Reactor Pattern & Event-Driven Programming

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

Lin Jen-Shin, http://godfat.org/

Reactor Pattern & Event-Driven Programming

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

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- concurrency, why and how in network
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concurrency, why and how in network

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concurrency, why and how in network

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- 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

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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

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Event-Driven Programming

```
loop{
  # you control the flow
  do_something
}
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- inversion of control

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

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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
}
```

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Reactor Pattern

Reactor Pattern

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

Reactor Pattern

```
loop{
  data = read
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```

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

Event-Driven Programming

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loop{
  # you control the flow
  do_something
}
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Reactor Pattern

by wikipedia

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Reactor Pattern

- resources # e.g. network I/O
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  # i.e. handler manager and event dispatcher

by wikipedia

Reactor Pattern

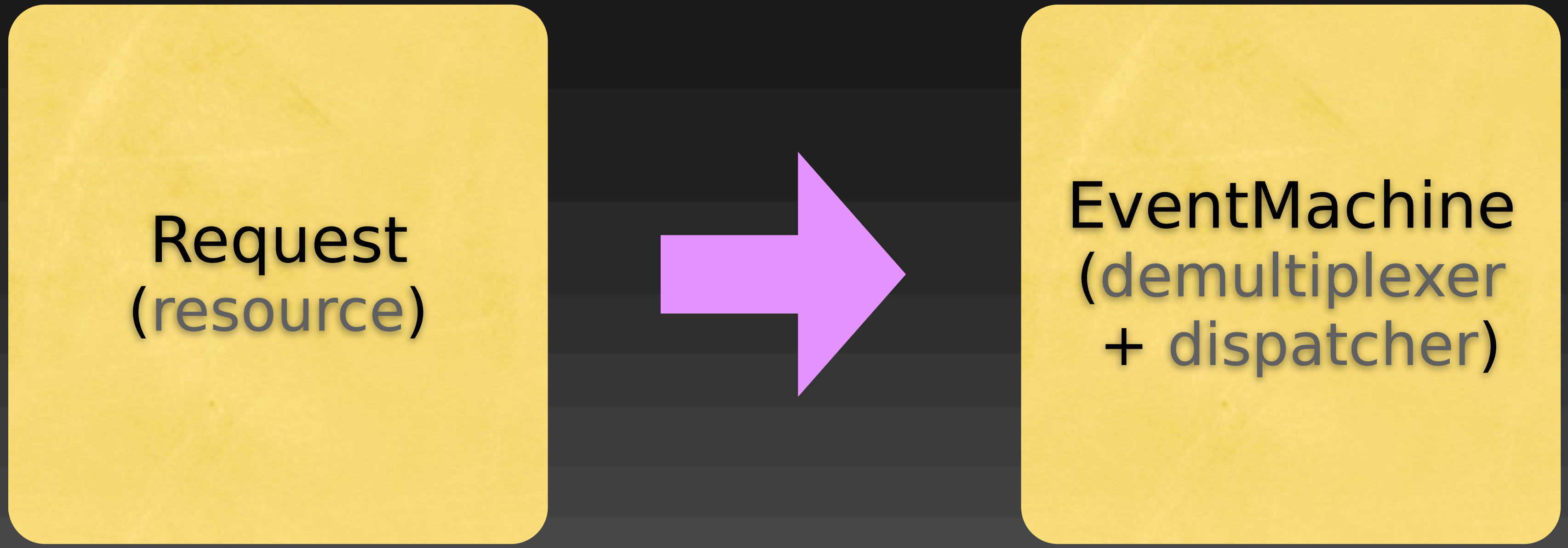
- resources # e.g. network I/O
- synchronous event demultiplexer
  # i.e. the blocking event loop
- dispatcher
  # i.e. handler manager and event dispatcher
- request handler # e.g. thin handler

by wikipedia

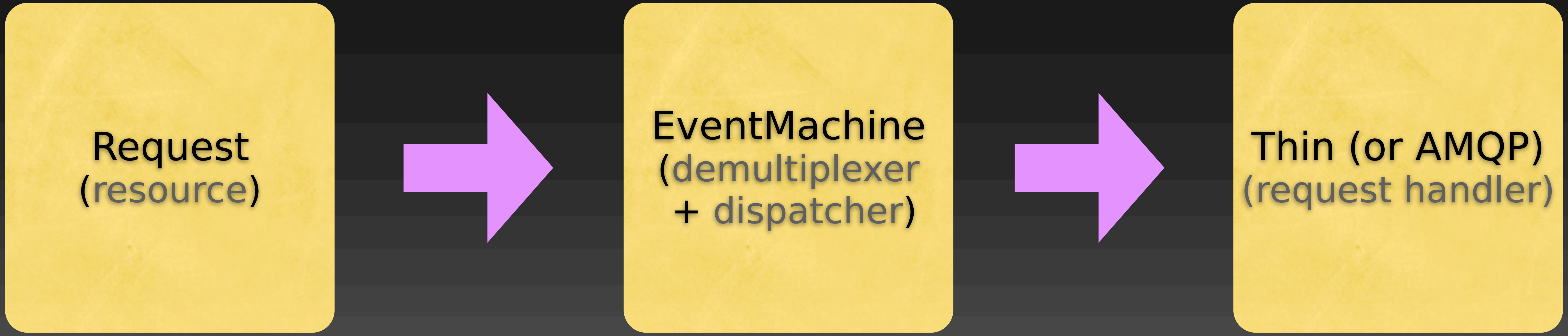
Reactor Pattern

Request
(resource)

Reactor Pattern



Reactor Pattern



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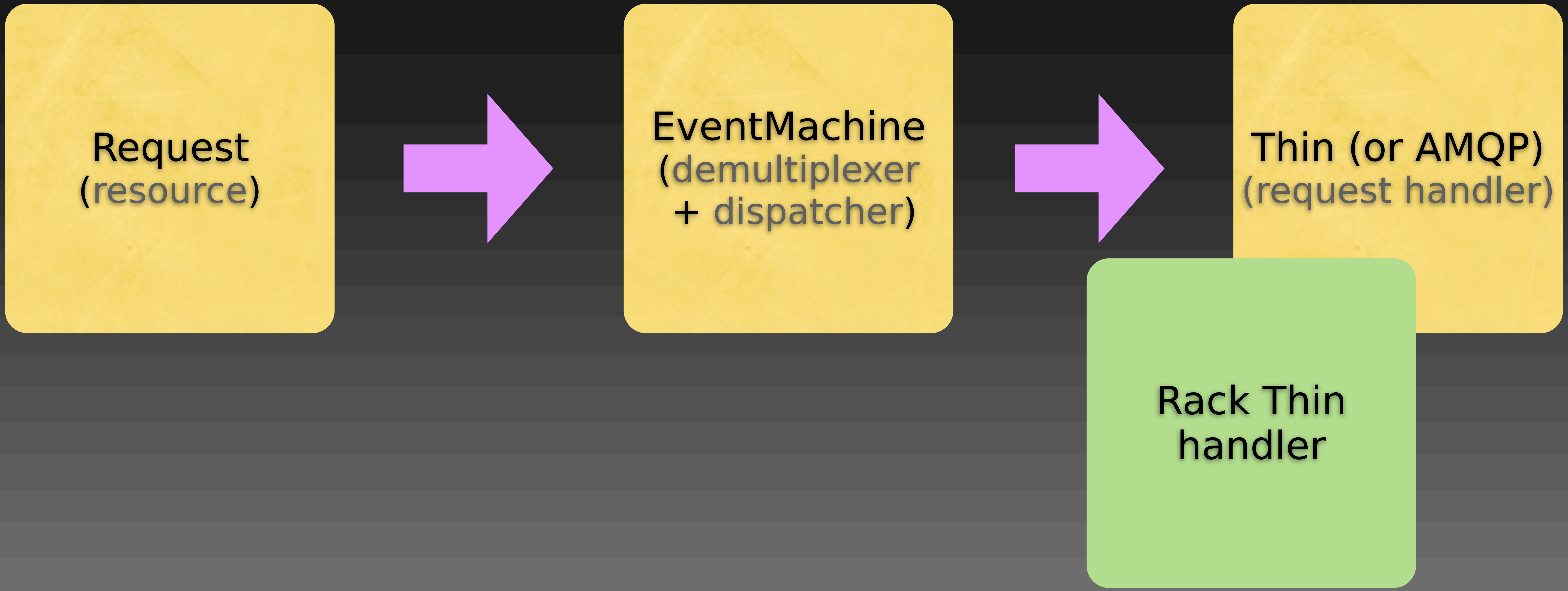

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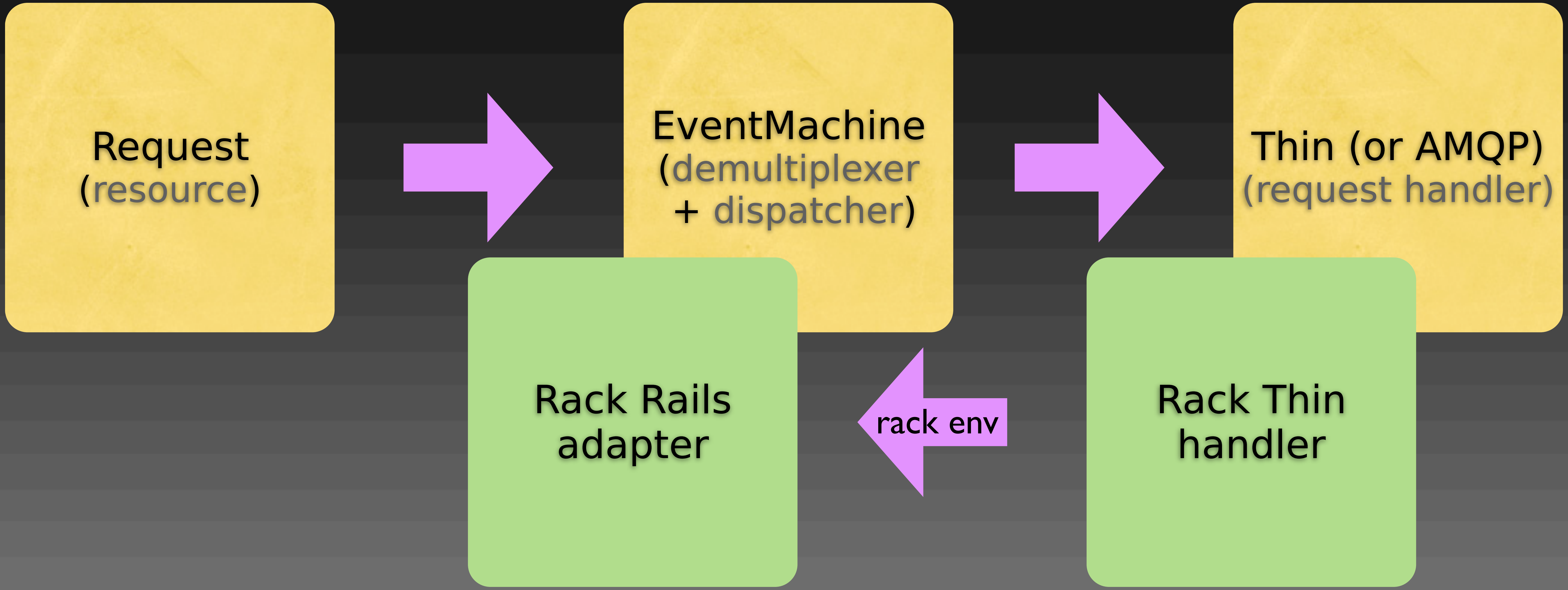

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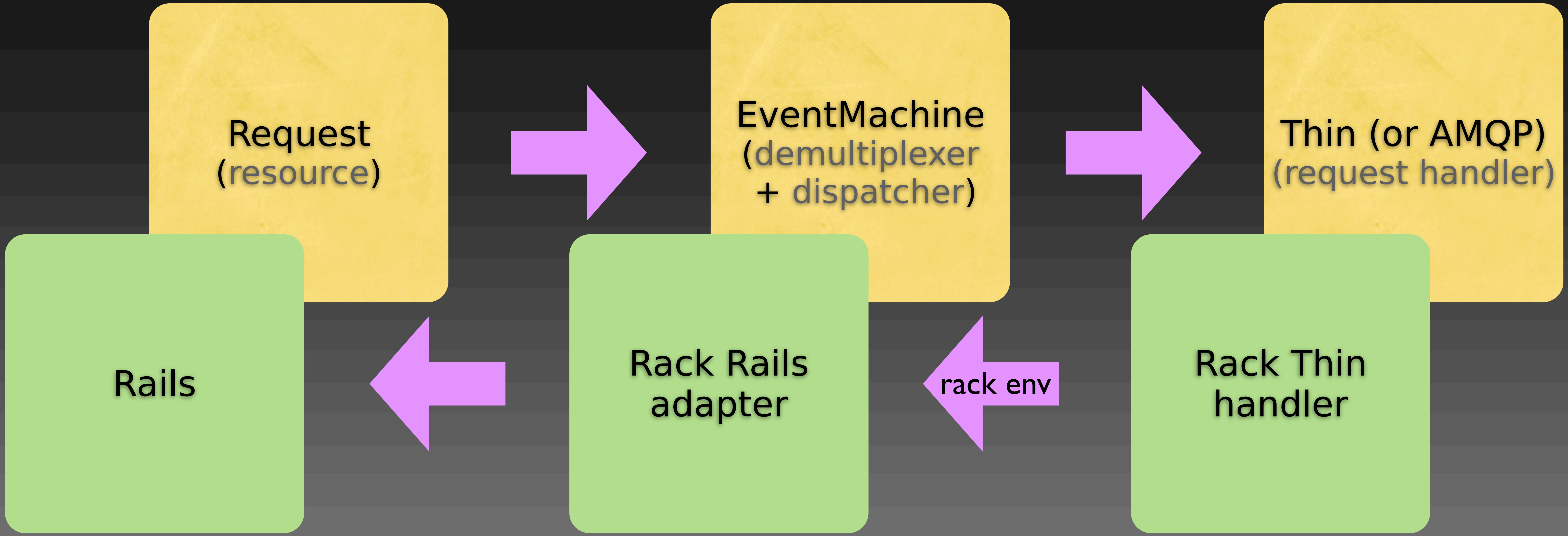

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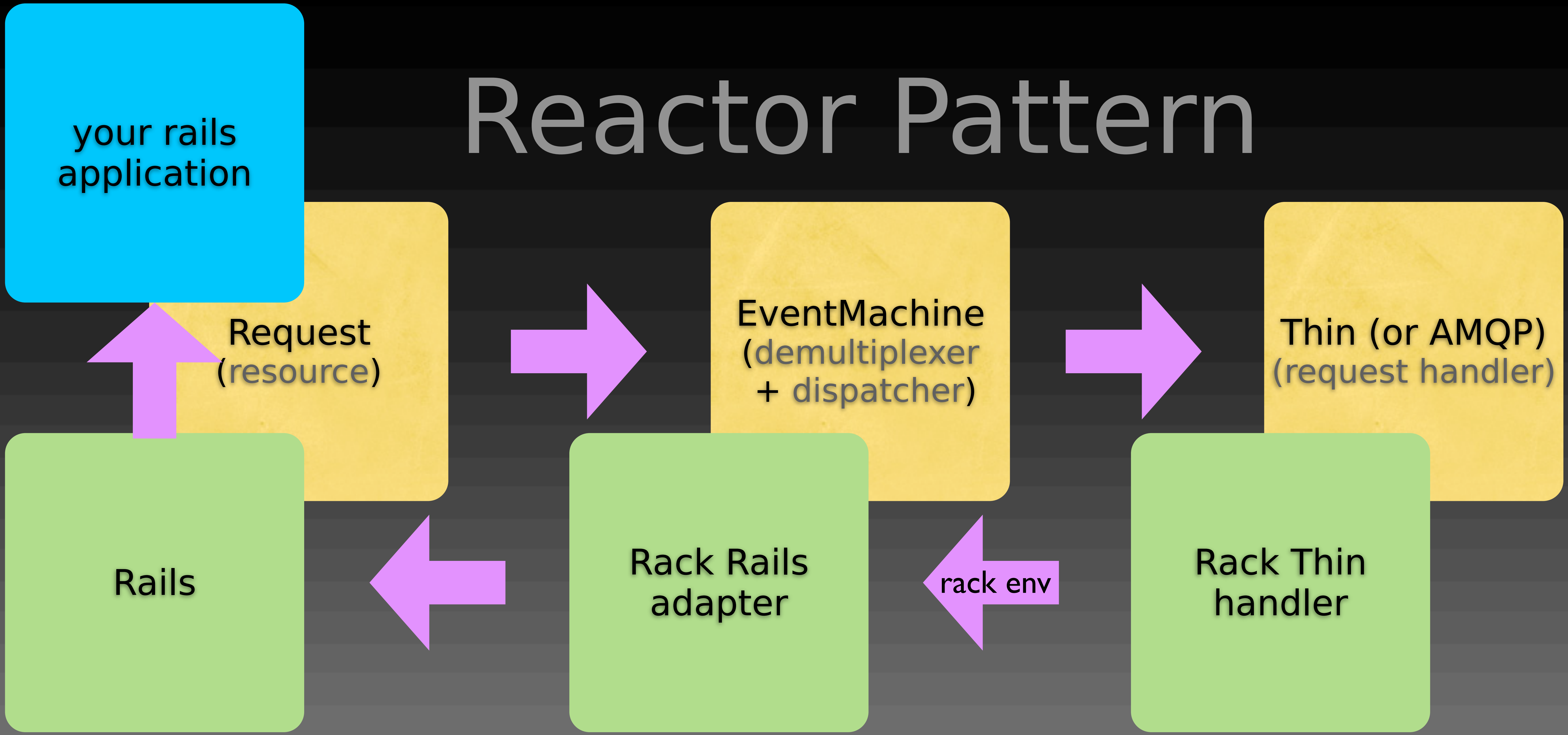

Reactor Pattern

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)
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- nodejs (JavaScript in V8)

Reactor Pattern

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

Reactor Pattern

- select (POSIX)

Reactor Pattern

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- poll (POSIX)

Reactor Pattern

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Reactor Pattern

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

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how Thin works

- `Thin::Server`

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

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- `Thin::Backends::TcpServer`
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- `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……

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