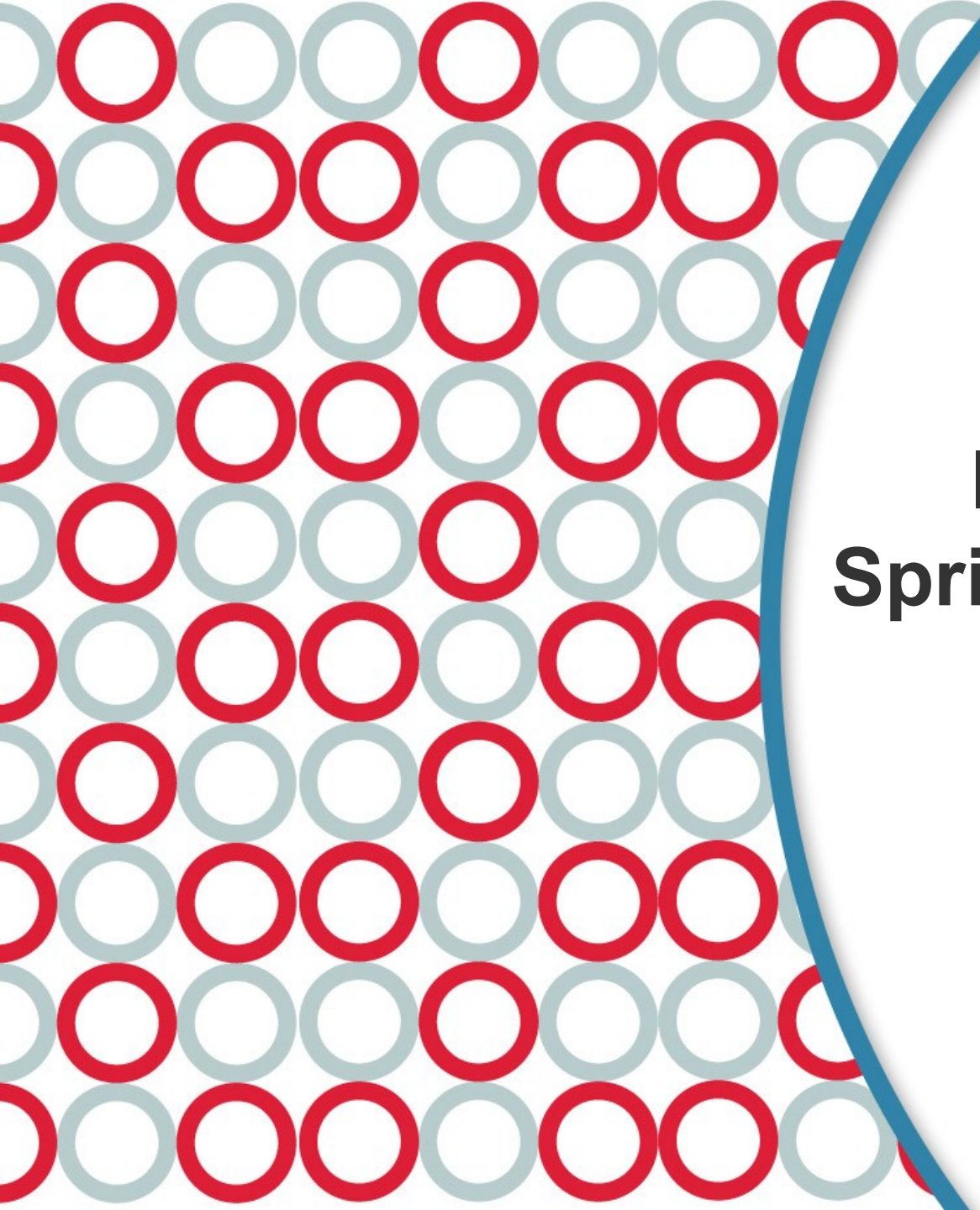

April 2021, IPT Course
Introduction to Spring 5

Introduction to Spring Framework

Trayan Iliev
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About me

Trayan Iliev

– CEO of IPT – Intellectual Products & Technologies

– Oracle® certified programmer 15+ Y

– end-to-end reactive fullstack apps with Java, ES6/7, TypeScript, Angular, React and Vue.js

– 12+ years IT trainer

– Voxxed Days, jPrime, jProfessionals, BGOUG, BGJUG, DEV.BG speaker

– Organizer RoboLearn hackathons and IoT enthusiast (http://robolearn.org)

What Will You Learn in the Course?

- Component-based architecture, Inversion of Control (IoC) principle, and Dependency Injection (DI) pattern
- Novelties in Spring Framework 5 and Java 8 & 9
- Use Spring Boot 2 to rapidly develop Spring applications
- Develop/secure Spring-based web applications and services using Spring MVC, WebSocket, and Spring Security
- Manage data with SQL (PostgreSQL) and NoSQL (Mongo) databases with Spring Data: JDBC, Hibernate & JPA
- Develop reactive REST services with Spring WebFlux
- Test Spring applications using JUnit 5, Spring MVC Test, WebTestClient, TestContext, and Mock objects

Where to Find the Demo Code?

Introduction to Spring 5 demos and examples are available @ GitHub:

https://github.com/iproduct/course-spring5

Agenda for This Session

- Introduction to Spring
- Evolution of Spring framework
- Main features
- Spring main modules
- Introduction to Maven and Gradle
- Building a HelloSpring application using XML and annotation-based configurations
- Introduction to Spring Boot 2.0 – building *HelloSpringMVC* & *HelloSpringWebFlux* simple web applications using *spring-boot-starter-web* & *spring-boot-starter-webflux*
- Going reactive with *WebFlux* and *Spring Reactor* – intro

Why Spring?

- The origin of Spring Framework: Expert One-on-One: J2EE Design and Development by Rod Johnson (Wrox, 2002)
- For more than 15 years Spring has become a major Java enterprise development framework
- A lot of projects, features, and great community support
- Supports different application architectures, including messaging, transactional data, persistence, and web
- Out of the box support for Java 9 modules in Spring 5
- Integrates carefully selected Java EE specifications
- Spring 5 baseline: Java 8 & JavaEE 7 (Servlet 3.1, JPA 2.1)

Java EE Specs Supported by Spring

- Servlet API (JSR 340)
- WebSocket API (JSR 356)
- Concurrency Utilities (JSR 236)
- JSON Binding API (JSR 367)
- Bean Validation (JSR 303)
- JPA (JSR 338)
- JMS (JSR 914)
- JTA/JCA transaction coordination
- Dependency Injection (JSR 330)
- Common Annotations (JSR 250)

Which Problems Spring Addresses?

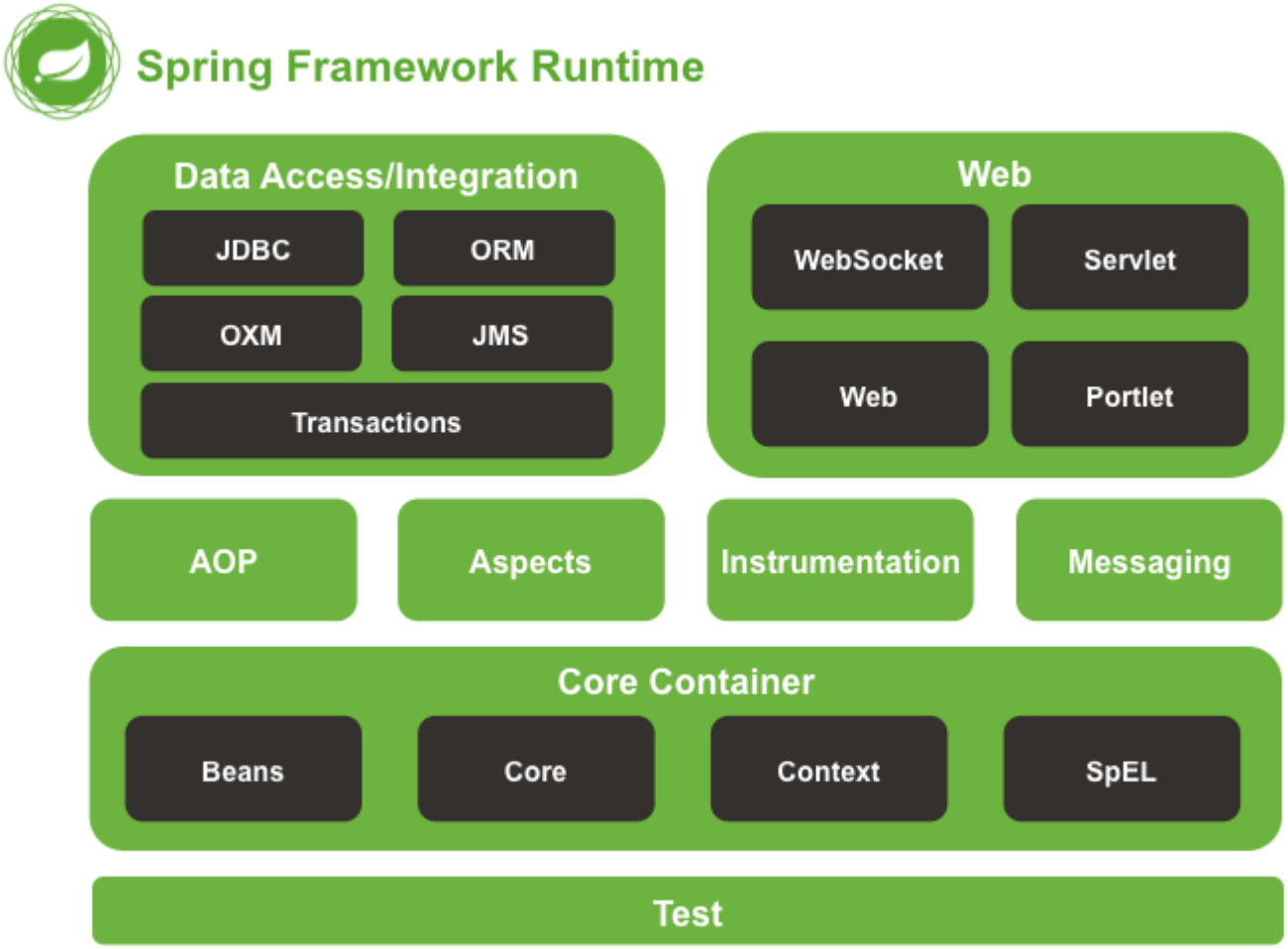
- Scalability and modularity
- Boiler plate code – using templates (JDBCTemplate, HibernateTemplate) and aspects (advises)
- Handling non-functional requirements – transactions, load scaling, security, logging, testability, maintainability, etc.
- Unit testing and integration testing
- Complex frameworks/application servers – POJO vs. EJB
- Code coupling – interfaces + Dependency Injection (DI)
- Separating What? From How? - declarative programmimg using XML config files, annotations & functional composition

Spring Framework Main Features

- Core technologies – dependency injection, events, resources, i18n, validation, data binding, type conversion, SpEL, AOP.
- Testing – mock objects, TestContext framework, Spring MVC Test, WebTestClient.
- Data Access – transactions, DAO support, JDBC, ORM, Marshalling XML.
- Spring MVC and Spring WebFlux web frameworks
- Integration – remoting, JMS, JCA, JMX, email, tasks, scheduling, cache.
- Languages – Kotlin, Groovy, dynamic languages.

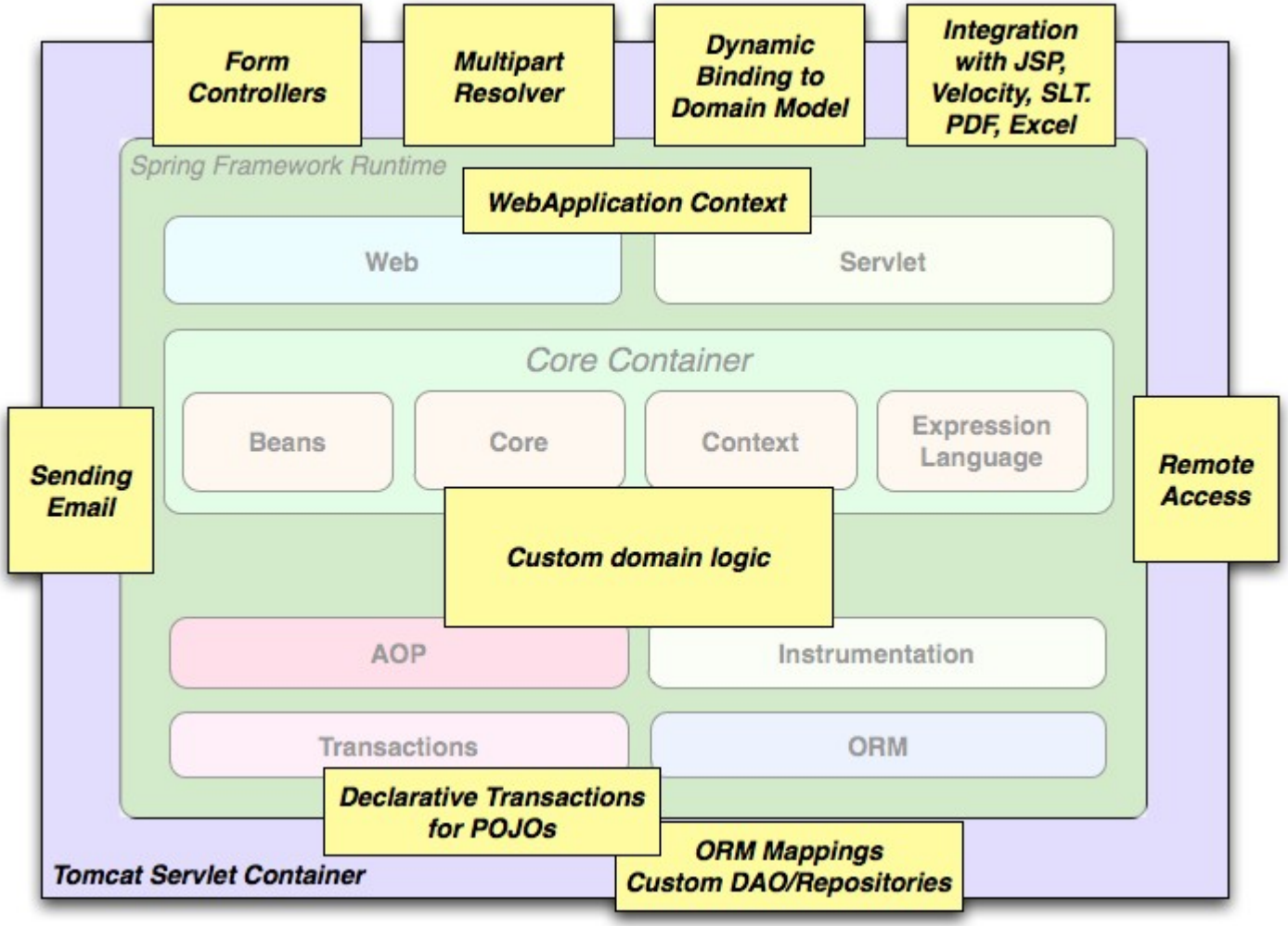
Source: https://projects.spring.io/spring-framework/

Spring Framework 4.2 Main Modules



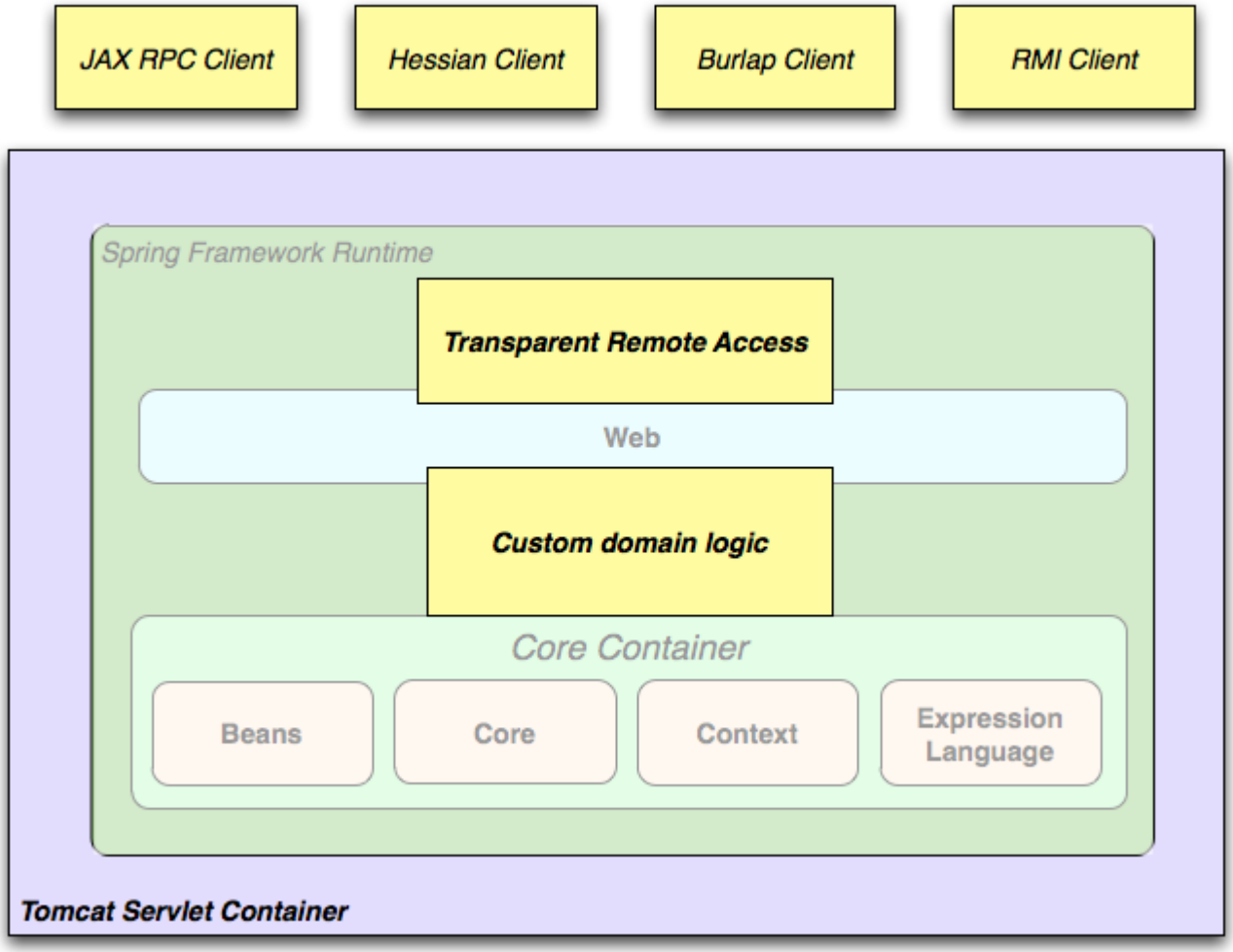
Source: https://docs.spring.io/spring/docs/4.2.x/spring-framework-reference/html/overview.html

Fully Fledged Spring Web Application



Source: https://docs.spring.io/spring/docs/4.2.x/spring-framework-reference/html/overview.html

Remoting Application



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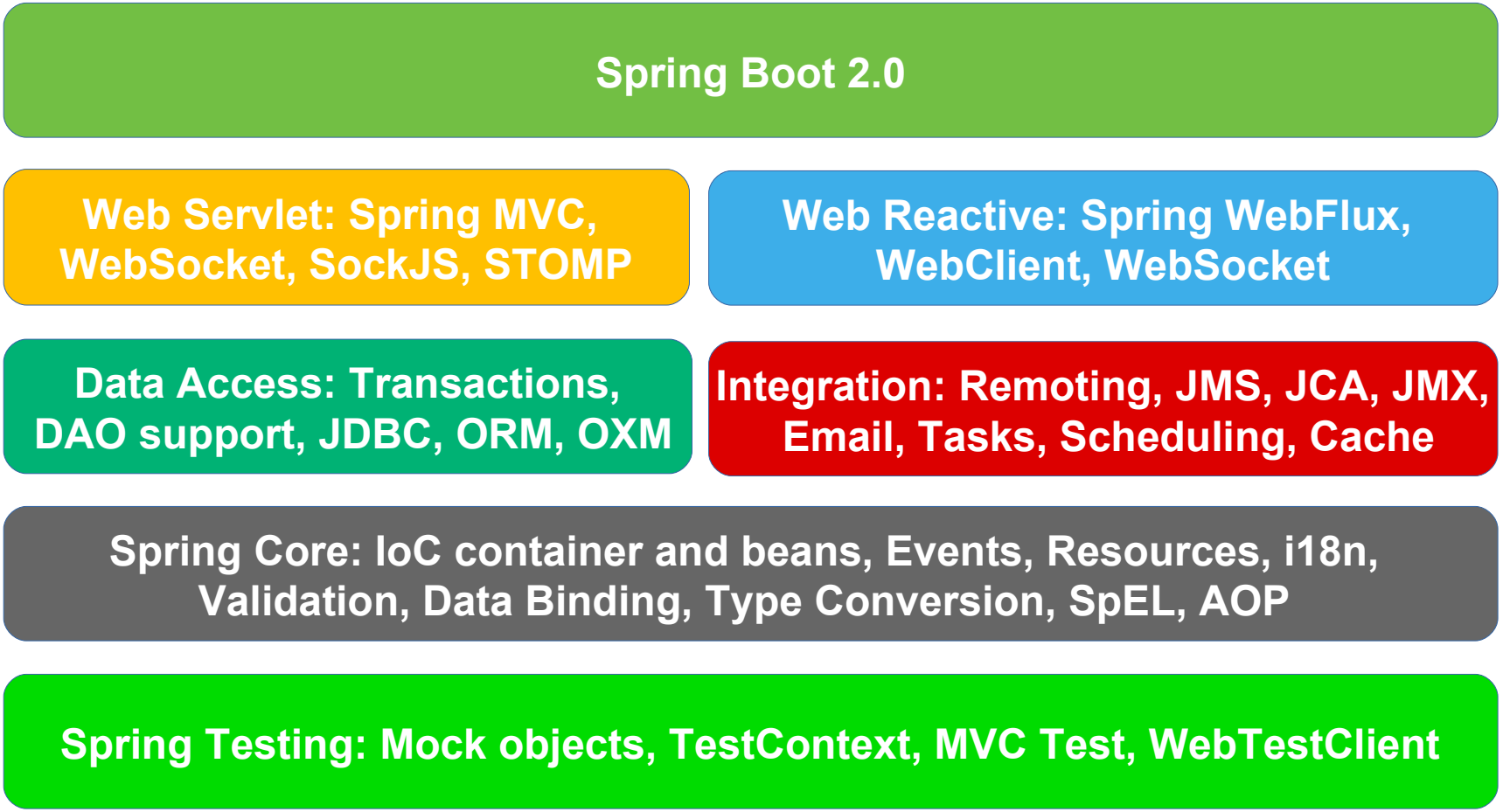
Spring 5 Framework Modules



Source: https://docs.spring.io

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Evolution of Spring Framework - I

- Spring 1.x – Spring Core, Spring Context, Spring DAO, Spring ORM, Spring AOP, Spring Web, Spring WebMVC
- Spring 2.x (2006) – declarative transactions, @AspectJ, JPA, JMS, MVC form tags, Portlet MVC, Acegi Security
- Spring 2.5 (2007) – @Autowired, JSR-250(@Resource, @PostConstruct, @PreDestroy), stereotype annotations (@Component, @Repository, @Service, @Controller), automatic classpath scanning, AOP updates, TestContext
- Spring 3.x (2009) – Java-based @Configuration model, Spring Expression Language (SpEL), JSR-303:Bean Validation,REST
- Spring 3.1.x (2009) – WebApplicationInitializer, @Cacheable, @Profile, @EnableTransactionManagement..., c: namespace

Evolution of Spring Framework - II

- Spring 4.x (2013, Pivotal) – Java 8, Spring Boot, WebSocket, SockJS, and STOMP messaging, composed annotations, improvements in the core container, CORS, Hibernate 5.0, Spring IO, Spring XD
- Spring 5.x (2017) – JDK 9, Junit 5, XML configuration namespaces streamlined to unversioned schemas, Protobuf 3.0, Java EE7 API level required in Servlet 3.1, Bean Validation 1.1, JPA 2.1, JMS 2.0. Tomcat 8.5+, Jetty 9.4+, Wildfly 10+, Reactor, WebFlux, Spring Vault, Spring Cloud Stream, Micrometer

Spring Design Phylosophy

- Provide choice at every level. Spring lets you defer design decisions as late as possible – e.g. persistence providers, infrastructure, third-party APIs
- Accommodate diverse perspectives – not opinionated
- Maintain strong backward compatibility
- Care about API design – intuitive APIs
- Code quality – high standards, meaningful, current, and accurate javadoc, clean code structure with no circular dependencies between packages.

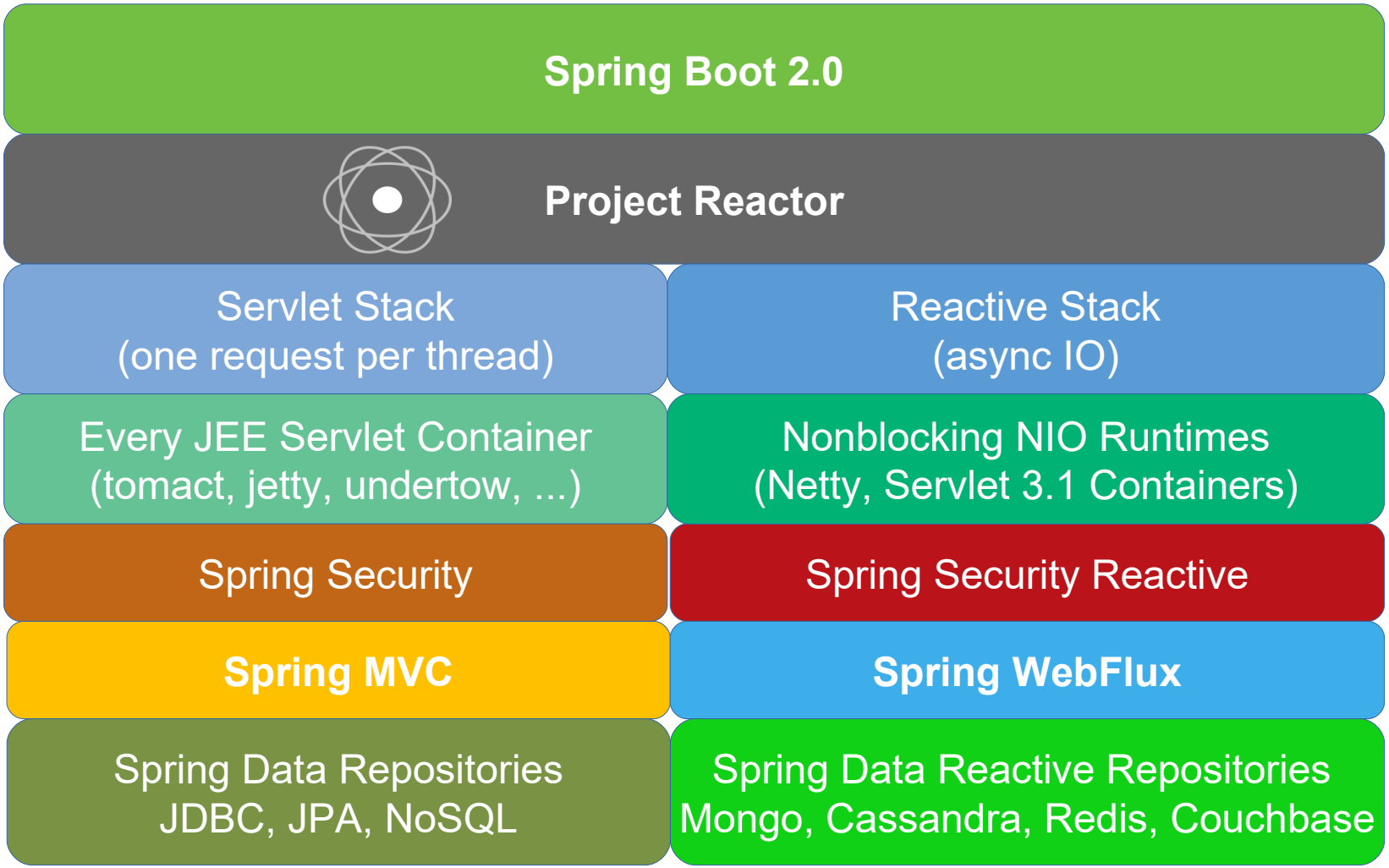
Source: https://spring.io

Top New Features in Spring 5

- Reactive Programming Model
- Spring Web Flux – takes advantage of multi-core processors, handles massive number of connections
- Reactive DB repositories & integrations + hot event streaming: MongoDB, CouchDB, Redis, Cassandra, Kafka
- JDK 8+ and Java EE 7+ baseline
- Testing improvements – WebTestClient (based on reactive WebFlux WebClient)
- Kotlin functional DSL

Source: https://spring.io

Spring 5 Web Application Building Blocks



Source: https://spring.io

Maven Dependency Management

- Apache Maven – https://spring.io/guides/gs/maven/
- Common arguments: **mvn compile, mvn package, mvn install, mvn clean deploy site-deploy**
- Example configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
         http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>org.iproduct.spring</groupId>
    <artifactId>01-introduction-maven</artifactId>
    <version>1.0-SNAPSHOT</version>
```

Maven Configuration (continued)

```
<dependencies>
    <dependency>
        <groupId>org.springframework</groupId>
        <artifactId>spring-context</artifactId>
        <version>5.0.5.RELEASE</version>
    </dependency>
</dependencies>

<repositories>
    <repository>
        <id>io.spring.repo.maven.release</id>
        <url>http://repo.spring.io/release/</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </repository>
</repositories>
```

Maven Configuration (continued)

```
    <build>
        <plugins>
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-compiler-plugin</artifactId>
                <configuration>
                    <source>9</source>
                    <target>9</target>
                </configuration>
            </plugin>
        </plugins>
    </build>

</project>
```

Maven Configuration (enhanced)

```
<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework</groupId>
            <artifactId>spring-framework-bom</artifactId>
            <version>5.0.5.RELEASE</version>
            <type>pom</type>
            <scope>import</scope>
        </dependency>
    </dependencies>
</dependencyManagement>

<dependencies>
    <dependency>
        <groupId>org.springframework</groupId>
        <artifactId>spring-context</artifactId>
    </dependency>
</dependencies>
```

Gradle Dependency Management

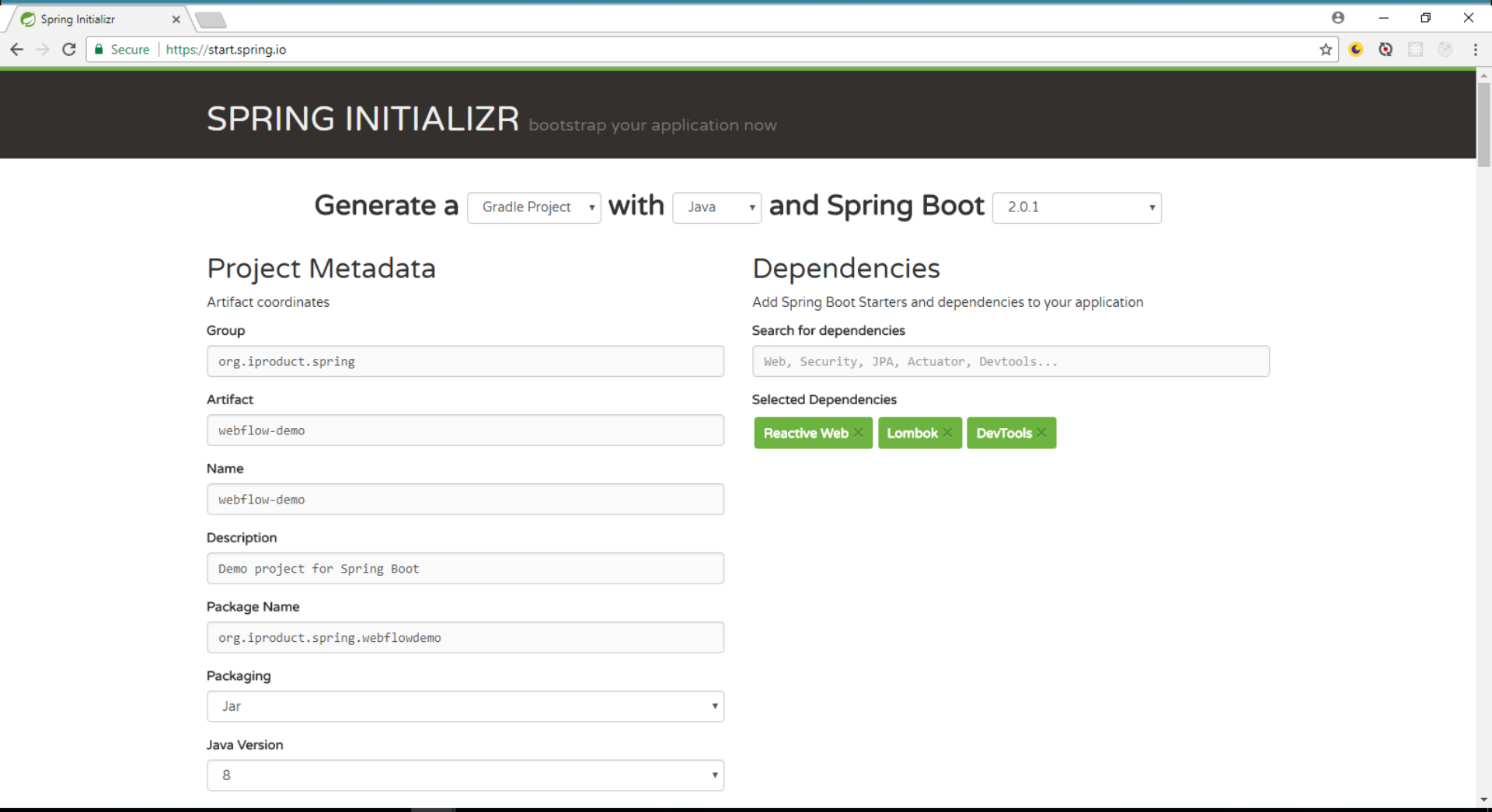
- Gradle – https://spring.io/guides/gs/gradle/
- Init new project/ convert exisitng from Maven: **`gradle init`**
- Build project: **`gradle build`**
- Build project: **`gradle run`**
- Example configuration:

```
group 'org.iproduct.spring'
version '1.0-SNAPSHOT'
apply plugin: 'java'
apply plugin: 'application'
mainClassName =
     'org.iproduct.spring.demo.xmlconfig.HelloWorldSpringDI'

sourceCompatibility = 1.8
```

Gradle Configuration (continued)

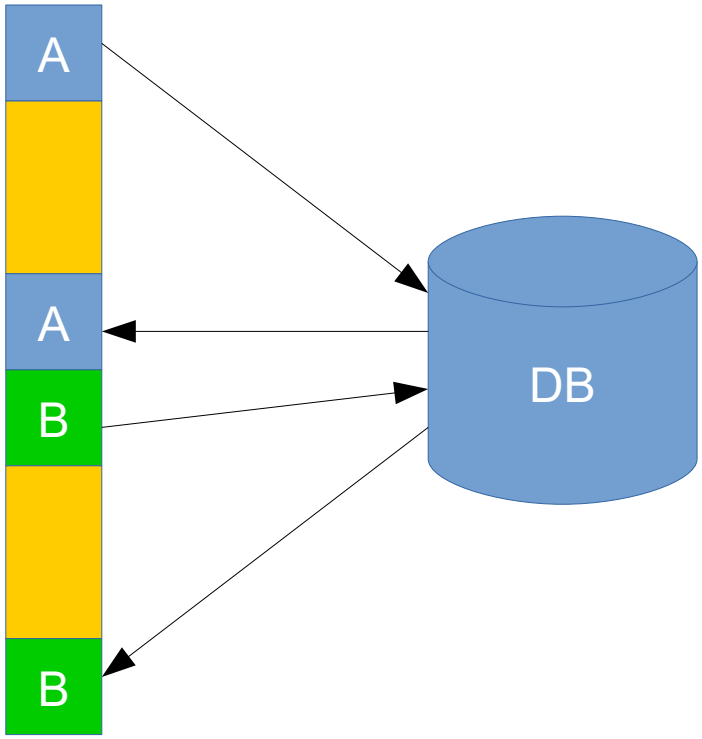
```
task runApp(type: JavaExec) {
    classpath = sourceSets.main.runtimeClasspath
    main =
'org.iproduct.spring.demo.xmlconfig.HelloWorldSpringDI'
}

repositories {
    mavenLocal()
    mavenCentral()
    maven { url "https://repo.spring.io/snapshot" }
    maven { url "https://repo.spring.io/milestone" }
}

dependencies {
    compile group: 'org.springframework',
            name: 'spring-context', version: '5.0.5.RELEASE'
    testCompile group: 'junit', name: 'junit', version: '4.12'
}
```

Making Projects Easy: Spring Boot 2

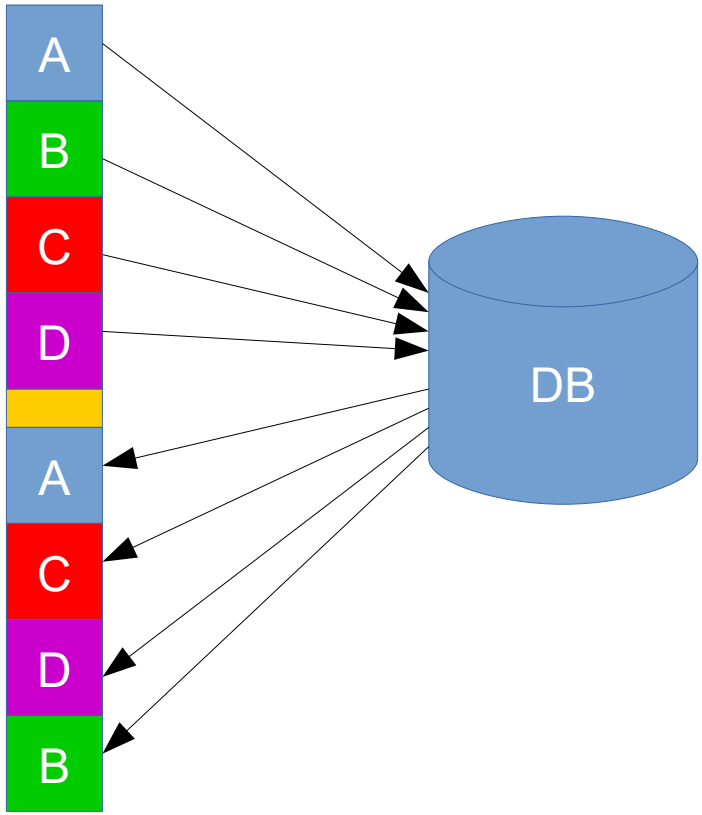


Synchronous vs. Asynchronous IO

Synchronous

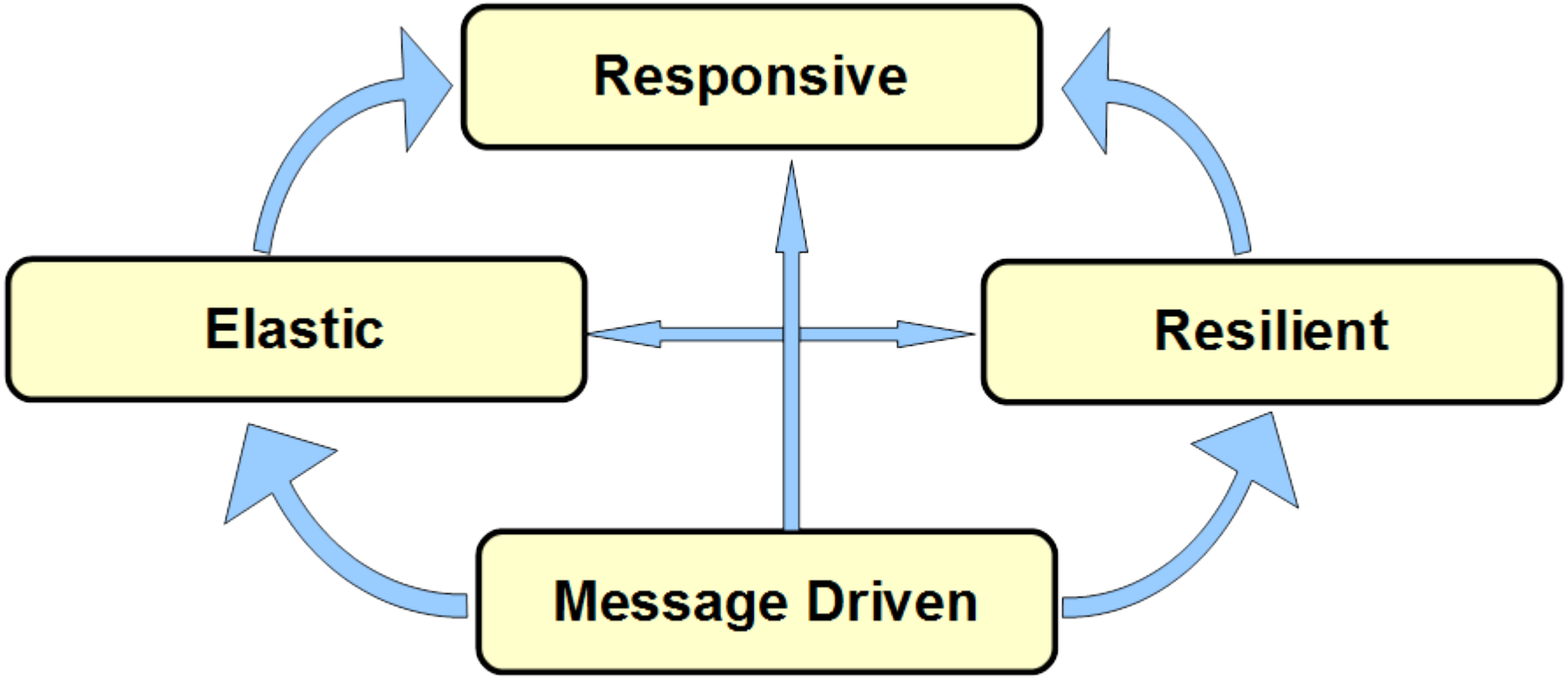


Asynchronous

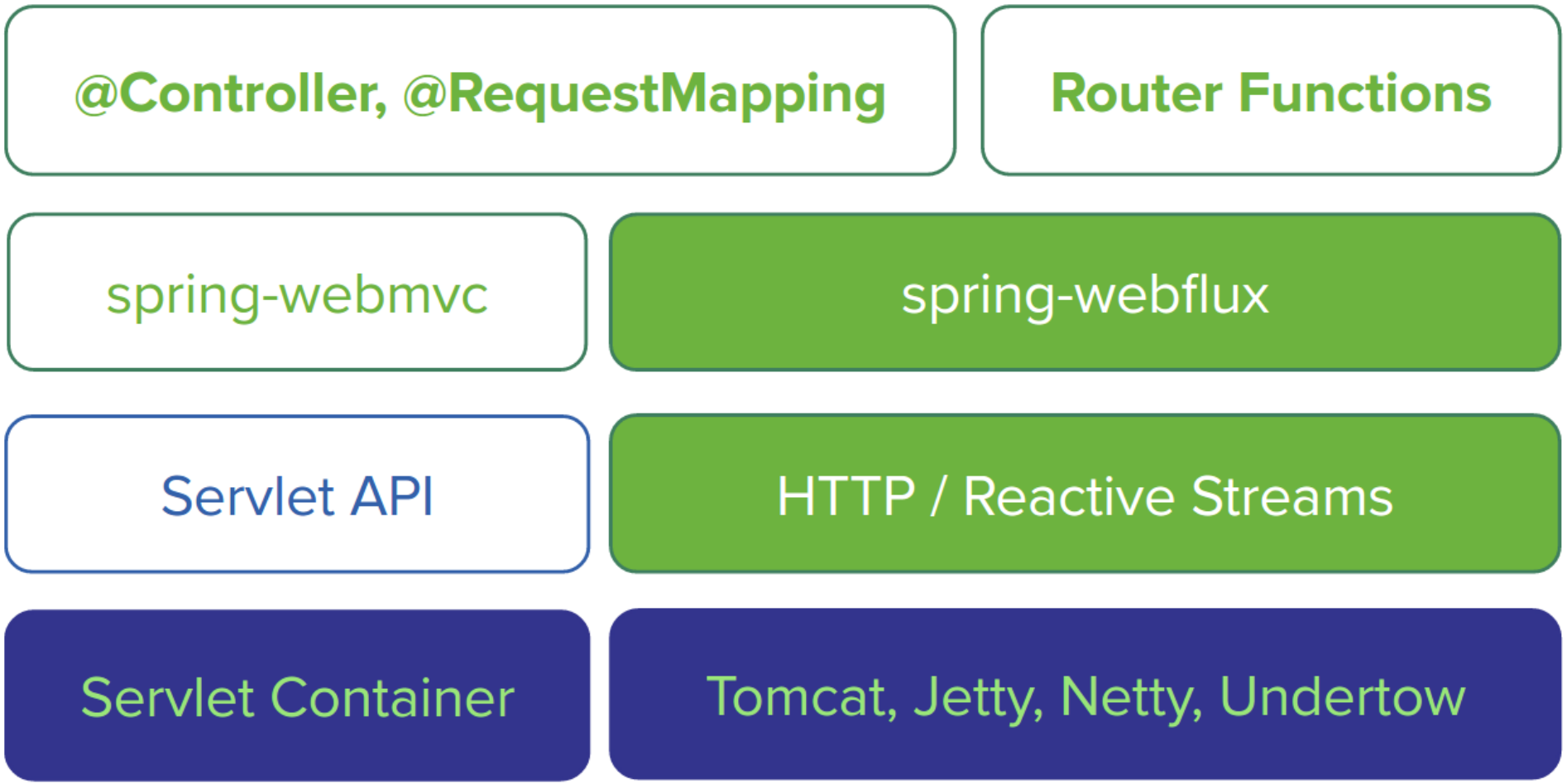


Reactive Manifesto

[http://www.reactivemanifesto.org]



Spring 5 WebFlux



Imperative and Reactive

- Reactive Programming: using static or dynamic data flows and propagation of change

Example: a := b + c

- Functional Programming: evaluation of mathematical functions,
  - Avoids changing-state and mutable data, declarative programming
  - Side effects free => much easier to understand and predict the program behavior.

Example: books.stream().filter(book -> book.getYear() > 2010)
.forEach(System.out::println)

Functional Reactive (FRP)

According to **Connal Elliot's** (ground-breaking paper @ Conference on Functional Programming, 1997), **FRP** is:

(a) Denotative

(b) Temporally continuous

FRP = Async Data Streams

- **FRP** is asynchronous data-flow programming using the building blocks of functional programming (e.g. map, reduce, filter) and explicitly modeling time
- Used for GUIs, robotics, and music. Example (RxJava):

```
Observable.from(
     new String[]{"Reactive", "Extensions", "Java"})
    .take(2).map(s -> s + " : on " + new Date())
    .subscribe(s -> System.out.println(s));
```

Result:

```
Reactive : on Wed Jun 17 21:54:02 GMT+02:00 2015
Extensions : on Wed Jun 17 21:54:02 GMT+02:00 2015
```

Reactive Streams Spec.

- Reactive Streams – provides standard for asynchronous stream processing with non-blocking back pressure.
- Minimal set of interfaces, methods and protocols for asynchronous data streams
- April 30, 2015: has been released version 1.0.0 of Reactive Streams for the JVM (Java API, Specification, TCK and implementation examples)
- Java 9: java.util.concurrent.Flow

Reactive Streams Spec.

- **Publisher** – provider of potentially unbounded number of sequenced elements, according to Subscriber(s) demand.

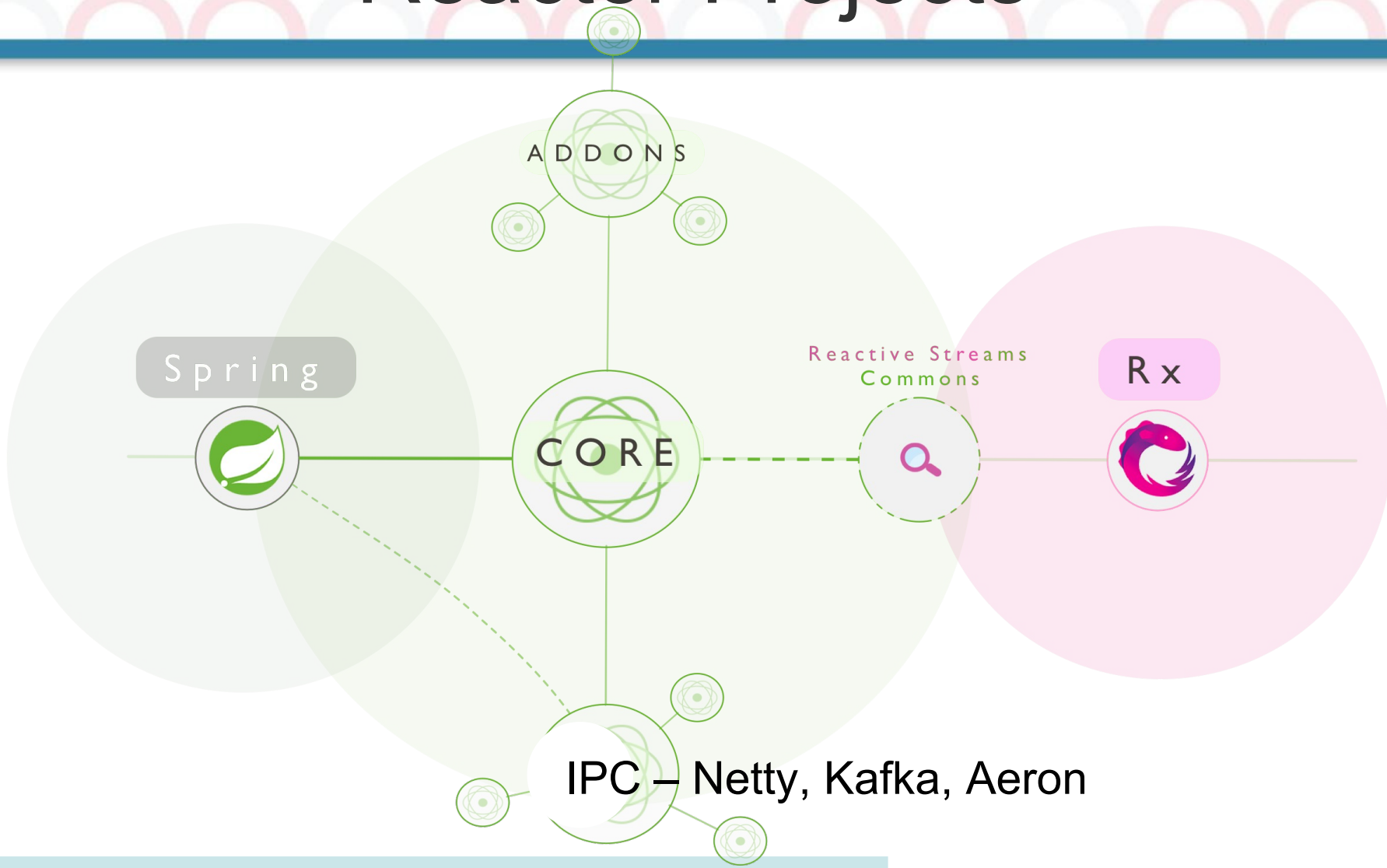
Publisher.subscribe(Subscriber) => **onSubscribe onNext* (onError | onComplete)?**

- **Subscriber** – calls **Subscription.request(long)** to receive notifications
- **Subscription** – one-to-one **Subscriber** ↔ **Publisher**, request data and cancel demand (allow cleanup).
- **Processor** = **Subscriber** + **Publisher**

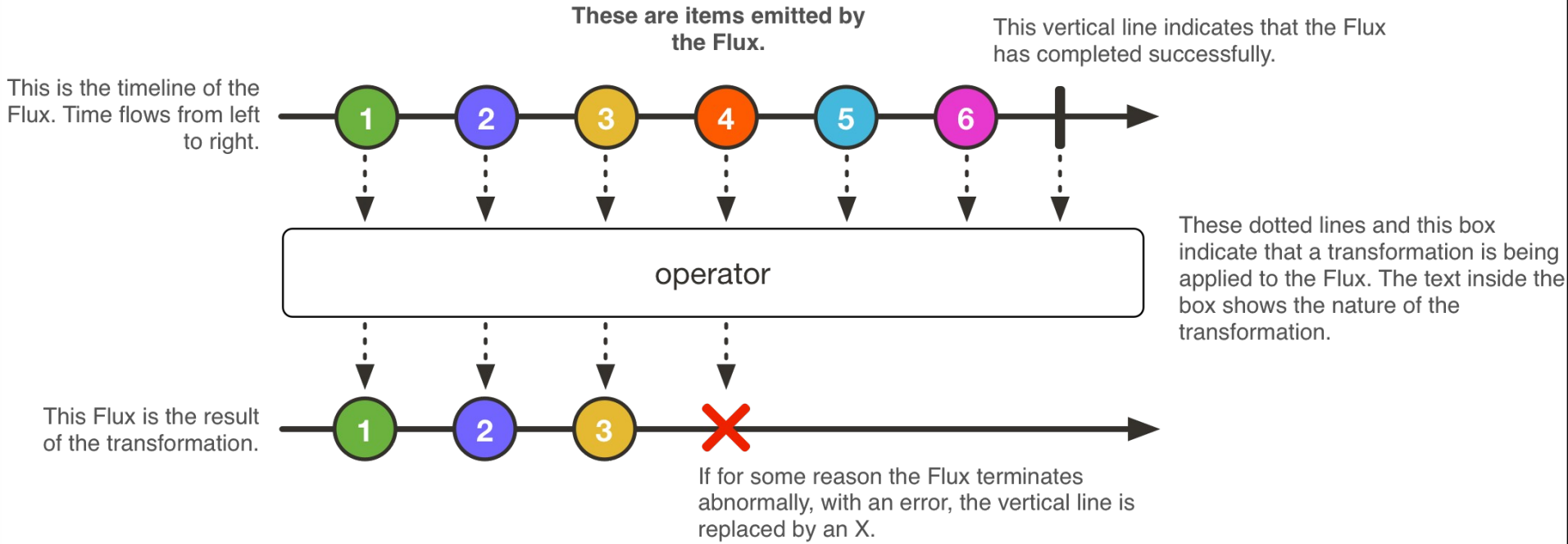
Project Reactor

- Reactor project allows building high-performance (low latency high throughput) non-blocking asynchronous applications on JVM.
- Reactor is designed to be extraordinarily fast and can sustain throughput rates on order of 10's of millions of operations per second.
- Reactor has powerful API for declaring data transformations and functional composition.
- Makes use of the concept of Mechanical Sympathy built on top of Disruptor / RingBuffer.

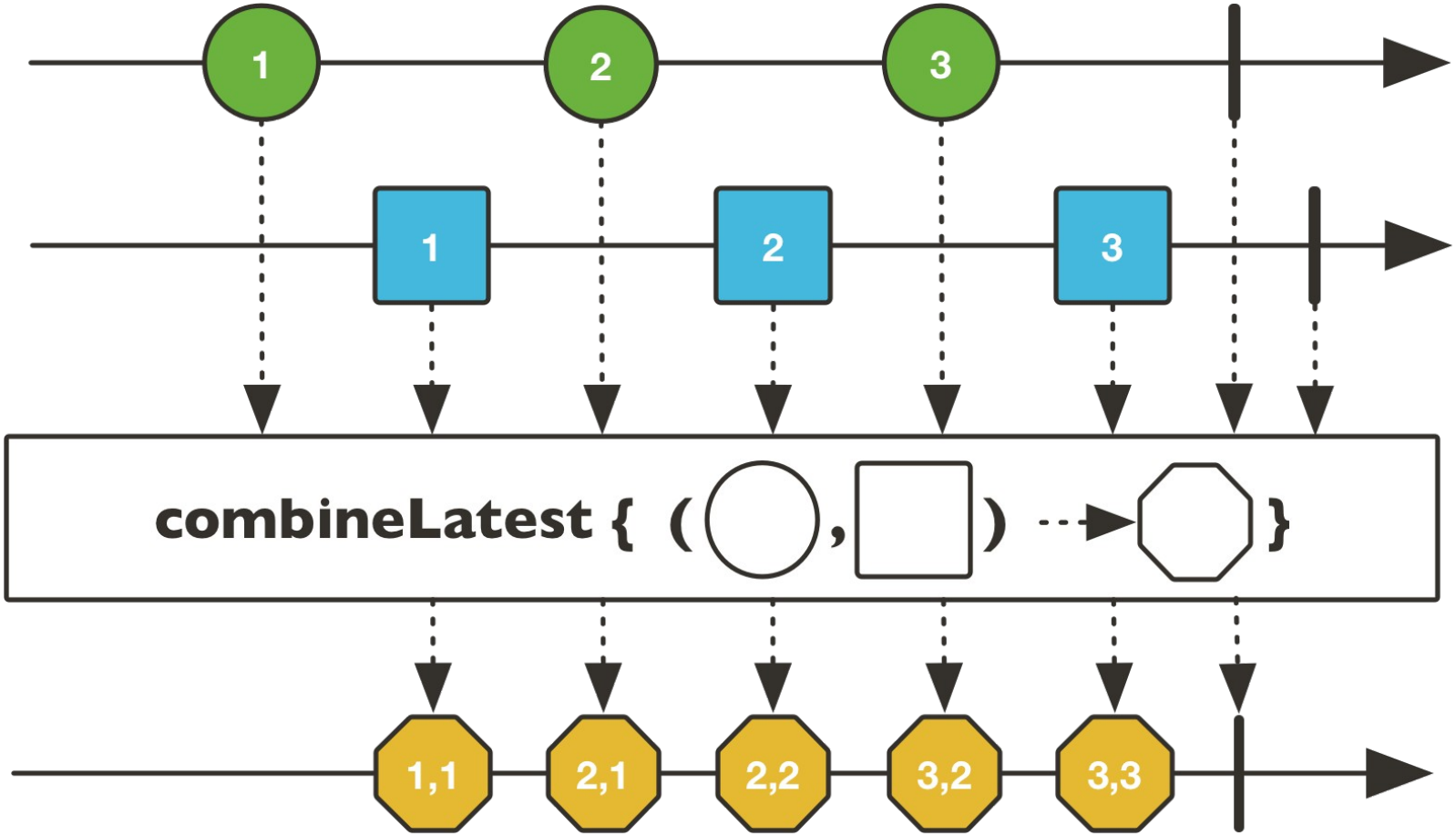
Reactor Projects



Reactor Flux

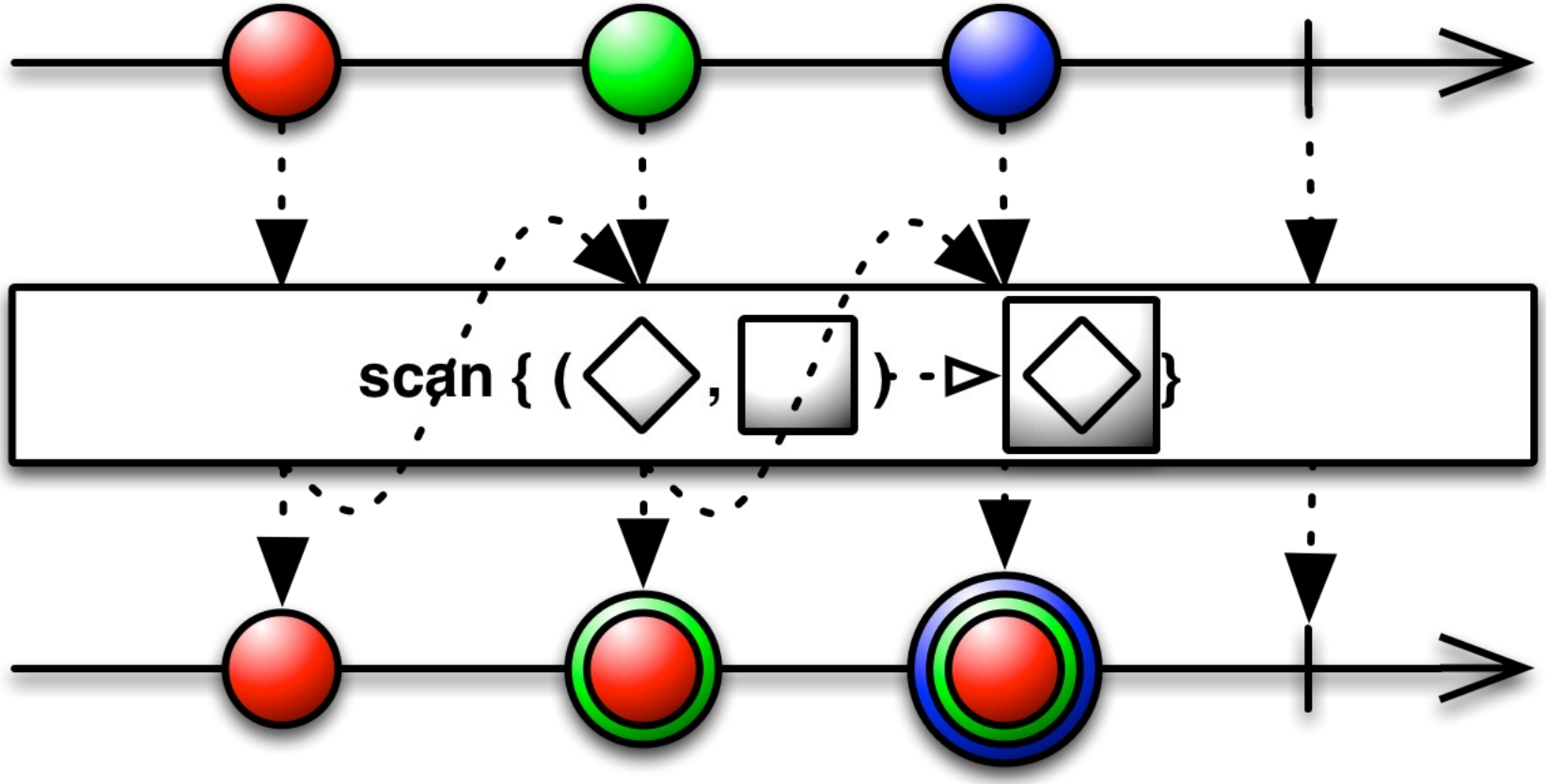


Example: Flux.combineLatest()



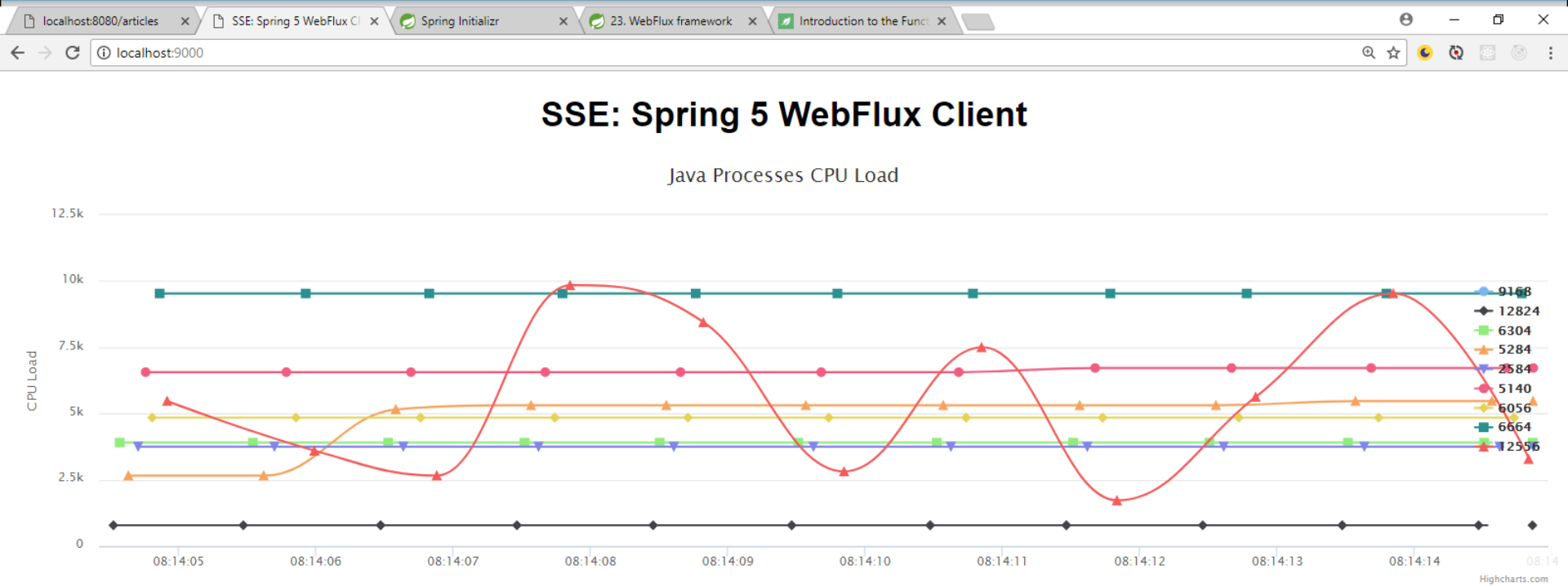
https://projectreactor.io/core/docs/api/, Apache Software License 2.0

Redux == Rx Scan Opearator



Source: RxJava 2 API documentation, http://reactivex.io/RxJava/2.x/javadoc/

Demo Time :)



- PID: 9168 - C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2018.1\jre64\bin\java.exe
- PID: 12824 - C:\Program Files\Java\jdk1.8.0_152\bin\java.exe
- PID: 6304 - C:\Program Files\Java\jdk-9.0.1\bin\java.exe
- PID: 5284 - C:\Program Files\Java\jdk1.8.0_152\bin\java.exe
- PID: 2584 - C:\Program Files\Java\jdk1.8.0_152\bin\java.exe
- PID: 5140 - C:\Program Files\Java\jdk1.8.0_152\bin\java.exe
- PID: 6056 - C:\Program Files\Java\jdk1.8.0_152\bin\java.exe
- PID: 6664 - C:\Program Files\Java\jdk-9.0.1\bin\java.exe
- PID: 12556 - C:\Program Files\Java\jdk-9.0.1\bin\java.exe

Tips & Tricks

- In order to automatically create **/src** folder when creating new Gradle project with IntelliJ IDEA, check that the following option is enabled: Settings / Build, Execution, Depolyment / Gradle / Create directories for empty content roots automatically
- If you use project Lombok and Lombok plugin in IntelliJ – don't forget to enable Annotation processing from: Settings / Build, Execution, Deployment / Compiler / Annotation Processors.

Thank's for Your Attention!

Trayan Iliev

CEO of IPT – Intellectual Products & Technologies

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