

# Reactor Pattern & Event-Driven Programming

A scalable concurrent approach,  
using `EventMachine` with `Thin` as an example

# Reactor Pattern & Event-Driven Programming

<http://godfat.org/slide/2010-02-29-reactor-pattern-and.pdf>

# Table of Contents

# Table of Contents

- concurrency, why and how in network

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin
- how Thin works

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin
- how Thin works
- how EventMachine works



# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin
- how Thin works
- how EventMachine works

# concurrency, why and how in network

# concurrency, why and how in network

- [network I/O] is slow, we shouldn't wait for [network I/O] while make [CPU] idle.

# concurrency, why and how in network

- [network I/O] is slow, we shouldn't wait for [network I/O] while make [CPU] idle.
- you can replace [network I/O] and [CPU] with all other resources like [disc I/O], [memory I/O], etc.

# concurrency, why and how in network

- [network I/O] is slow, we shouldn't wait for [network I/O] while make [CPU] idle.
- you can replace [network I/O] and [CPU] with all other resources like [disc I/O], [memory I/O], etc.
- each kernel process/thread for each client using a blocking I/O is easy to write but not scalable at all

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin
- how Thin works
- how EventMachine works

# Event-Driven Programming

to the rescue

# Event-Driven Programming

- only one process/thread



# Event-Driven Programming

- only one process/thread
- inversion of control

# Event-Driven Programming

- only one process/thread
- inversion of control
- consists of an event loop and various event handlers

# Event-Driven Programming

- inversion of control

# Event-Driven Programming

```
loop{  
  # you control the flow  
  do_something  
}
```

- inversion of control

# Event-Driven Programming

```
                                register method(:do_something)
loop{                            loop{
  # you control the flow        # event loop control the flow,
  do_something                  # later it calls your callback
}                                event = pop_event_queue
                                dispatch event if event
                                }
```

- inversion of control

# Event-Driven Programming

```
register method(:do_something)
loop{
  # event loop control the flow,
  # later it calls your callback
  event = pop_event_queue
  dispatch event if event
}
```

- consists of an event loop and various event handlers

# Event-Driven Programming

```
register method(:do_something)
```

```
loop{
```

```
# event loop control the flow,
```

```
# later it calls your callback
```

```
event = pop_event_queue
```

```
dispatch event if event
```

```
}
```

- consists of an event loop and various event handlers

# Event-Driven Programming

```
register method(:do_something)
```

```
loop{
```

```
# event loop control the flow,
```

```
# later it calls your callback
```

```
event = pop_event_queue
```

```
dispatch event if event
```

```
}
```

- consists of an event loop and various event handlers



# Event-Driven Programming in Flash with Ruby syntax

# Event-Driven Programming in Flash with Ruby syntax

- game loop, an example of event loop

# Event-Driven Programming in Flash with Ruby syntax

- game loop, an example of event loop
- Flash ActionScript, onEnterFrame

# Event-Driven Programming in Flash with Ruby syntax

- game loop, an example of event loop
- Flash ActionScript, onEnterFrame
- frame by frame

# Event-Driven Programming in Flash with Ruby syntax

```
# in each sprite thread
30.times{
  application.draw sprite
  sprite.x += 1
}
```

```
sprite.onEnterFrame = lambda{  
    sprite.x += 1  
}
```

---

```
# in each sprite thread  
30.times{  
    application.draw sprite  
    sprite.x += 1  
}
```

```
sprite.onEnterFrame = lambda{
  sprite.x += 1
}
application.register sprite
30.times{ # event loop, also called game loop
  events = application.pop_event_queue
  events.each{ |event|
    application.dispatch event
  }
  # model/view separation
  application.draw application.sprites
}
```

---

```
# in each sprite thread
30.times{
  application.draw sprite
  sprite.x += 1
}
```

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin
- how Thin works
- how EventMachine works



# Reactor Pattern

# Reactor Pattern

```
loop{  
    data = read  
    handle data  
}
```

# Reactor Pattern

```
loop{
    data = read
    handle data
}

register method(:handle)
loop{
    data = partial_read
    event = process data
    dispatch event if event
}
```

# Event-Driven Programming

```
loop{
    # you control the flow
    do_something
}

register method(:do_something)
loop{
    # event loop control the flow,
    # later it calls your callback
    event = pop_event_queue
    dispatch event if event
}
```

# Reactor Pattern

```
loop{
    data = read
    handle data
}

register method(:handle)
loop{
    data = partial_read
    event = process data
    dispatch event if event
}
```

# Reactor Pattern

by wikipedia

# Reactor Pattern

- resources # e.g. network I/O

by wikipedia

# Reactor Pattern

- resources # e.g. network I/O
- synchronous event demultiplexer  
# i.e. the blocking event loop

by wikipedia



# Reactor Pattern

- resources # e.g. network I/O
- synchronous event demultiplexer  
# i.e. the blocking event loop
- dispatcher  
# i.e. handler manager and event dispatcher

by wikipedia

# Reactor Pattern

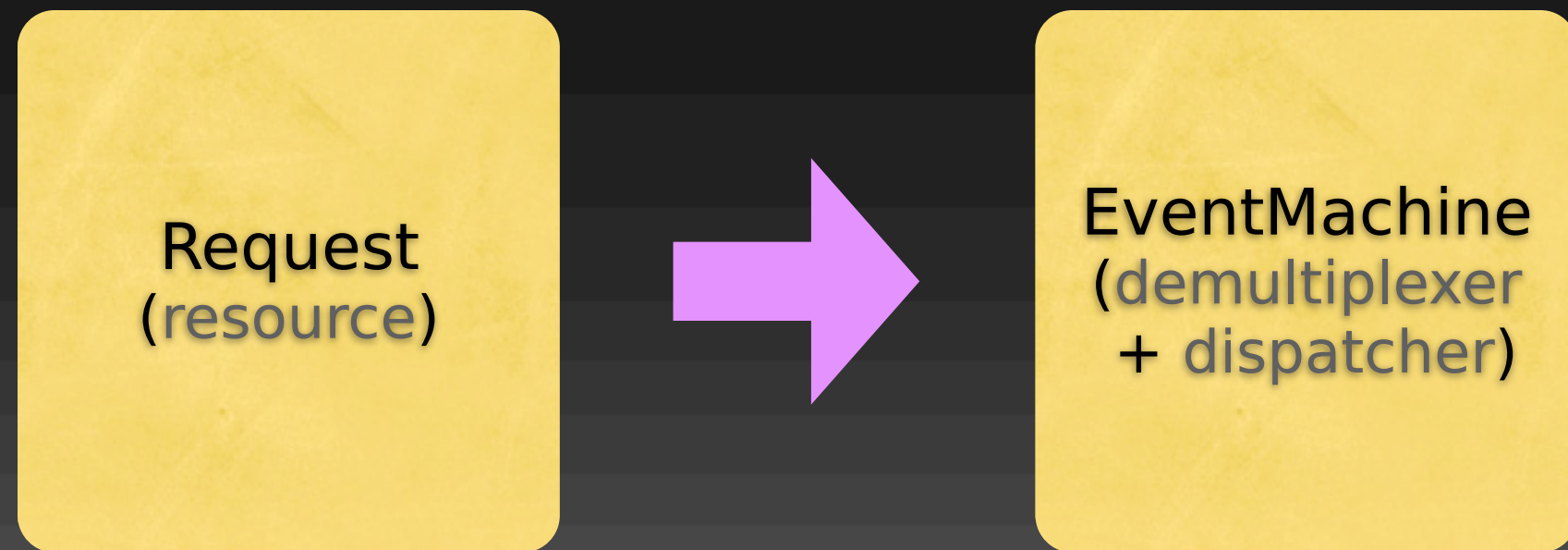
- resources # e.g. network I/O
- synchronous event demultiplexer  
# i.e. the blocking event loop
- dispatcher  
# i.e. handler manager and event dispatcher
- request handler # e.g. thin handler  
by wikipedia

# Reactor Pattern

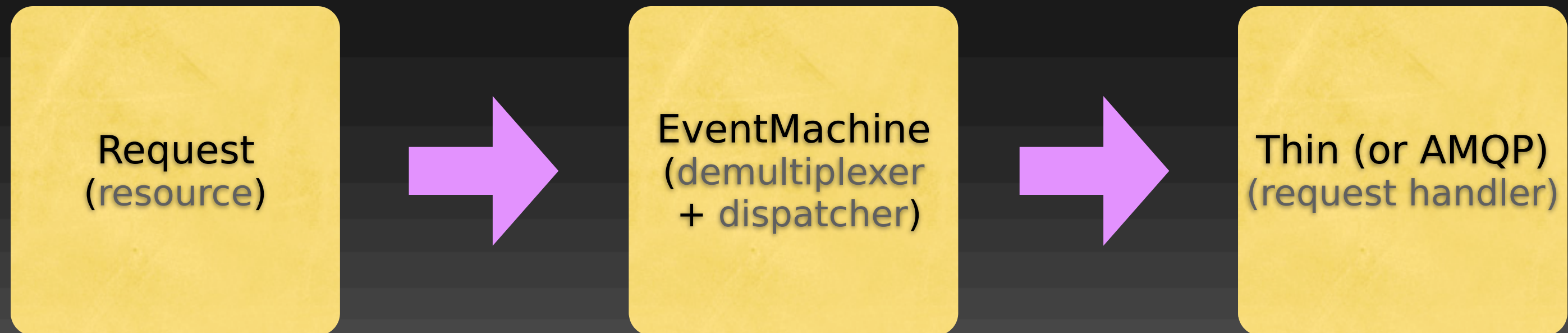


Request  
(resource)

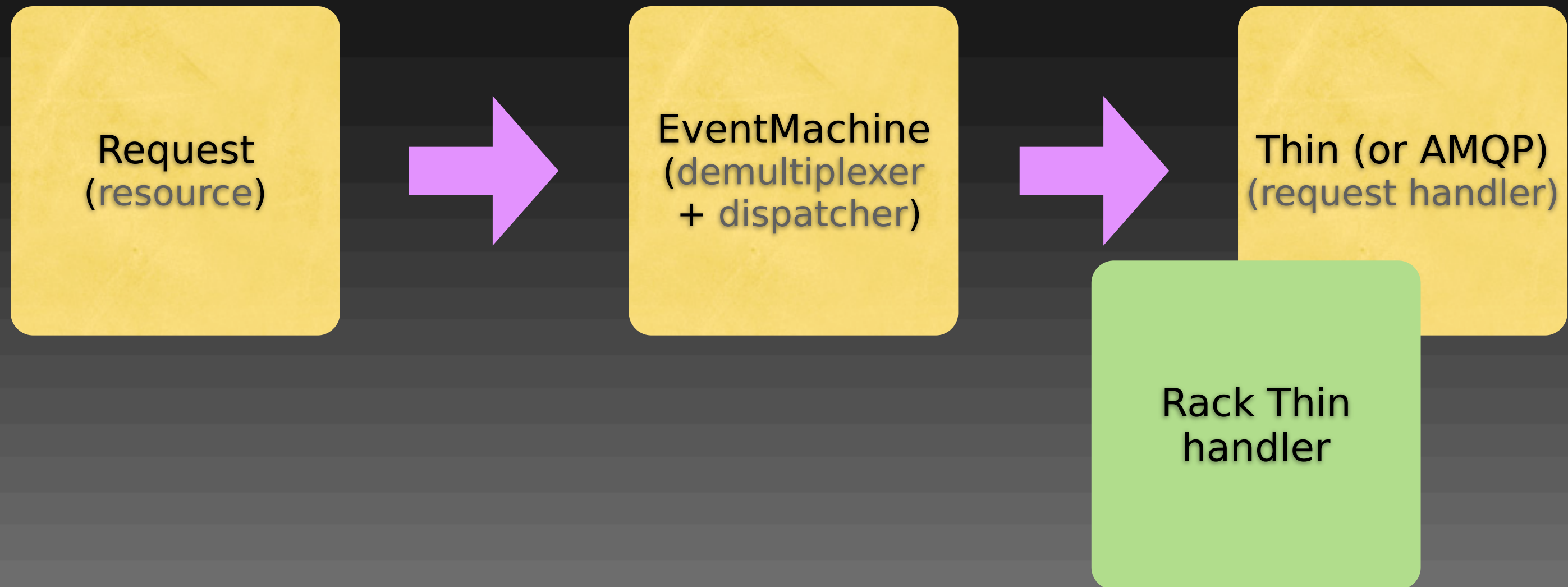
# Reactor Pattern



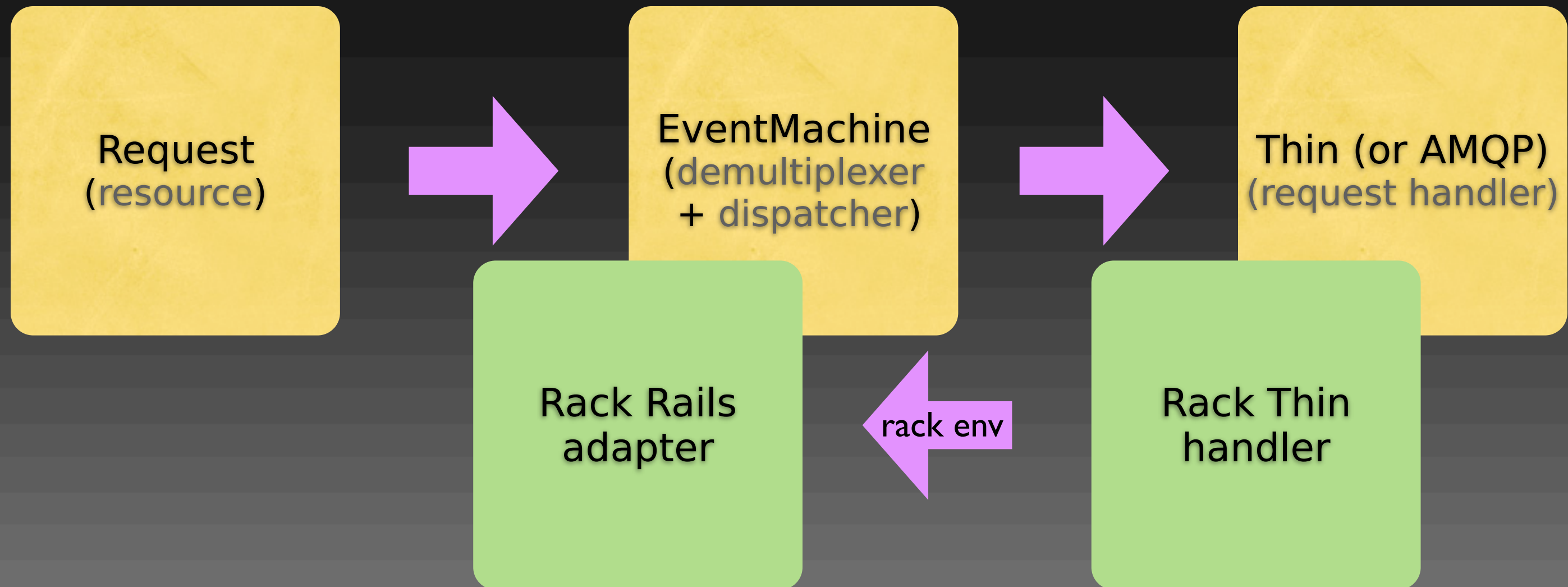
# Reactor Pattern



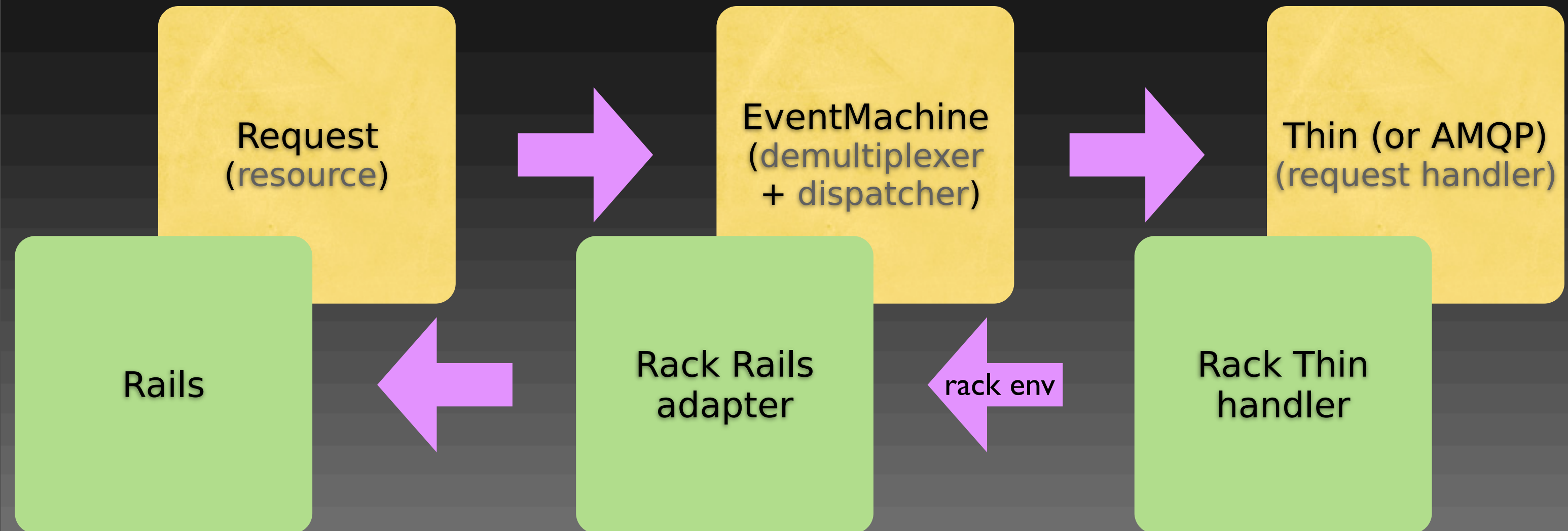
# Reactor Pattern



# Reactor Pattern



# Reactor Pattern





# Reactor Pattern

your rails  
application

Request  
(resource)

EventMachine  
(demultiplexer  
+ dispatcher)

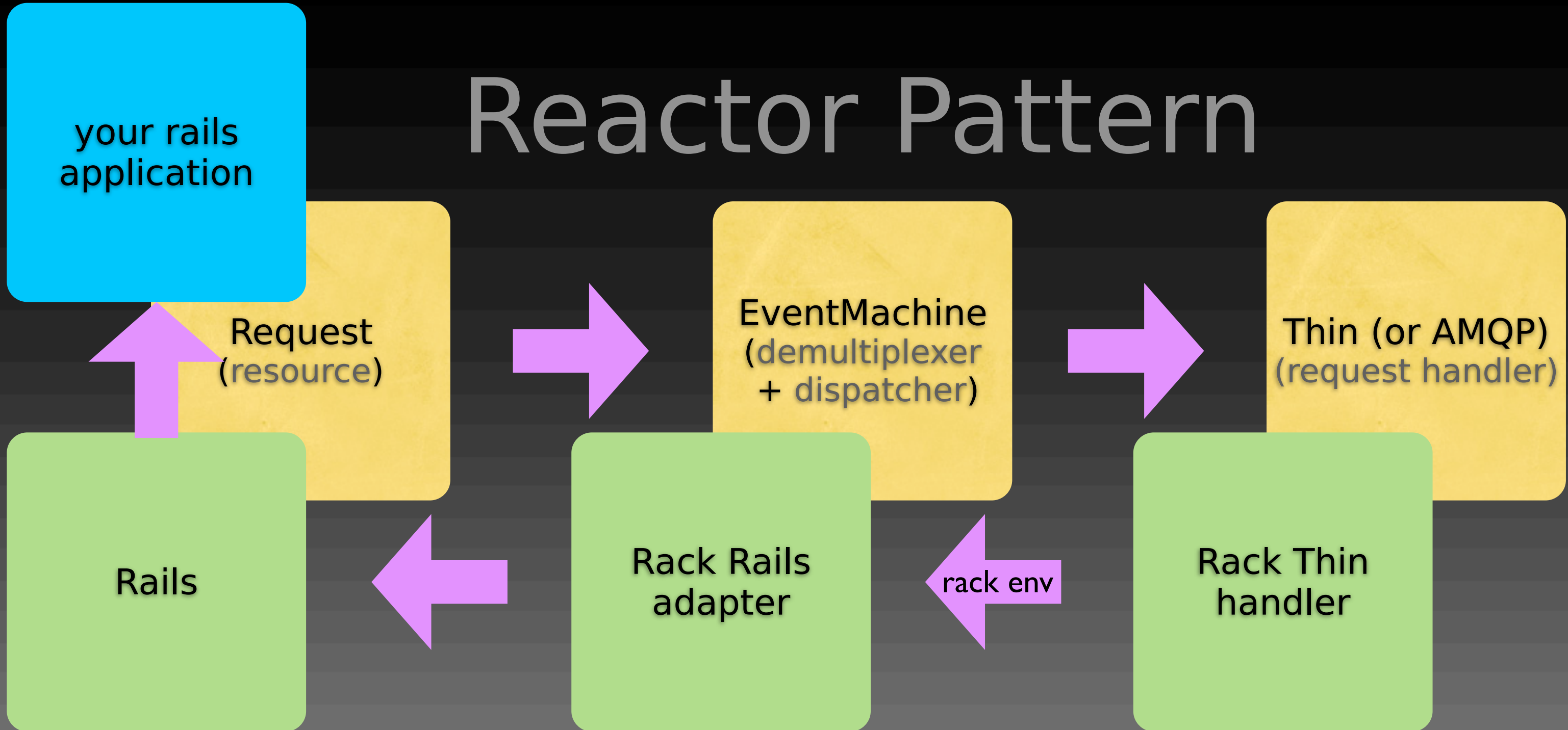
Thin (or AMQP)  
(request handler)

Rails

Rack Rails  
adapter

rack env

Rack Thin  
handler



# Reactor Pattern

EventMachine is a generic network I/O server/client library due to I/O and request handler separation in  
Reactor Pattern

# Reactor Pattern

- EventMachine (Ruby)

# Reactor Pattern

- EventMachine (Ruby)
- Twisted (Python)

# Reactor Pattern

- EventMachine (Ruby)
- Twisted (Python)
- nodejs (JavaScript in V8)

# Reactor Pattern

- EventMachine (Ruby)
- Twisted (Python)
- nodejs (JavaScript in V8)
- libevent and libev (C)

# Reactor Pattern

- select (POSIX)

# Reactor Pattern

- select (POSIX)
- poll (POSIX)



# Reactor Pattern

- select (POSIX)
- poll (POSIX)
- epoll (Linux)

# Reactor Pattern

- select (POSIX)
- poll (POSIX)
- epoll (Linux)
- kqueue (BSD, Mac OS X (Darwin))

# Table of Contents

- concurrency, why and how in network
- Event-Driven Programming explained in Flash with Ruby syntax
- Reactor Pattern in EventMachine with Thin
- how Thin works
- how EventMachine works

# how Thin works

- Thin::Server

# how Thin works

- `Thin::Server`
- `Thin::Backends::TcpServer`  
# communicate with EventMachine

# how Thin works

- `Thin::Server`
- `Thin::Backends::TcpServer`  
# communicate with EventMachine
- `Thin::Connection`  
# EventMachine event handler

# how Thin works

- `Thin::Server`
- `Thin::Backends::TcpServer`  
# communicate with EventMachine
- `Thin::Connection`  
# EventMachine event handler
- `Thin::Request`  
# partial HTTP request parsing  
# Rack env builder

how Thin works

Sorry! To be continued.....



how Thin works

Sorry! To be continued.....

