# Overview of the Java Reactive Streams API


Douglas C. Schmidt

d.schmidt@vanderbilt.edu

www.dre.vanderbilt.edu/~schmidt

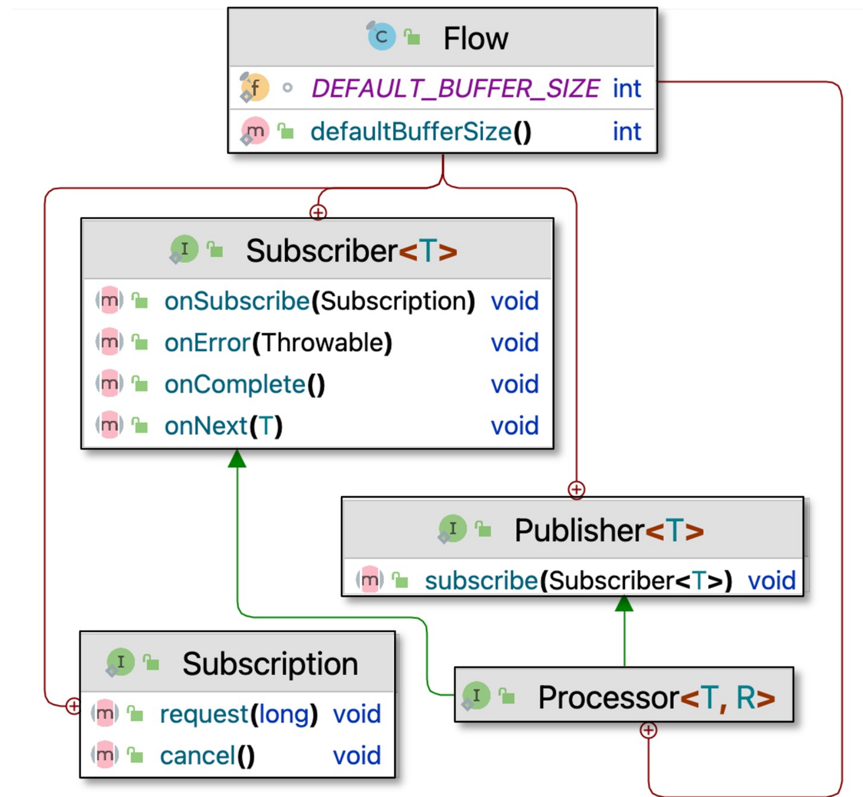
Professor of Computer Science

Institute for Software
Integrated Systems

Vanderbilt University
Nashville, Tennessee, USA

# Learning Objectives in this Part of the Lesson

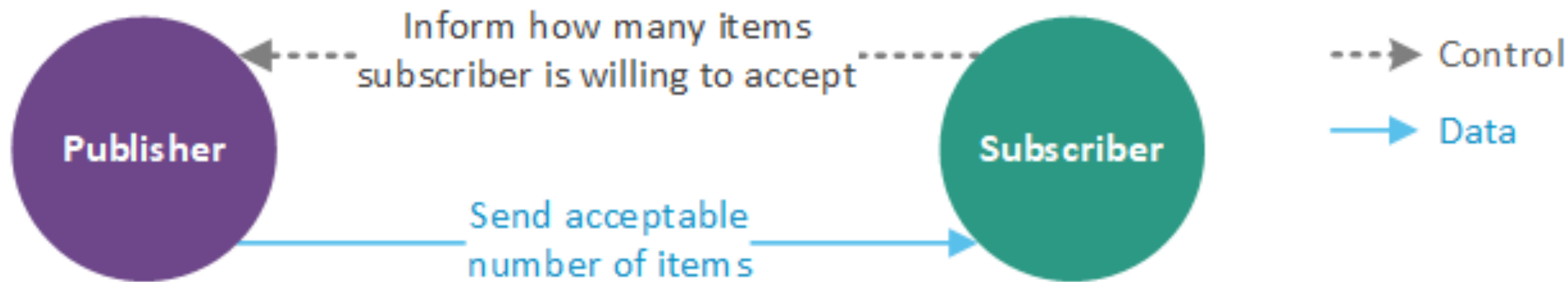
- Understand the key benefits & principles underlying the reactive programming paradigm
- Know the Java reactive streams API




See community.oracle.com/docs/DOC-1006738

# Learning Objectives in this Part of the Lesson

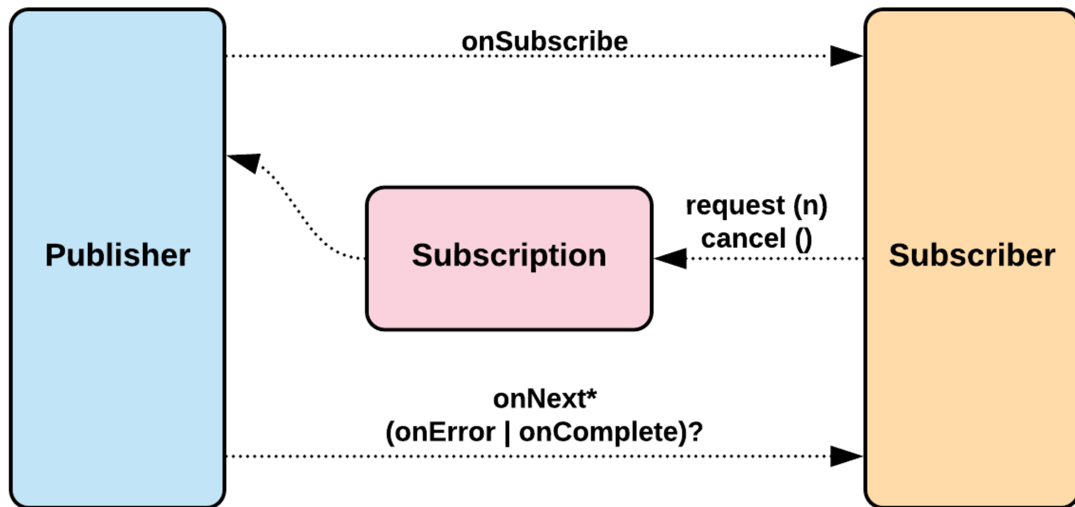
- Understand the key benefits & principles underlying the reactive programming paradigm
- Know the Java reactive streams API
  - Be aware of key patterns




See community.oracle.com/docs/DOC-1006738

# Learning Objectives in this Part of the Lesson

- Understand the key benefits & principles underlying the reactive programming paradigm
- Know the Java reactive streams API
  - Be aware of key patterns
  - Recognize key abstractions



# Reactive Programming & Java Reactive Streams

# Reactive Programming & Java Reactive Streams

- Java 9+ supports reactive programming via Reactive Streams & the Flow API

## Class Flow

java.lang.Object
    java.util.concurrent.Flow

```
public final class Flow
extends Object
```

Interrelated interfaces and static methods for establishing flow-controlled components in which `Publishers` produce items consumed by one or more `Subscribers`, each managed by a `Subscription`.

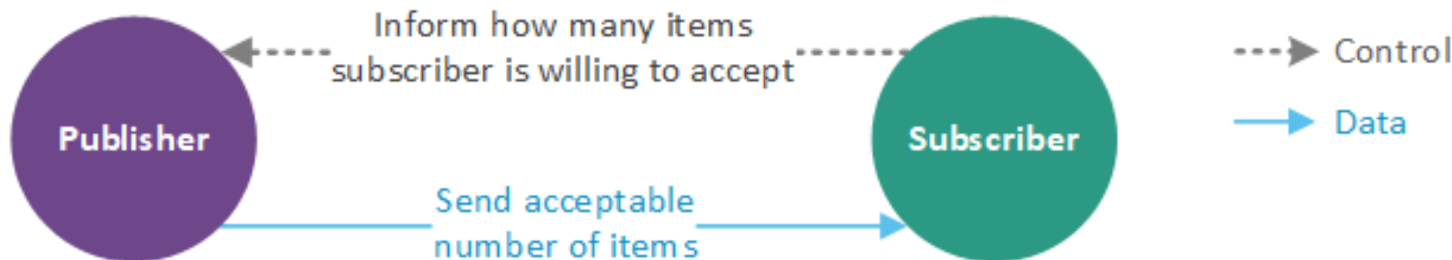
These interfaces correspond to the reactive-streams specification. They apply in both concurrent and distributed asynchronous settings: All (seven) methods are defined in `void` "one-way" message style. Communication relies on a simple form of flow control (method `Flow.Subscription.request(long)`) that can be used to avoid resource management problems that may otherwise occur in "push" based systems.

**Examples.** A `Flow.Publisher` usually defines its own `Flow.Subscription` implementation; constructing one in method `subscribe` and issuing it to the calling `Flow.Subscriber`. It publishes items to the subscriber asynchronously, normally using an `Executor`. For example, here is a very simple publisher that only issues (when requested) a single `TRUE` item to a single subscriber. Because the subscriber receives only a single item, this class does not use buffering and ordering control required in most implementations (for example `SubmissionPublisher`).

See docs.oracle.com/javase/9/docs/api/java/util/concurrent/Flow.html

# Reactive Programming & Java Reactive Streams

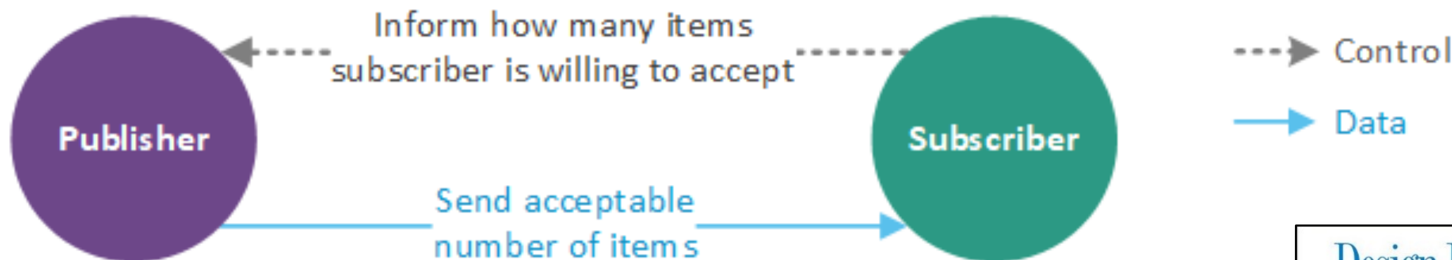
- Java 9+ supports reactive programming via Reactive Streams & the Flow API
  - Adds support for stream-oriented pub/sub patterns



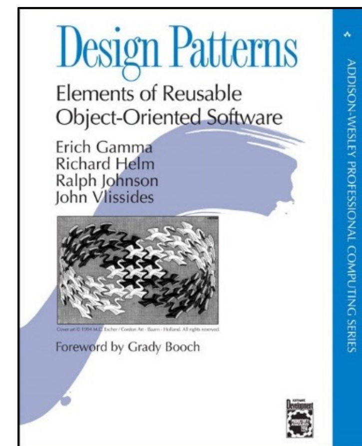

See [javasampleapproach.com/java/java-9/java-9-flow-api-example-publisher-and-subscriber](javasampleapproach.com/java/java-9/java-9-flow-api-example-publisher-and-subscriber)

# Reactive Programming & Java Reactive Streams

- Java 9+ supports reactive programming via Reactive Streams & the Flow API
  - Adds support for stream-oriented pub/sub patterns



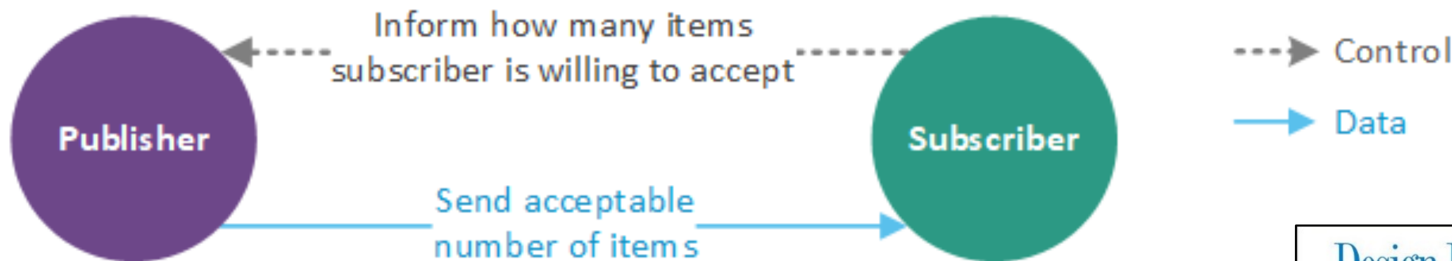

- Combines two patterns



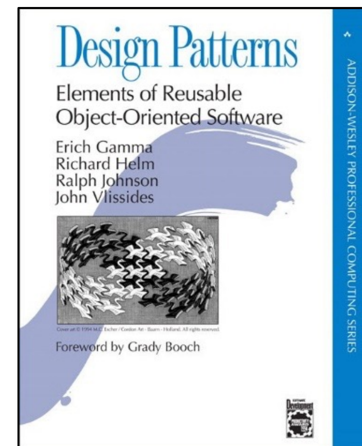

See www.journaldev.com/20723/java-9-reactive-streams

# Reactive Programming & Java Reactive Streams

- Java 9+ supports reactive programming via Reactive Streams & the Flow API
  - Adds support for stream-oriented pub/sub patterns



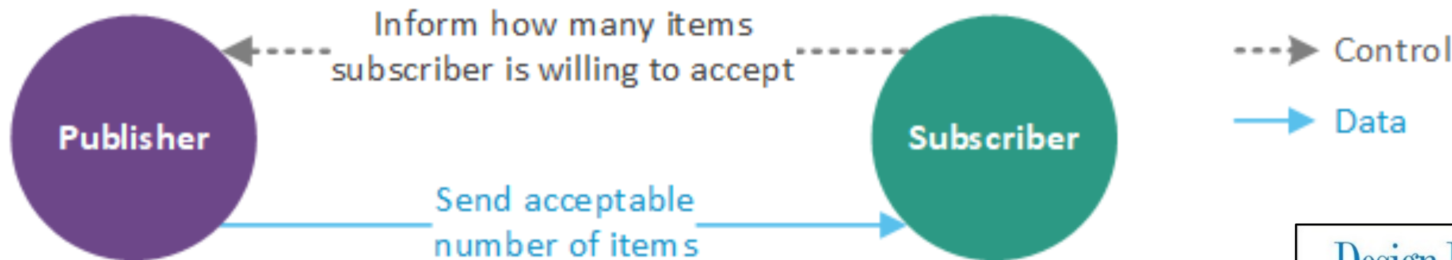

- Combines two patterns
  - *Iterator*, which applies a “pull model” where app subscriber(s) pull items from a publisher source



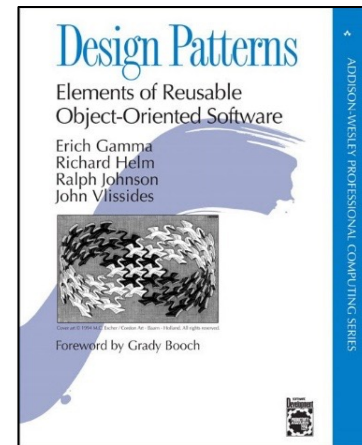

See en.wikipedia.org/wiki/Iterator_pattern

# Reactive Programming & Java Reactive Streams

- Java 9+ supports reactive programming via Reactive Streams & the Flow API
  - Adds support for stream-oriented pub/sub patterns



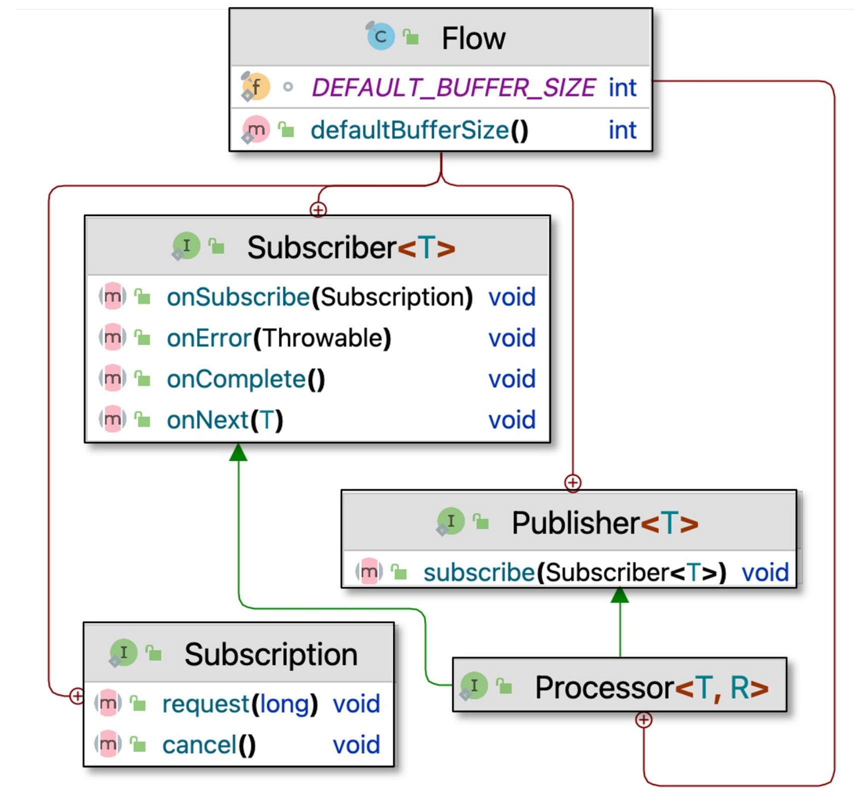

- Combines two patterns
  - *Iterator*, which applies a "pull model" where app subscriber(s) pull items from a publisher source
  - *Observer*, which applies a "push model" that reacts when a publisher source pushes an item to subscriber sink(s)




See en.wikipedia.org/wiki/Observer_pattern

# Reactive Programming & Java Reactive Streams

- The Java Flow API defines interfaces designed to ensure interoperability of reactive streams implementations

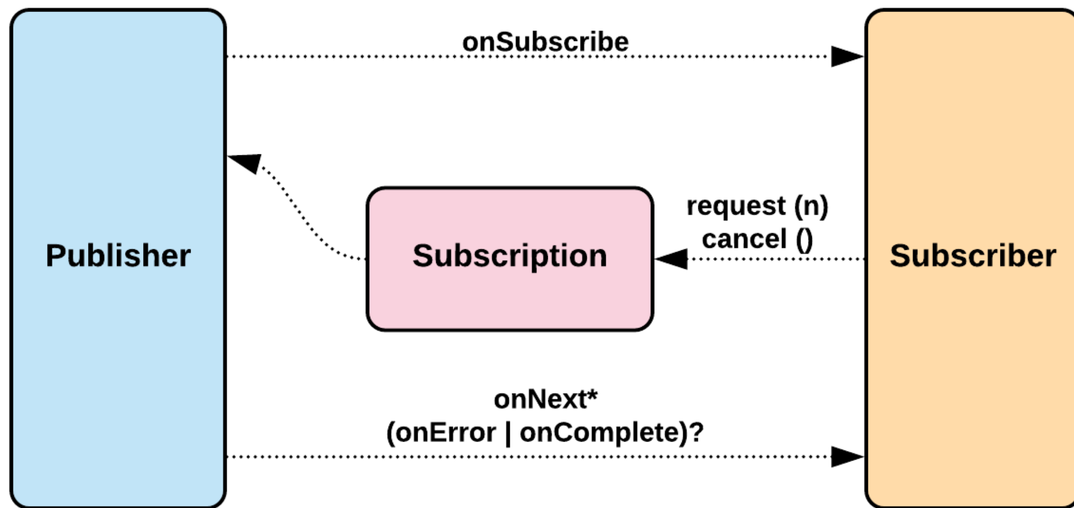



See [www.reactive-streams.org](http://www.reactive-streams.org)

# Key Abstractions in the Java Flow API

# Key Abstractions in the Java Flow API

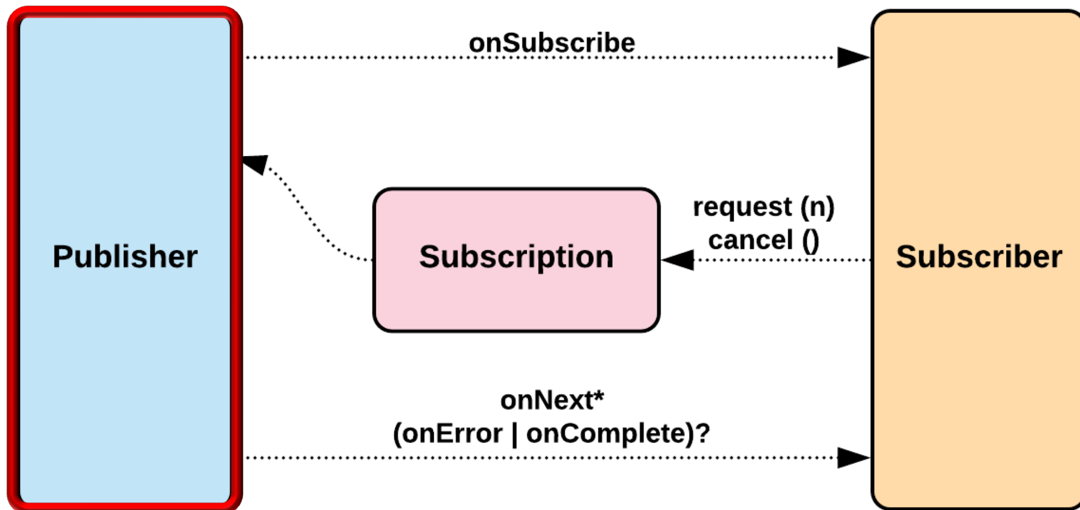
- A “flow” involves interactions between three key abstractions




See [www.baeldung.com/java-9-reactive-streams](http://www.baeldung.com/java-9-reactive-streams)

# Key Abstractions in the Java Flow API

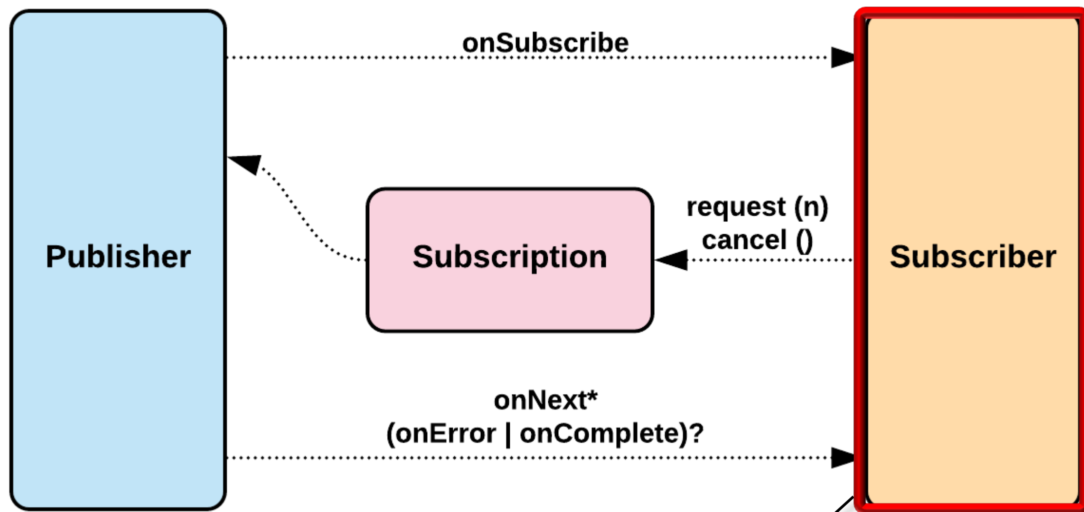
- A "flow" involves interactions between three key abstractions




*1. Publisher(s) are sources that produce 0+ events that can be pushed to subscriber(s)*

# Key Abstractions in the Java Flow API

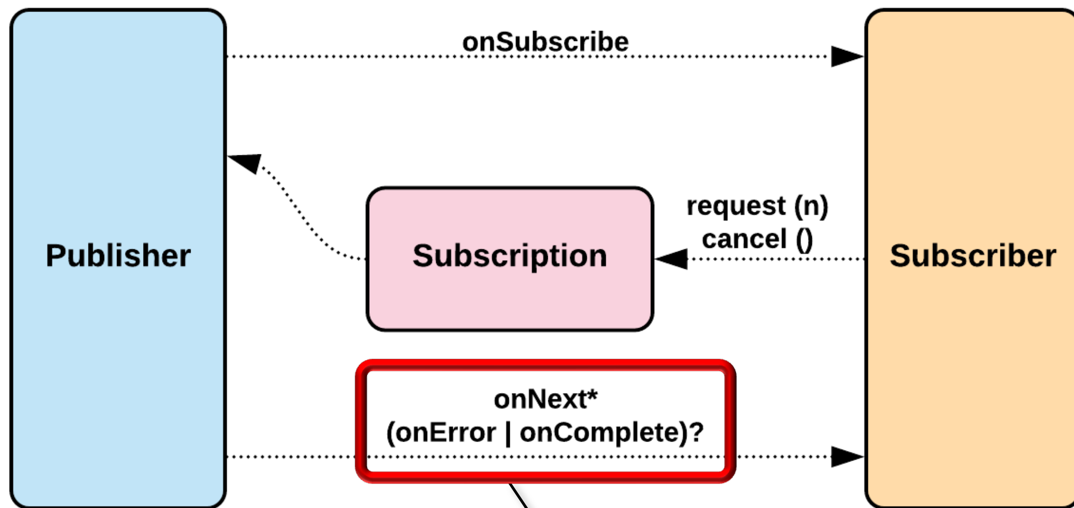
- A "flow" involves interactions between three key abstractions




*2. Subscriber(s) are sinks that register for & consume events pushed by publisher(s)*

# Key Abstractions in the Java Flow API

- A "flow" involves interactions between three key abstractions

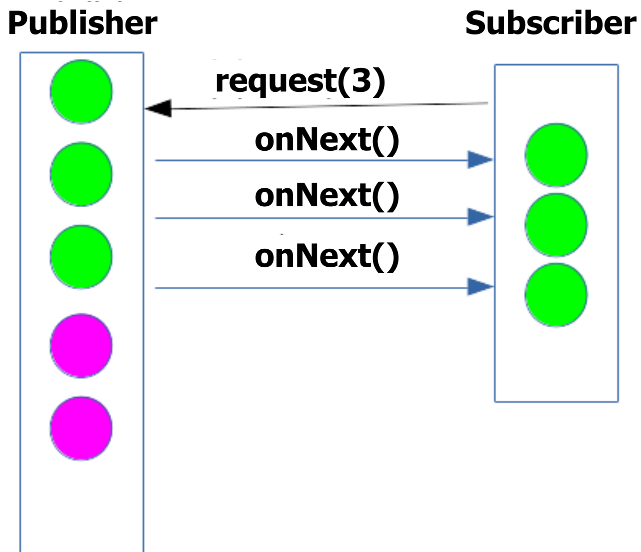


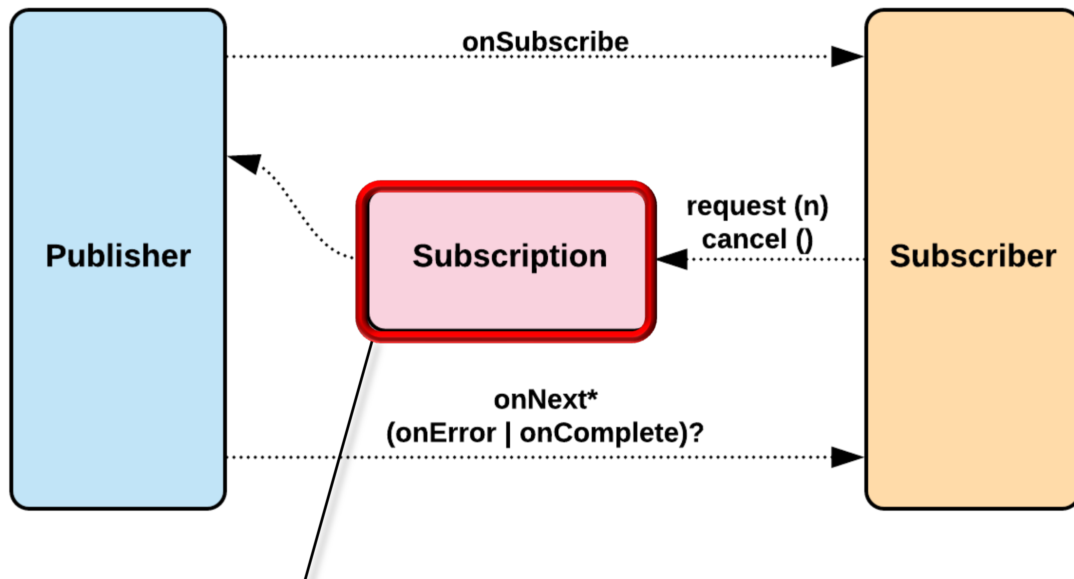

*Publisher(s) push events to registered subscriber(s) by invoking hook methods*

See [wiki.c2.com/?HookMethod](wiki.c2.com/?HookMethod)

# Key Abstractions in the Java Flow API

- A "flow" involves interactions between three key abstractions



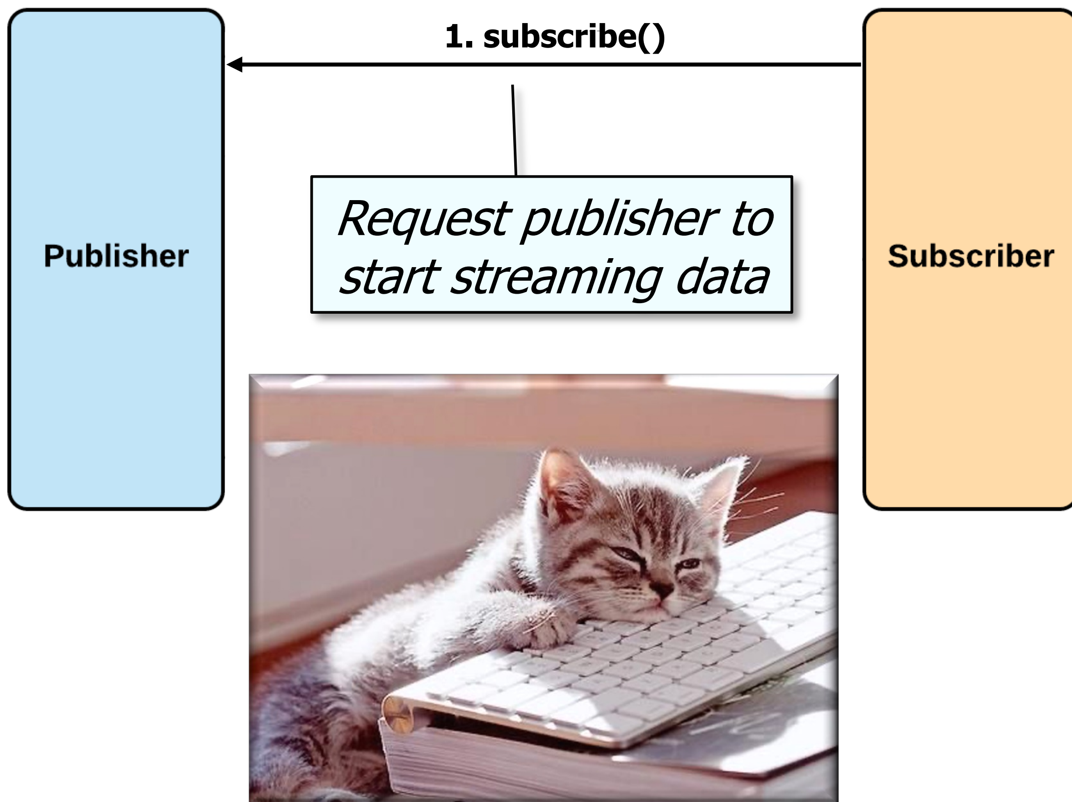




*3. Subscription is used to control the flow of events between a subscriber & a publisher*

See en.wikipedia.org/wiki/Flow_control_(data)

# Key Abstractions in the Java Flow API

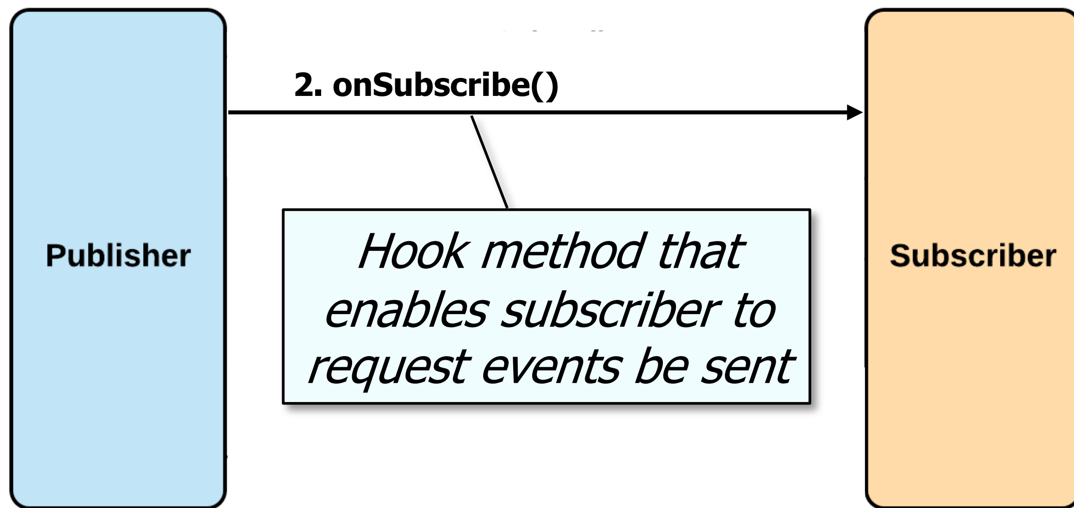
- A "flow" involves interactions between three key abstractions




A reactive stream is "lazy" & just starts processing when subscribe() is called

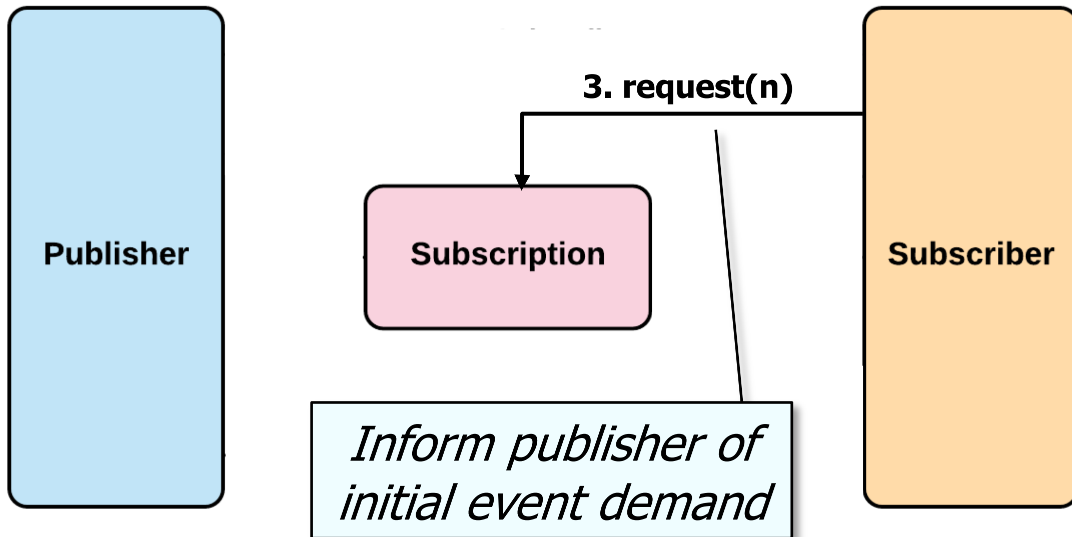
# Key Abstractions in the Java Flow API

- A "flow" involves interactions between three key abstractions



# Key Abstractions in the Java Flow API

- A "flow" involves interactions between three key abstractions




No events are sent by a publisher until demand is signaled via this method

# Key Abstractions in the Java Flow API

- A "flow" involves interactions between three key abstractions

Publisher

Subscription

Subscriber

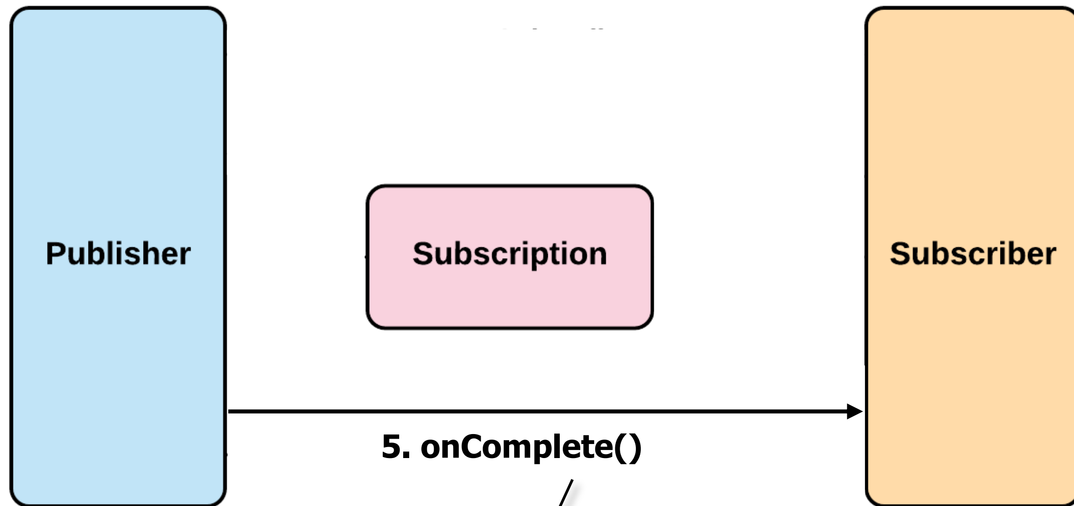
4. onNext(data)

*Data notification hook method called by the publisher in response to requests*

There can be 0 or more onNext() notifications, which form a "stream"

# Key Abstractions in the Java Flow API

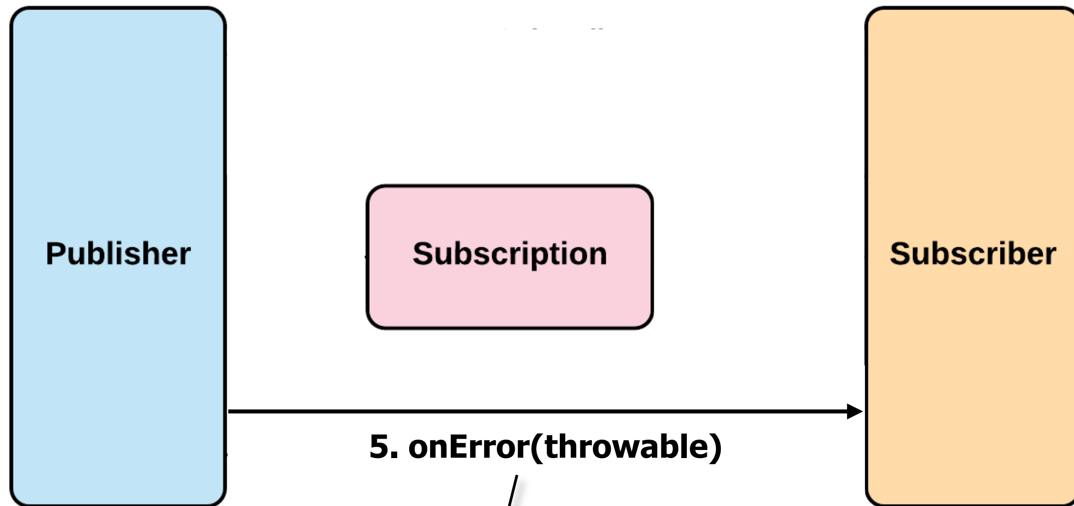
- A “flow” involves interactions between three key abstractions




*Hook method called by publisher when all events have been sent successfully*

# Key Abstractions in the Java Flow API

- A “flow” involves interactions between three key abstractions




*Hook method called by a publisher when an error occurs to convey the exception*

# End of Overview of the Java Reactive Streams API