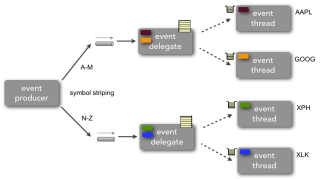
Reactive Architecture Patterns 2

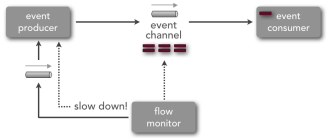
Mark Richards
Independent Consultant
Hands-on Software Architect / Published Author
Founder, DeveloperToArchitect.com
www.wmrichards.com

Author of *Software Architecture Fundamentals Video Series* (O'Reilly)
Author of Microservices Pitfalls and AntiPatterns (O'Reilly)
Author of Microservices vs. Service-Oriented Architecture (O'Reilly)
Author of *Enterprise Messaging Video Series* (O'Reilly)
Author of *Java Message Service 2nd Edition* (O'Reilly)

reactive architecture agenda



thread
delegate
pattern



producer
control flow
pattern

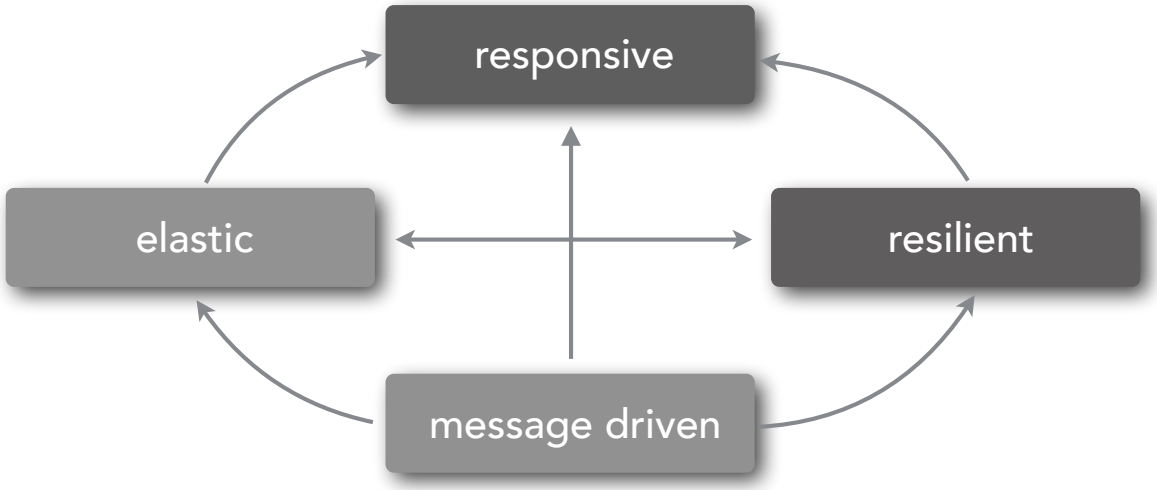
source code

https://github.com/wmr513/reactive

Thread Delegate Pattern

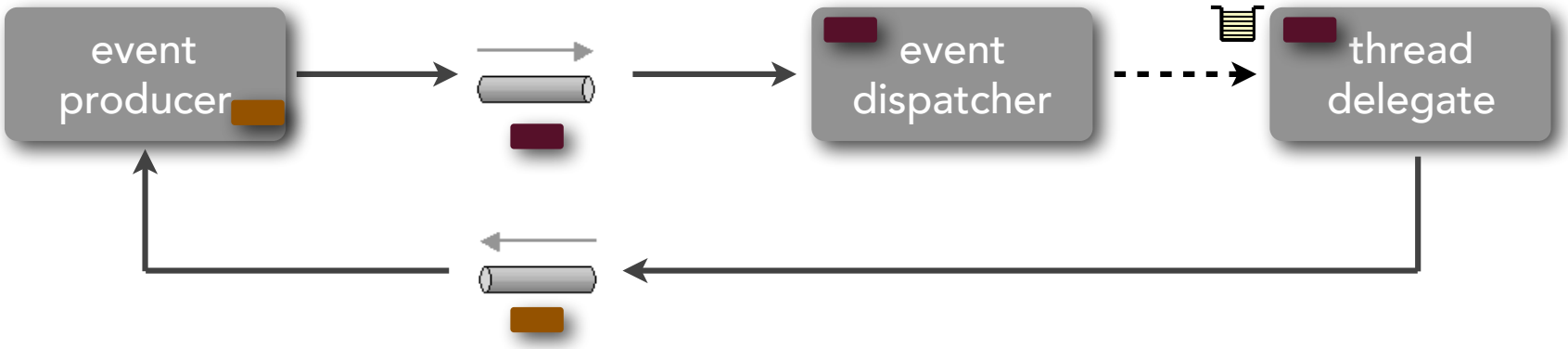
thread delegate pattern

how can you ensure timely and consistent response time as your system grows?

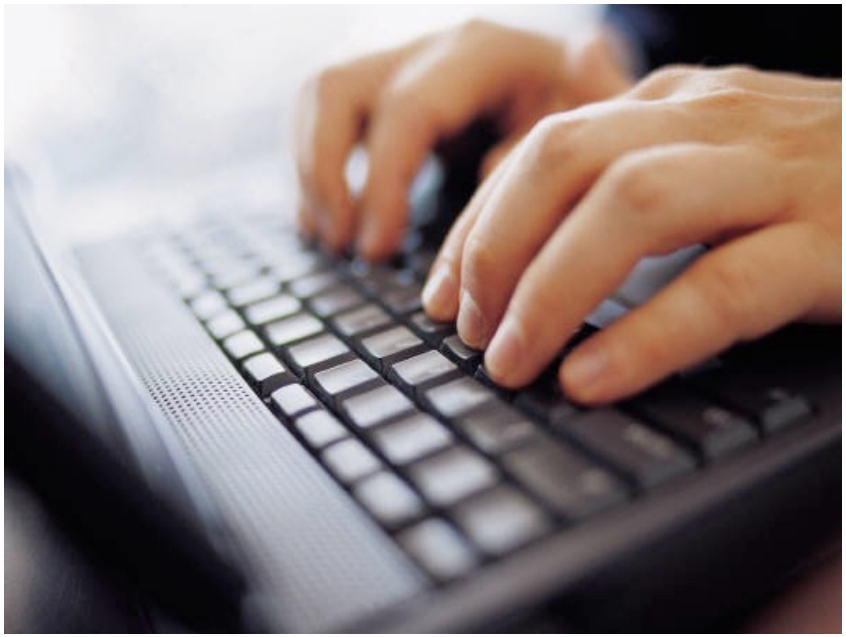


thread delegate pattern

how can you ensure timely and consistent response time as your system grows?



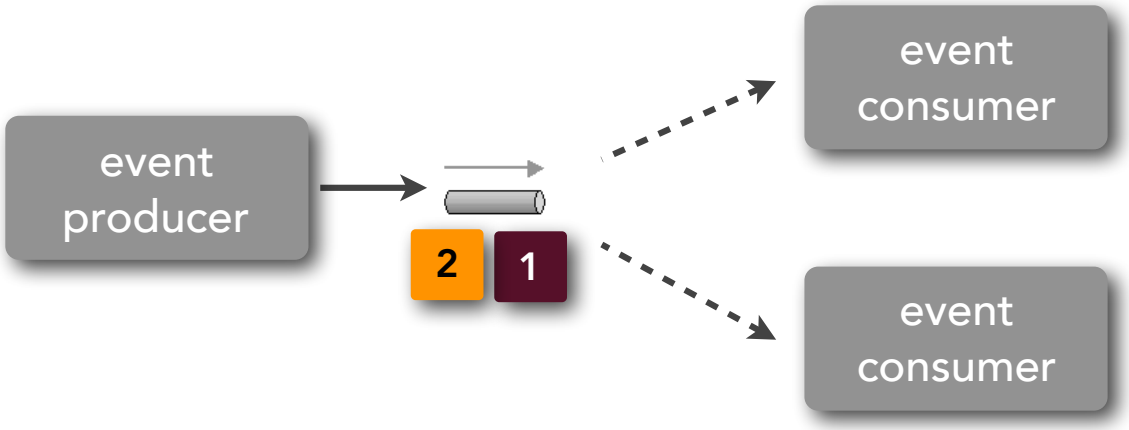
thread delegate pattern



let's see the issue…

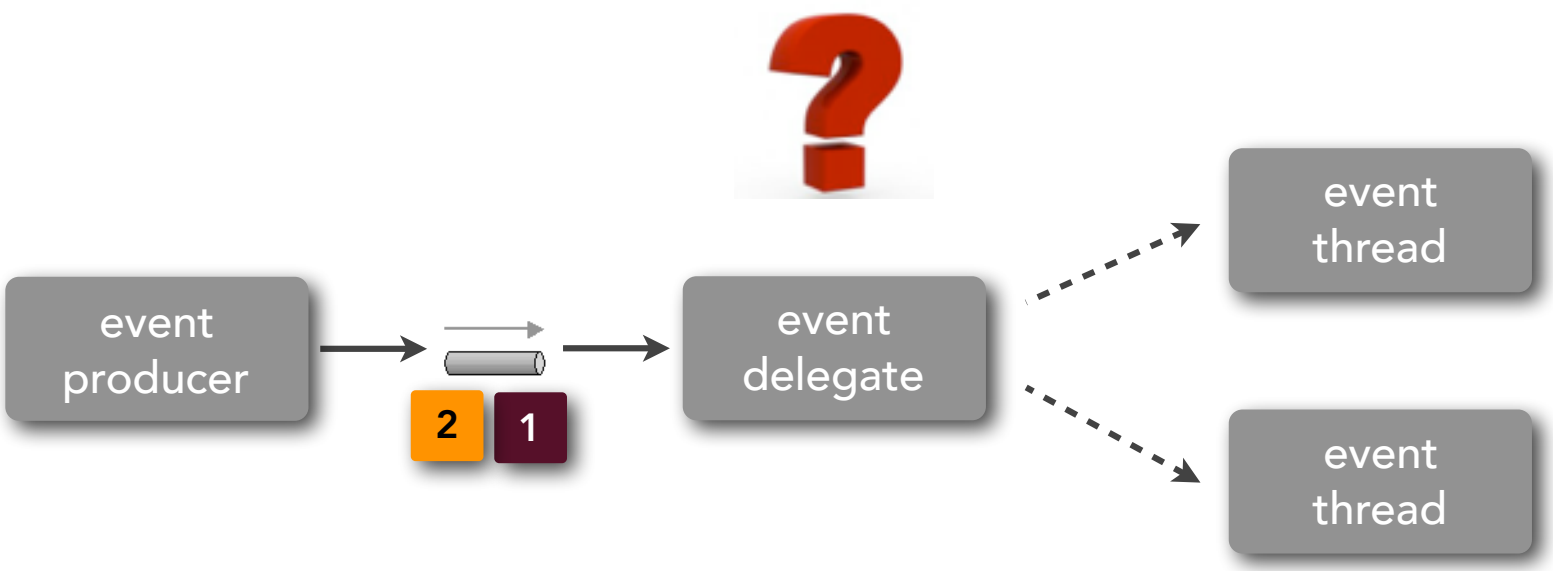
thread delegate pattern

preserving message order



thread delegate pattern

preserving message order



thread delegate pattern

preserving message order

premise: not every message must be ordered, but rather messages *within a context* must be ordered

```
1. PLACE  AAPL A-136 2,000,000.00
2. CANCEL AAPL A-136 2,000,000.00
3. REBOOK AAPL A-136 1,800,000.00
```

`1, 2, 3`

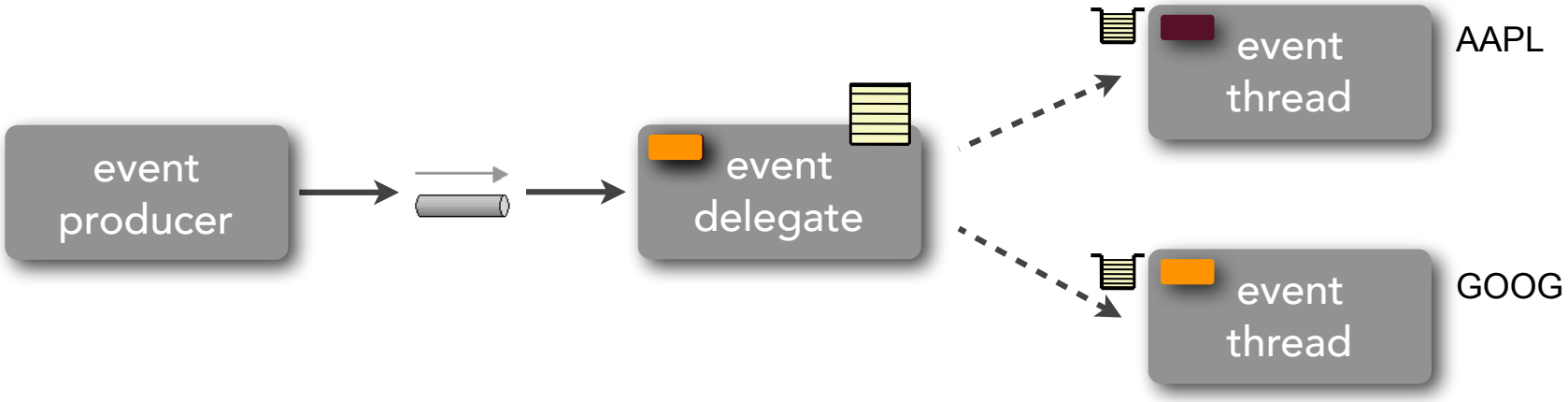
```
1. PLACE  AAPL A-136 2,000,000.00
2. PLACE  GOOG V-976   650,000.00
3. CANCEL GOOG V-976   650,000.00
4. CANCEL AAPL A-136 2,000,000.00
5. REBOOK AAPL A-136 1,800,000.00
6. REBOOK GOOG V-976   600,000.00
```

`1, 4, 5`

`2, 3, 6`

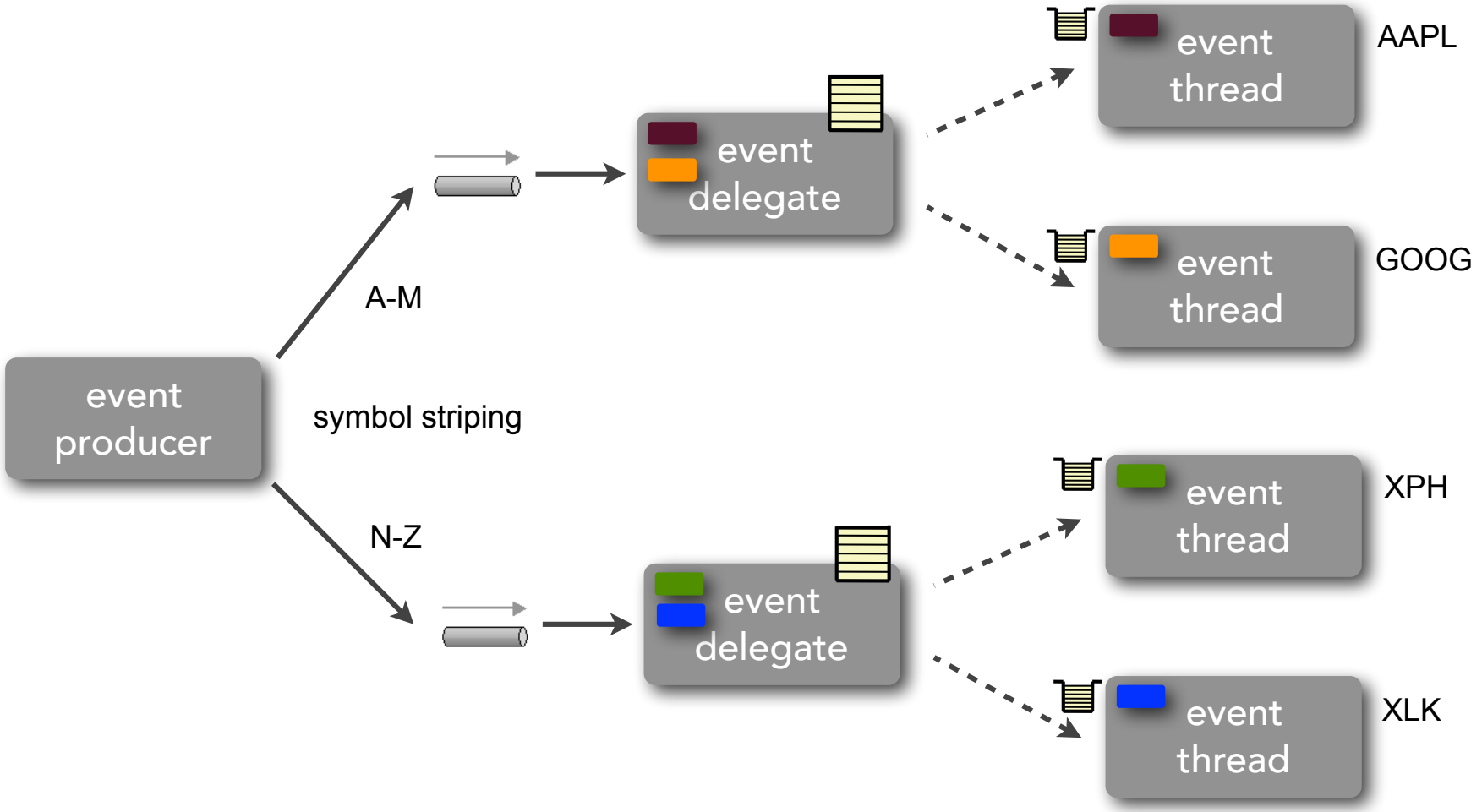
thread delegate pattern

preserving message order



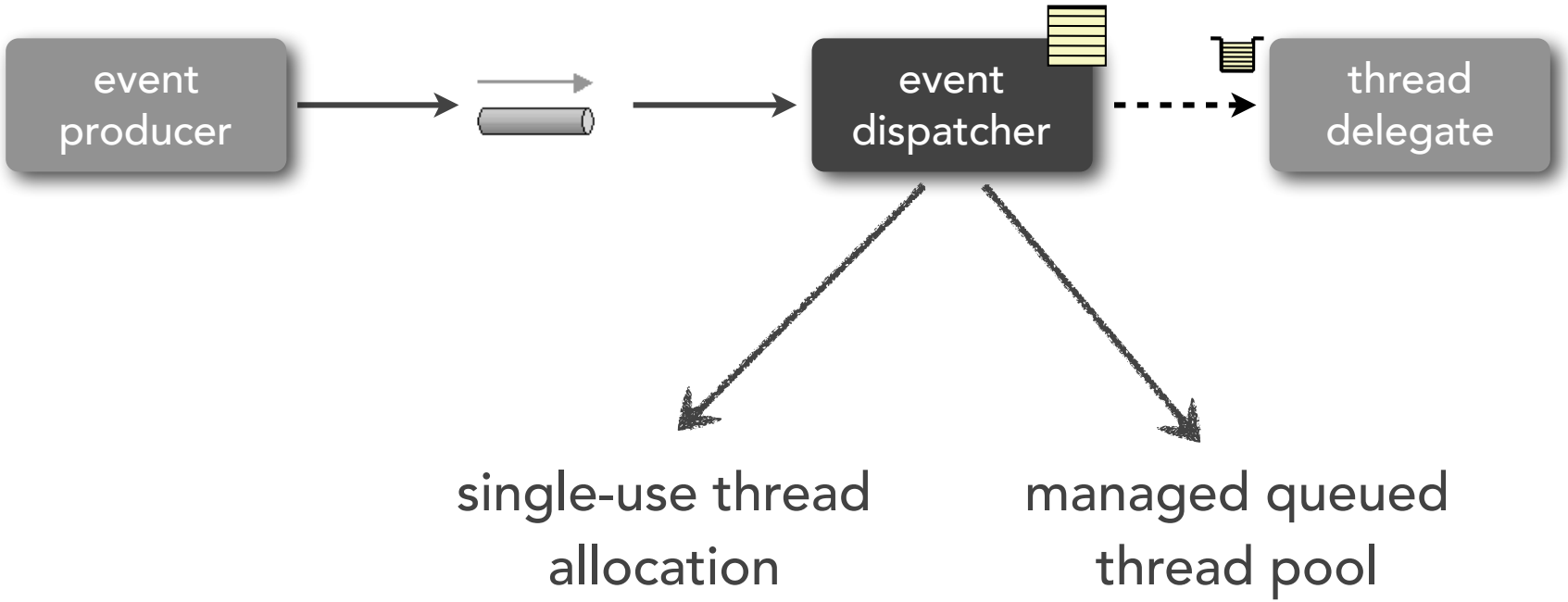
thread delegate pattern

preserving message order



thread delegate pattern

event dispatcher models

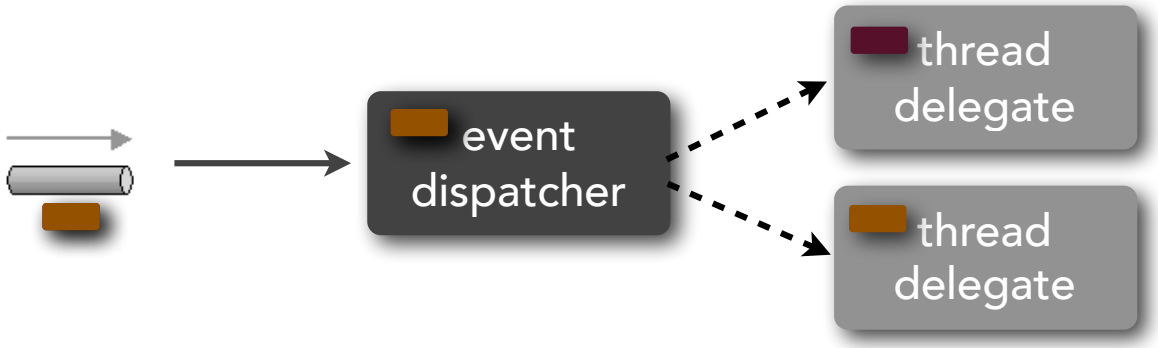


thread delegate pattern

single-use thread allocation

thread delegate pattern

single-use thread allocation



thread delegate pattern

single-use thread allocation

does not preserve message order

risk of running out of threads

risk of backing up primary delegate queue

thread delegate pattern

event dispatcher

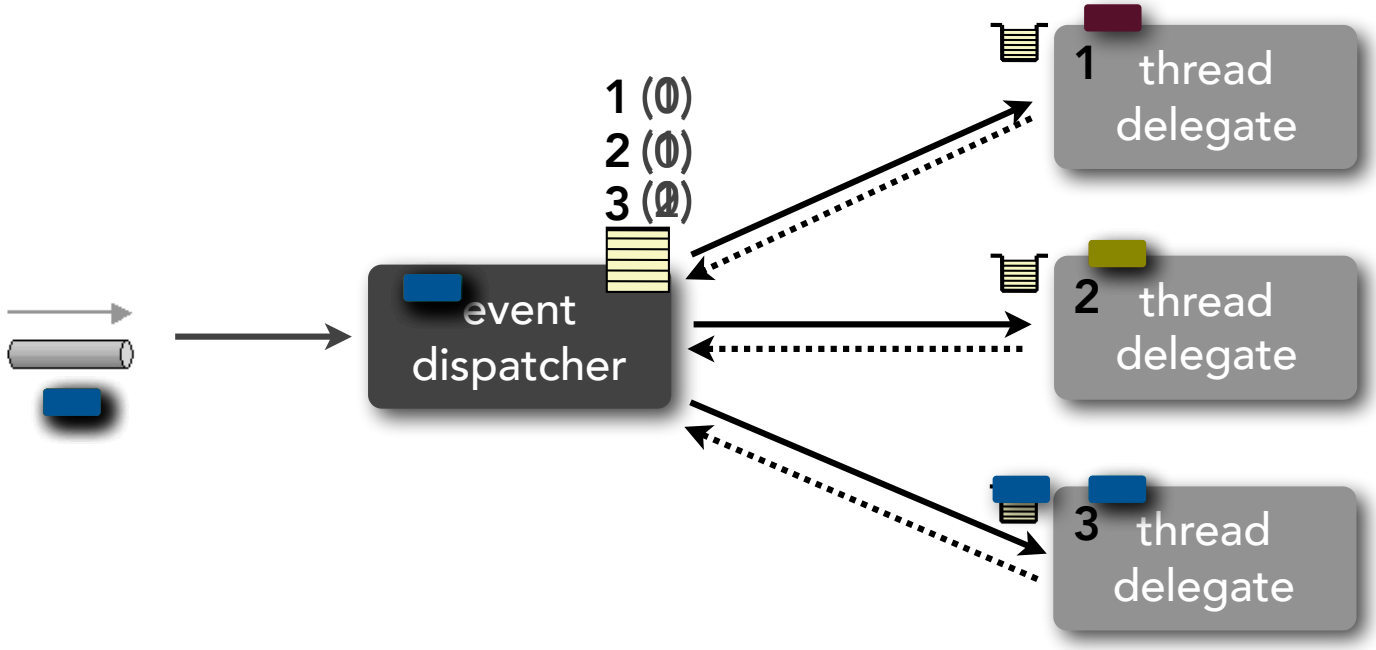
```
//connect to message broker and create consumer
while (true) {
   msg = getNextMessageFromQueue();
   new Thread(
      new ThreadProcessor(msg.getBody())).start();
}
```

thread delegate pattern

single-use thread allocation

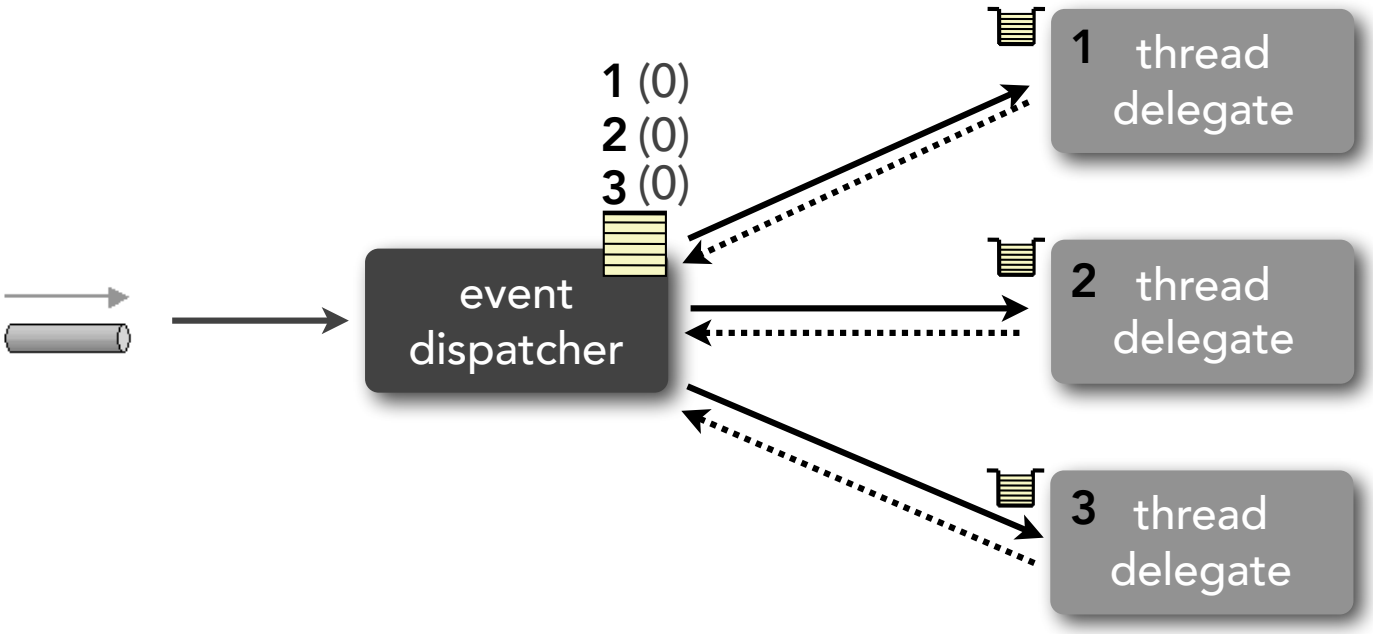
thread delegate pattern

managed queued thread pool



thread delegate pattern

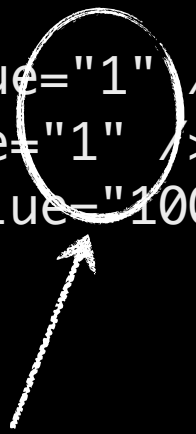
managed queued thread pool



thread delegate pattern

event dispatcher

```
<bean id="thread1"
   class="org.springframework.scheduling.concurrent.
   ThreadPoolTaskExecutor">
     <property name="corePoolSize" value="1" />
     <property name="maxPoolSize" value="1" />
     <property name="queueCapacity" value="100" />
</bean>
```



this makes it single-threaded
to preserve message order

thread delegate pattern

event dispatcher

```
//hold threads created by dispatcher
private List<TaskExecutor> threads =
   new ArrayList<TaskExecutor>();
private int index = 0;

//<symbol, thread instance>
private Map<String, Object> allocationMap =
  new HashMap<String, Object>();

//<thread instance, count>
private Map<Object, Long> threadCount =
  new HashMap<Object, Long>();
```

thread delegate pattern

event dispatcher

```
//STARTUP LOGIC

threads.add((TaskExecutor)ctx.getBean("thread1"));
threads.add((TaskExecutor)ctx.getBean("thread2"));
threads.add((TaskExecutor)ctx.getBean("thread3"));

//connect to message broker and create consumer
//wait for messages...
```

thread delegate pattern

event dispatcher

```
//DEQUEUE AND MESSAGE ASSIGNMENT LOGIC

msg = getNextMessageFromQueue();
String symbol = //get symbol from message properties
TaskExecutor thread = null;
if (allocationMap.containsKey(symbol)) {
   thread = (TaskExecutor)allocationMap.get(symbol);
} else {
   index = (index == threads.size()-1) ? 0 : index+1;
   thread = threads.get(index);
   allocationMap.put(symbol, thread);
}
incrementThreadCount(thread);
thread.execute(new TradeProcessorThread(this, msg));
```

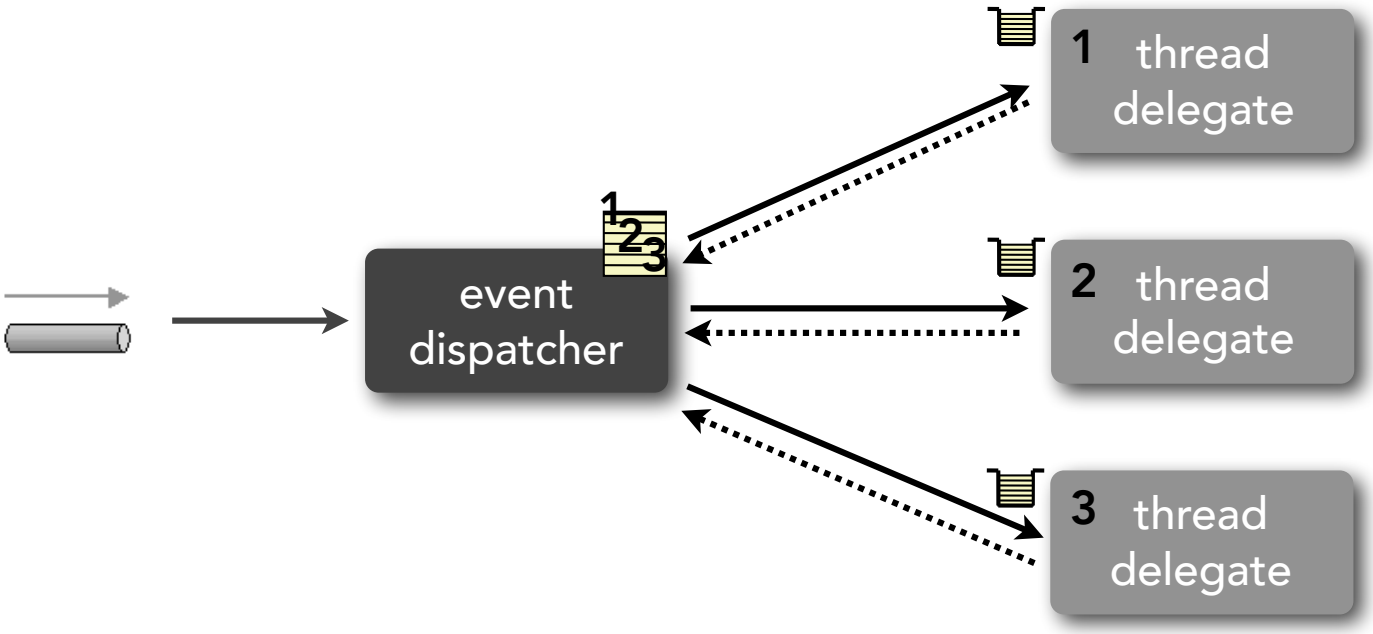
thread delegate pattern

event dispatcher

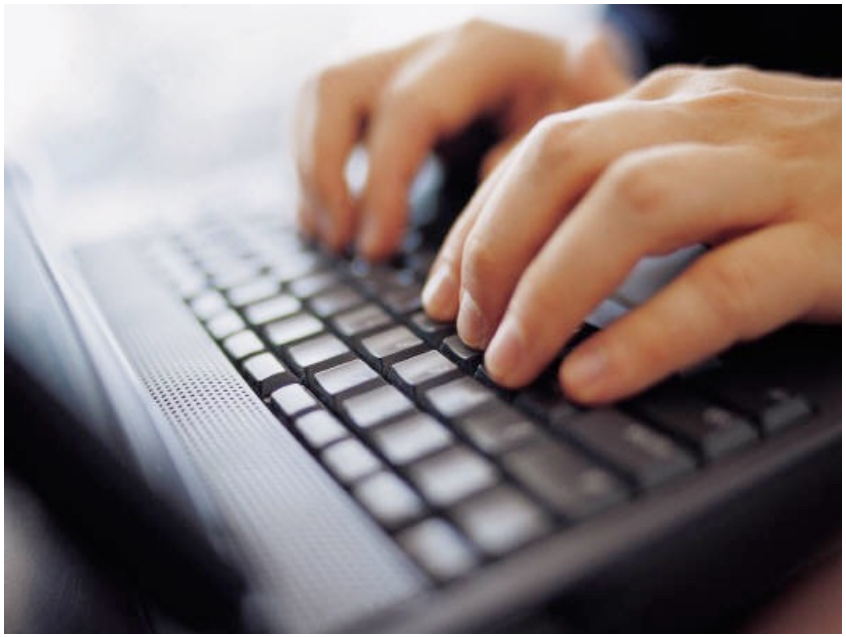
```
//THREAD CALLBACK AND ALLOCATION MAP CLEANUP LOGIC

public void requestComplete(Object thread, String symbol) {
    long count = decrementThreadCount(thread);
    if (count == 0) {
       allocationMap.remove(symbol);
    }
}
```

thread delegate pattern

managed queued thread pool



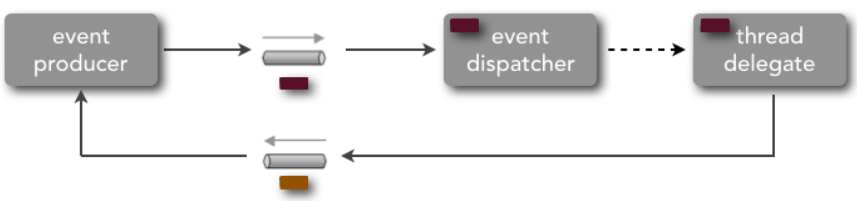
thread delegate pattern

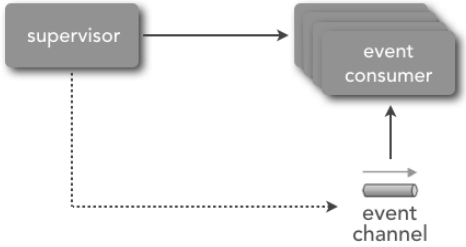


let’s see the result…

thread delegate pattern

thread delegate vs. consumer supervisor





scalability

consistent consumers

decoupled event processors

near-linear performance

elasticity

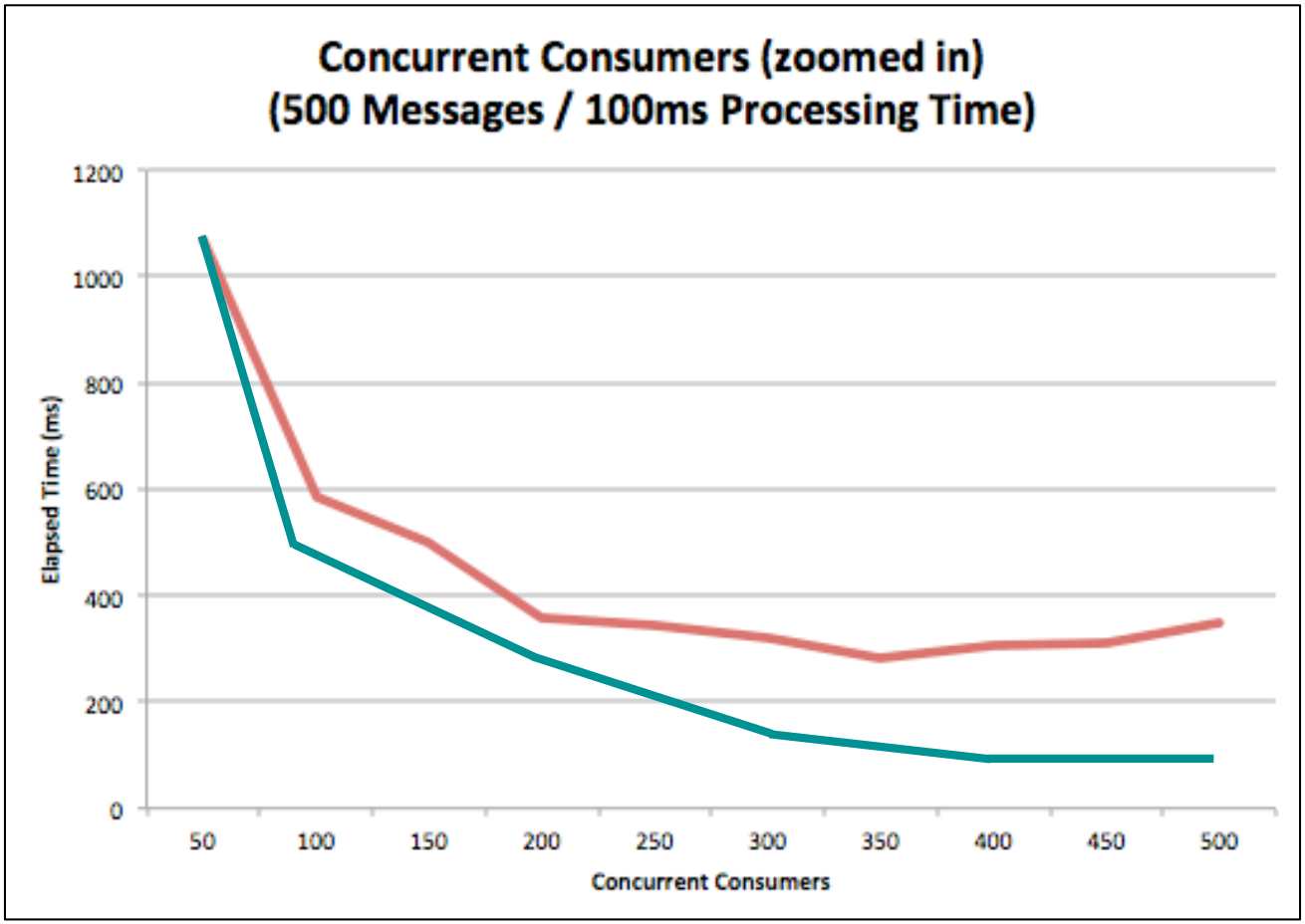
variable consumers

coupled event processors

diminishing performance

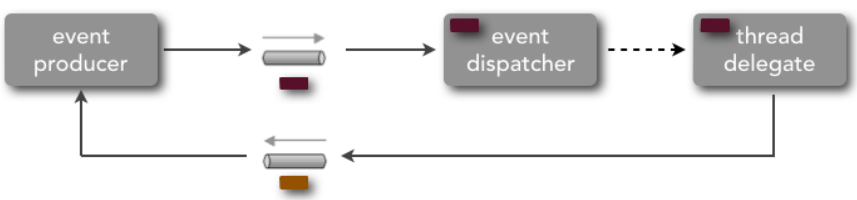
thread delegate pattern

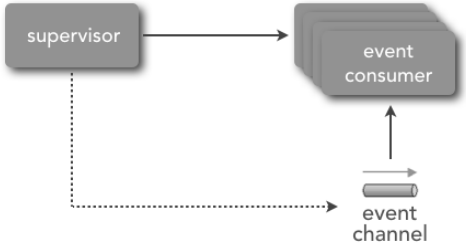
thread delegate vs. consumer supervisor



thread delegate pattern

thread delegate vs. consumer supervisor





scalability

consistent consumers

decoupled event processors

near-linear performance

can preserve message order

elasticity

variable consumers

coupled event processors

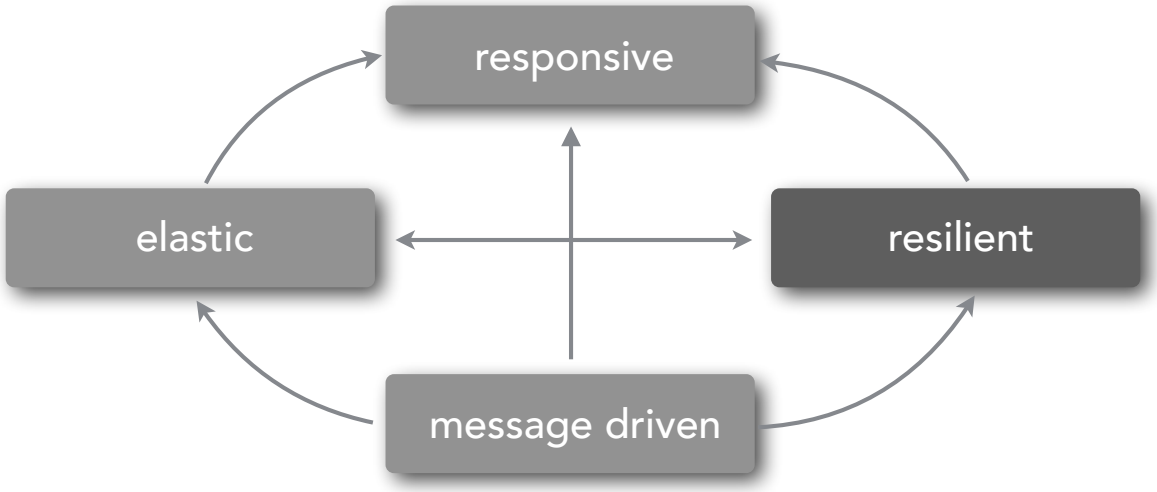
diminishing performance

message order not preserved

Producer Control Flow Pattern

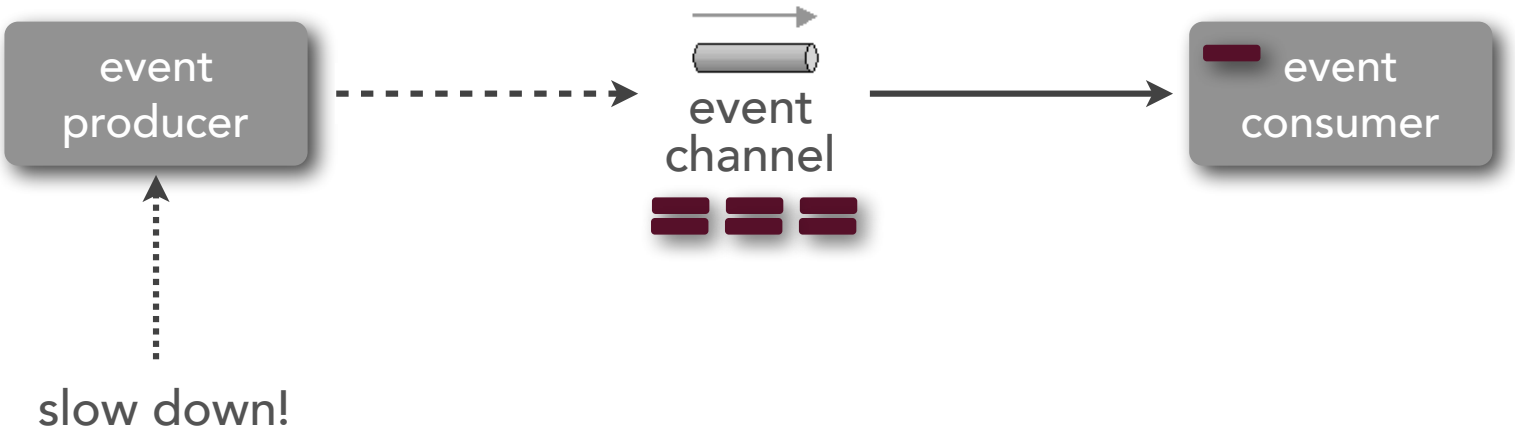
producer control flow pattern

how can you slow down message producers when the messaging system becomes overwhelmed?



producer control flow pattern

how can you slow down message producers when the messaging system becomes overwhelmed?

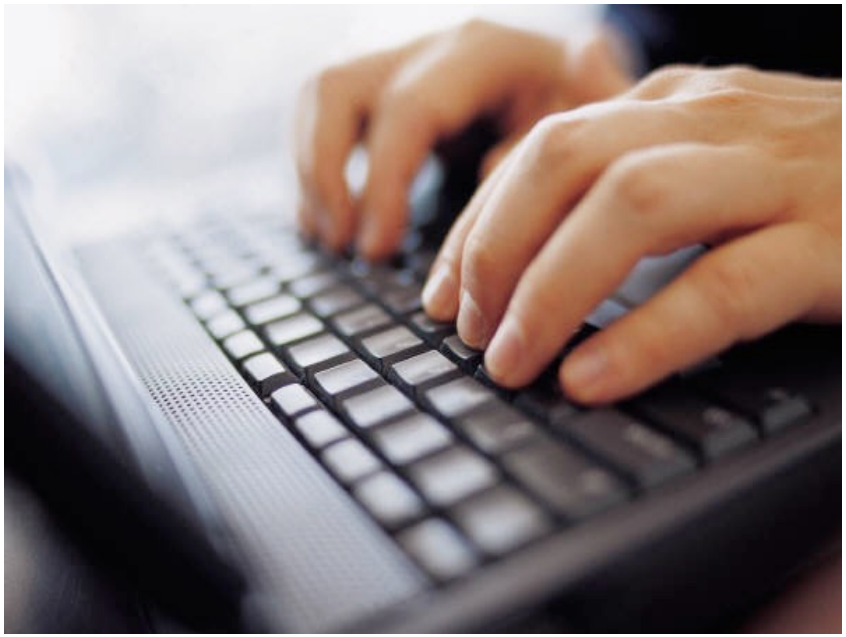


producer control flow pattern

how can you slow down message producers when the messaging system becomes overwhelmed?

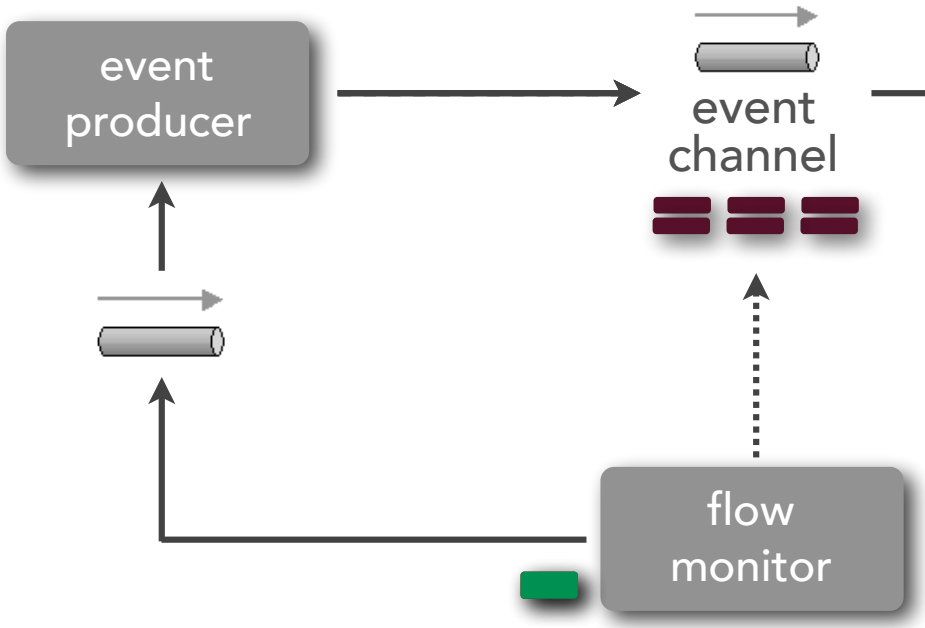
stop (broker) vs. slowdown (pattern)

producer control flow pattern



let’s see the issue….

producer control flow pattern



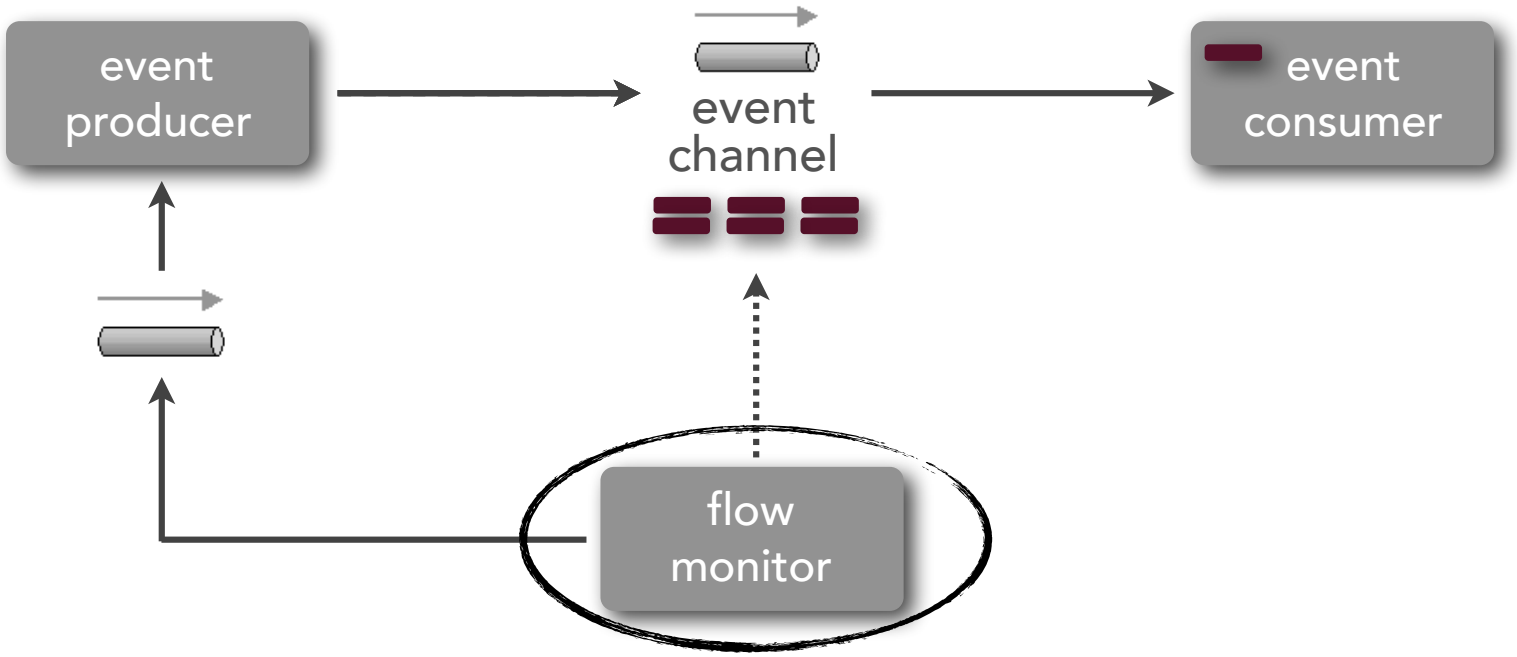
wait for upper threshold

tell producers to slow down

wait for lower threshold

tell producers to resume

producer control flow pattern



producer control flow pattern

flow monitor

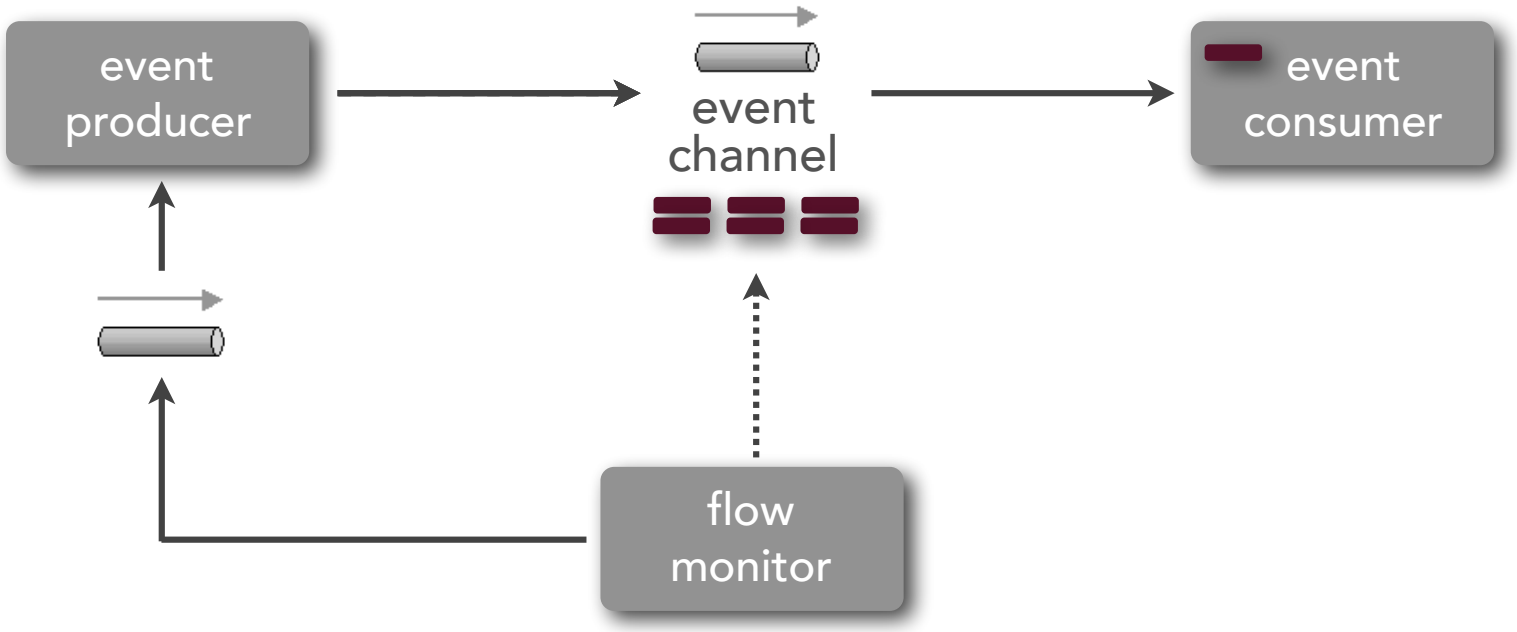
```
public void execute() throws Exception {
   //connect to message broker
   long threshold = 10;
   boolean controlFlow = false;
   while (true) {
      long queueDepth = getMessageCount("trade.eq.q");
      if (queueDepth > threshold && !controlFlow) {
         controlFlow = enableControlFlow(channel);
      } else if (queueDepth <= (threshold/2) && controlFlow) {
         controlFlow = disableControlFlow(channel);
      }
      Thread.sleep(3000);
   }
}
```

producer control flow pattern

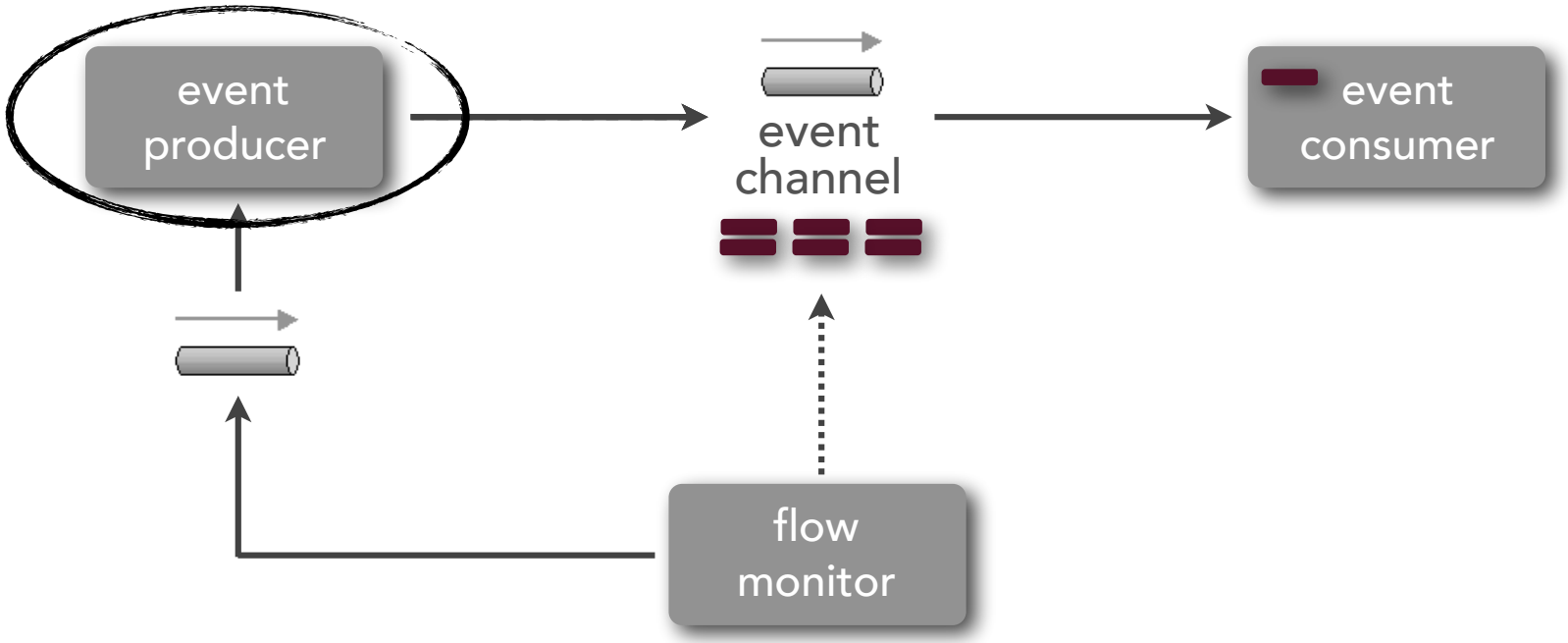
flow monitor

```
private boolean enableControlFlow(Channel channel) {
   Message msg = createMessage(delay, 3000);
   //send message to producer flow queue;
   return true;
}


private boolean disableControlFlow(Channel channel) {
   Message msg = createMessage(delay, 0);
   //send message to producer flow queue;
   return false;
}
```

producer control flow pattern



producer control flow pattern

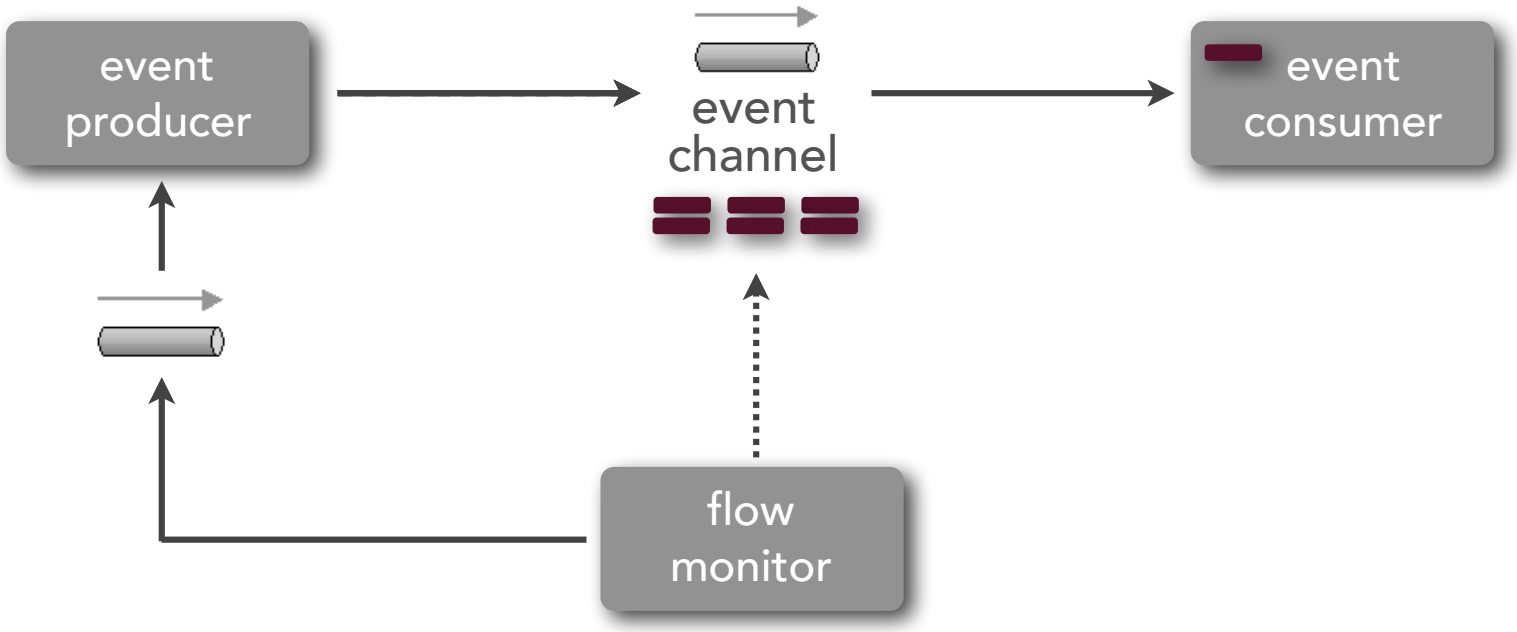


producer control flow pattern

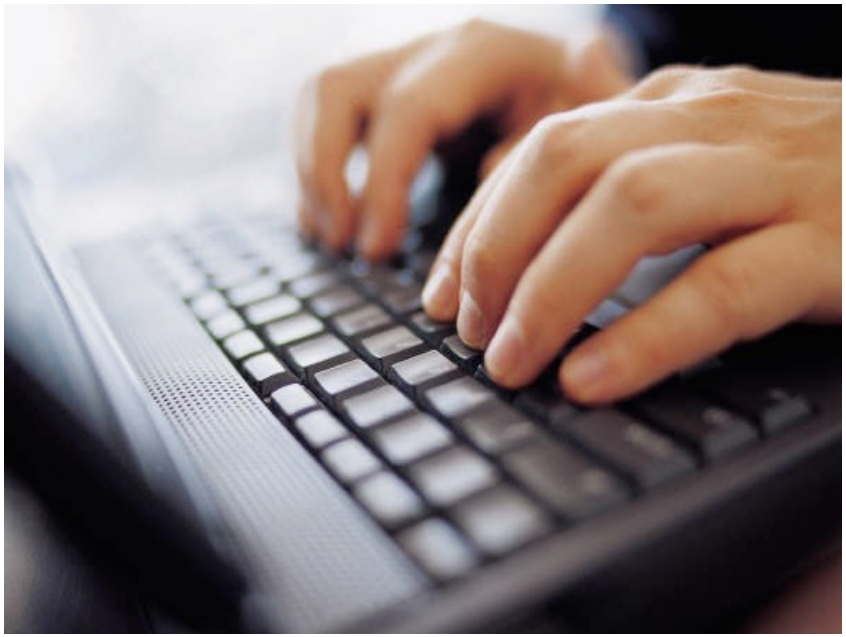
event producer

```
public void startListener() {
   new Thread(()-> {
      //connect to message broker and create consumer
      while (true) {
        msg = getNextMessageFromQueue();
        long delayValue = msg.getDelayValue();
        synchronized(delay) { delay = delayValue; }
      }
   }).start();
}

private void placeTrade() {
   Thread.sleep(delay);
   //send trade to processing queue...
}
```

producer control flow pattern



producer control flow pattern



let’s see the result…

Reactive Architecture Patterns 2

Mark Richards
Independent Consultant
Hands-on Software Architect / Published Author
Founder, DeveloperToArchitect.com
www.wmrichards.com

Author of *Software Architecture Fundamentals Video Series* (O'Reilly)
Author of Microservices Pitfalls and AntiPatterns (O'Reilly)
Author of Microservices vs. Service-Oriented Architecture (O'Reilly)
Author of *Enterprise Messaging Video Series* (O'Reilly)
Author of *Java Message Service 2nd Edition* (O'Reilly)


GREAT INDIAN
DEVELOPER™
SUMMIT 2019
Conference : April 23-26, Bangalore
12th EDITION
#gids19
Register early and get the best discounts!
www.developersummit.com
@greatindiandev
bit.ly/gidslinkedin
facebook.com/gids19
bit.ly/saltmarchyoutube
flickr.com/photos/saltmarch/