Developing applications with a microservice architecture

Chris Richardson

Author of POJOs in Action

Founder of the original CloudFoundry.com

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http://plainoldobjects.com

Presentation goal

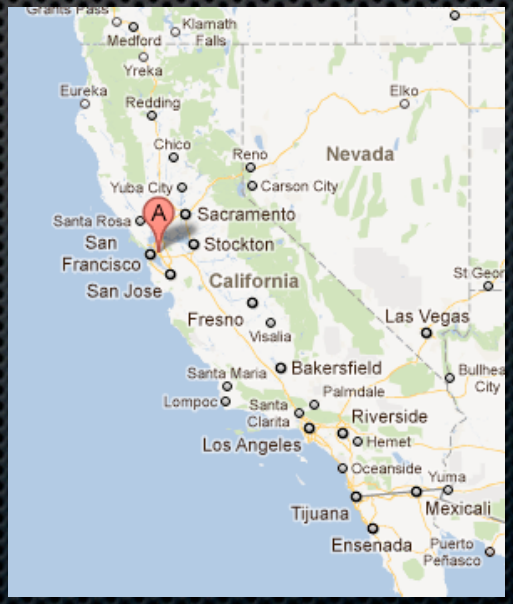
How decomposing applications into microservices

improves deployability and scalability

and

simplifies the adoption of new technologies

About Chris



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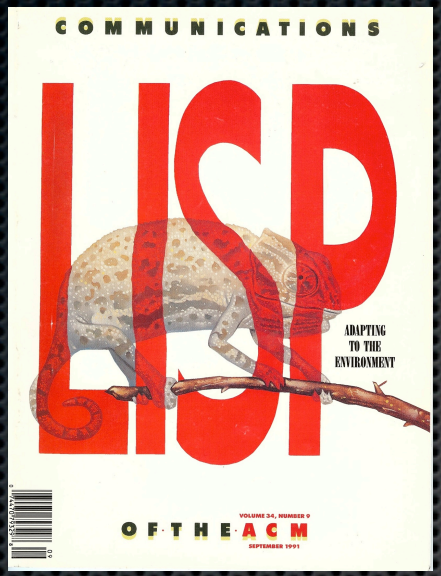
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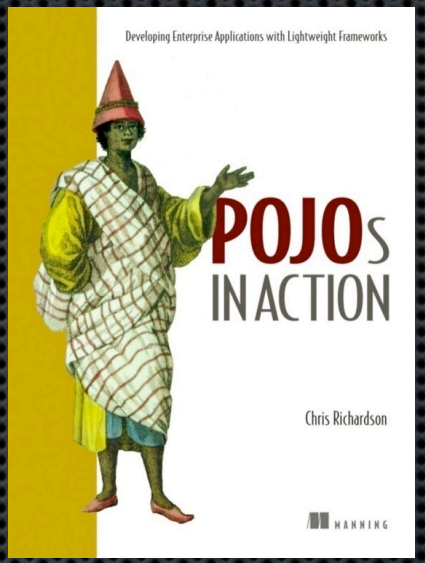
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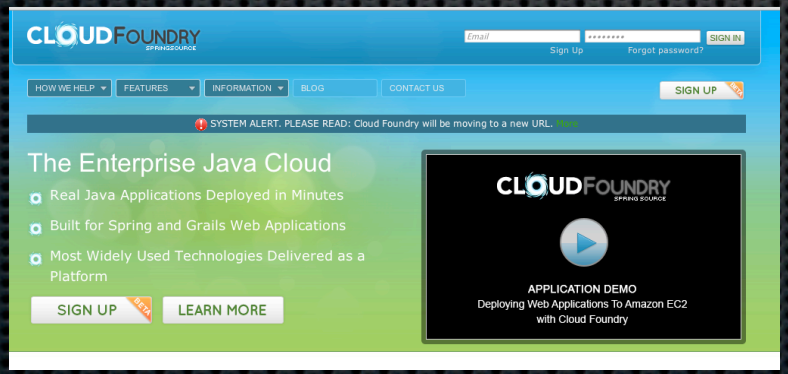
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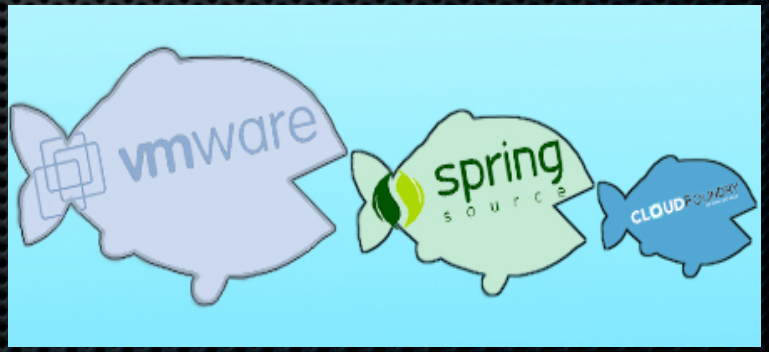
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About Chris

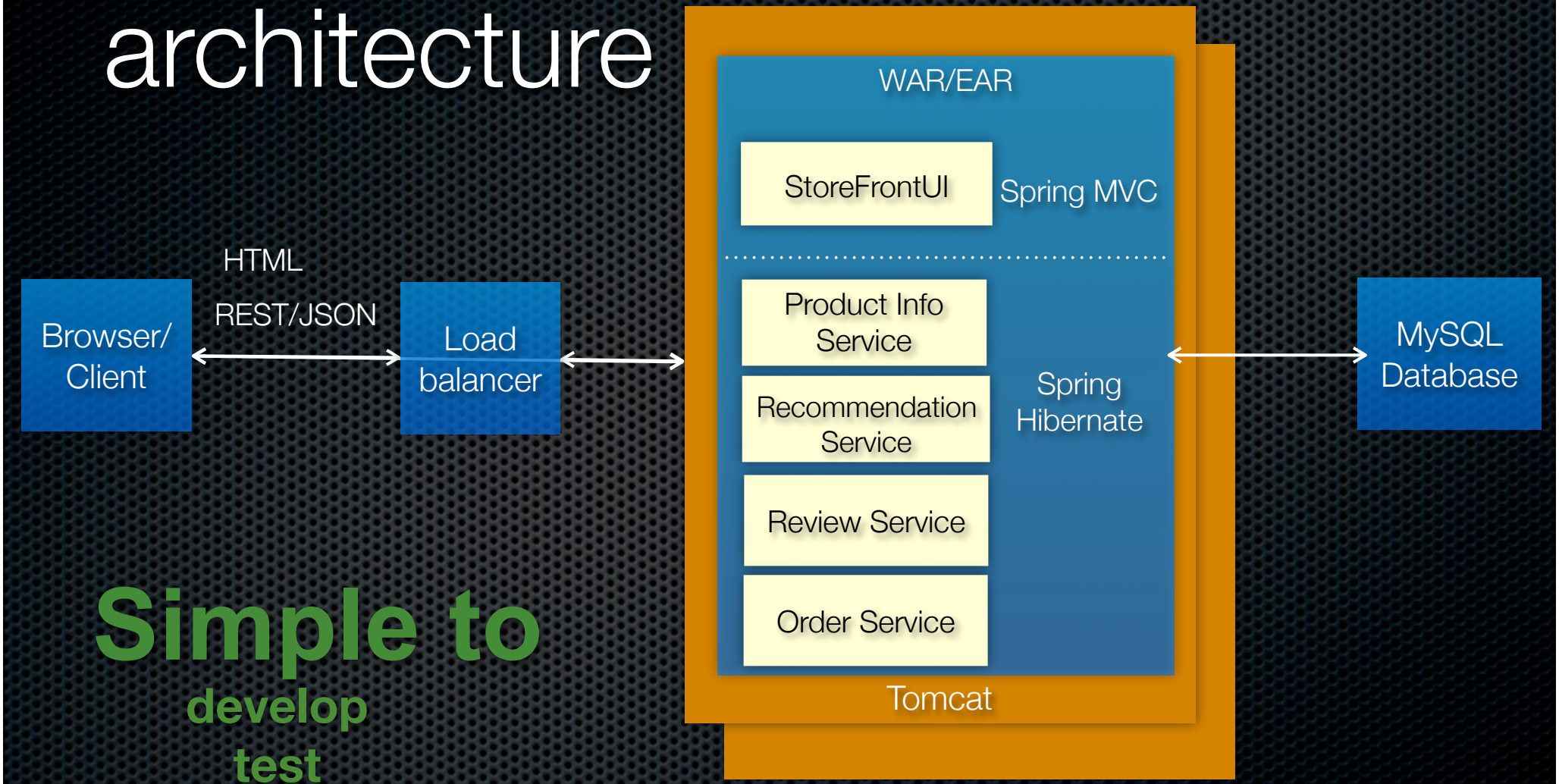
- Founder of a buzzword compliant (stealthy, social, mobile, big data, machine learning, ...) startup
- Consultant helping organizations improve how they architect and deploy applications using cloud computing, micro services, polyglot applications, NoSQL, ...

Agenda

- The (sometimes evil) monolith
- Decomposing applications into services
- Using an API gateway
- Inter-service communication mechanisms

Let’s imagine you are building an online store

Traditional application architecture



Simple to

develop

test

deploy

scale

But big, complex, monolithic applications

⇒

big problems

Intimidates developers

Obstacle to frequent deployments

- Need to redeploy everything to change one component
- Interrupts long running background (e.g. Quartz) jobs
- Increases risk of failure

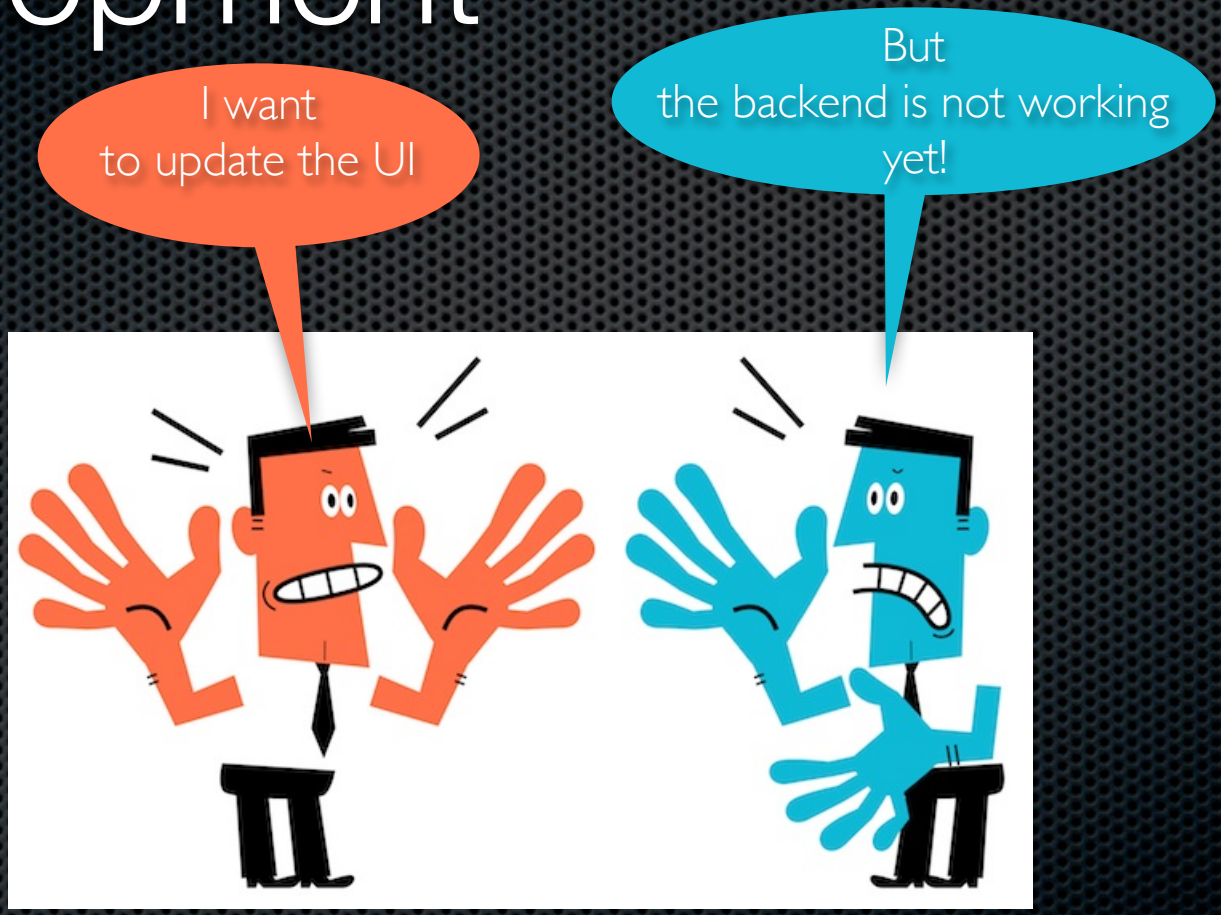
Eggs in one basket

- Updates will happen less often - really long QA cycles
- e.g. Makes A/B testing UI really difficult

Overloads your IDE and container

Slows down development

Obstacle to scaling development



Lots of coordination and communication required

Requires long-term commitment to a technology stack

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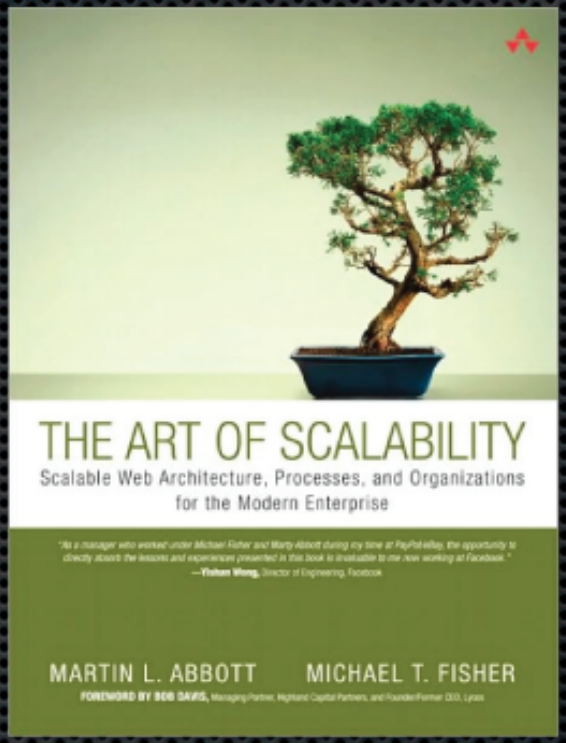
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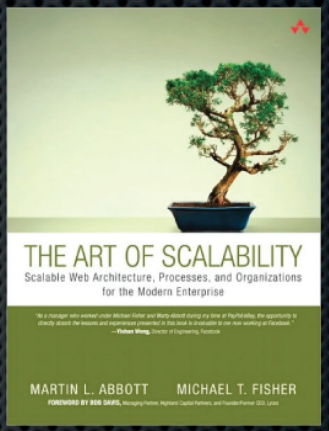
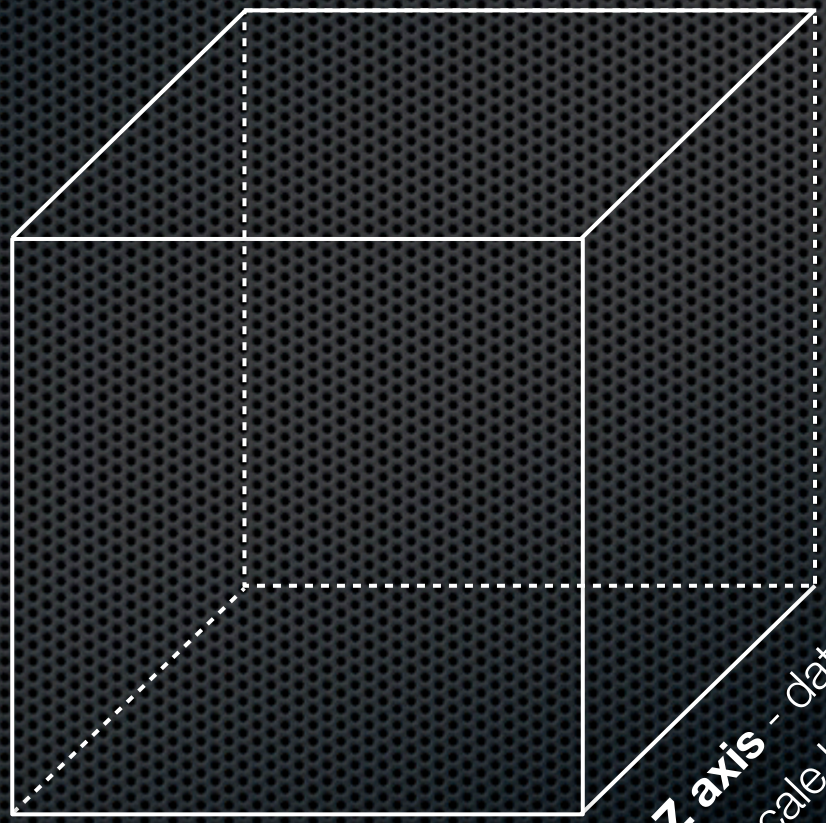
Scalable Web Architecture, Processes, and Organizations for the Modern Enterprise
MARTIN L. ABBOTT
MICHAEL T. FISHER

The scale cube



Y axis - functional decomposition

Scale by splitting different things



Z axis - data partitioning
Scale by splitting similar things

X axis
- horizontal duplication

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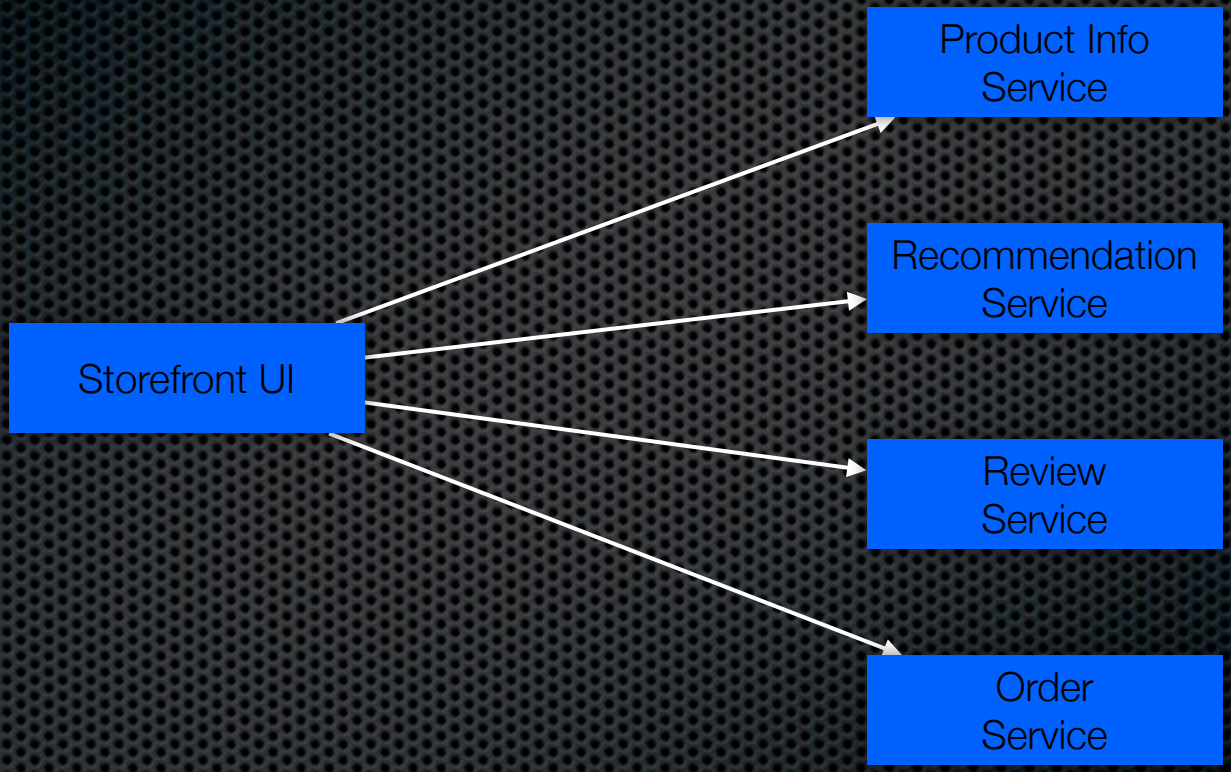
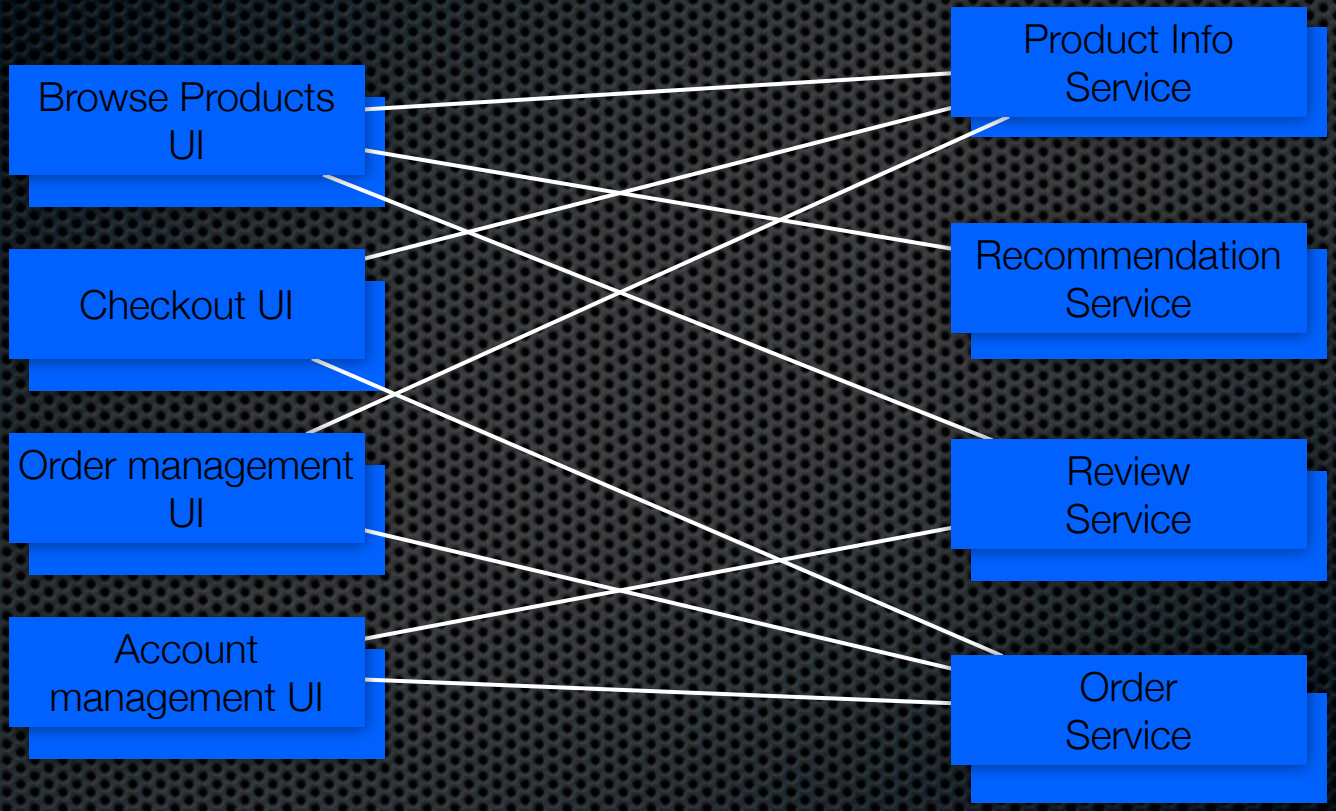
Y-axis scaling - application level

Y-axis scaling - application level



Y-axis scaling - application level



Apply X-axis and Z-axis scaling to each service independently

Service deployment options

Isolation, manageability

- VM or Physical Machine
- Docker/Linux container
- JVM
- JAR/WAR/OSGI bundle/...

Density/efficiency

Partitioning strategies...

- Partition by noun, e.g. product info service
- Partition by verb, e.g. Checkout UI
- Single Responsibility Principle
- Unix utilities - do one focussed thing well

Partitioning strategies

- Too few
  - Drawbacks of the monolithic architecture
- Too many - a.k.a. Nano-service anti-pattern
  - Runtime overhead
  - **Potential** risk of excessive network hops
  - **Potentially** difficult to understand system

Something of an art

Example micro-service

```
require 'sinatra'

post '/' do
  phone_number = params[:From]
  registration_url = "#{ENV['REGISTRATION_URL']}?phoneNumber=#{URI.encode(phone_number, "+")}"
  <<-eof
      <Response>
          <Sms>To complete registration please go to #{registration_url}</Sms>
      </Response>
eof
end
```

Responds to incoming SMS messages via Twilio

More service, less micro

But more realistically...

Focus on building services that make development and deployment easier

- not just tiny services

Real world examples

http://techblog.netflix.com/

~600 services

http://highscalability.com/amazon-architecture

100-150 services to build a page

http://www.addsimplicity.com/downloads/eBaySDForum2006-11-29.pdf

http://queue.acm.org/detail.cfm?id=1394128

There are many benefits

Smaller, simpler apps

- Easier to understand and develop
- Less jar/classpath hell - who needs OSGI?
- Faster to build and deploy
- Reduced startup time - important for GAE

Scales development: develop, deploy and scale each service independently

Improves fault isolation

Eliminates long-term commitment to a single technology stack

Modular, polyglot, multi-framework applications

Two levels of architecture

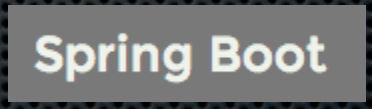
System-level

Services
Inter-service glue: interfaces and communication mechanisms
Slow changing

Service-level

Internal architecture of each service
Each service could use a different technology stack
Pick the best tool for the job
Rapidly evolving

Easily **try** other technologies



... and fail safely

But there are drawbacks

Complexity

Complexity of developing a distributed system

http://highscalability.com/blog/2014/4/8/microservices-not-a-free-lunch.html

Multiple databases
&
Transaction management

e.g. Fun with eventual consistency
Come to my 11.30 am talk

Complexity of testing a distributed system

http://highscalability.com/blog/2014/4/8/microservices-not-a-free-lunch.html

Complexity of deploying and operating a distributed system

http://highscalability.com/blog/2014/4/8/microservices-not-a-free-lunch.html

You need a lot of automation

Developing and deploying features that span multiple services requires careful coordination

When to use it?

In the beginning:

- You don't need it
- It will slow you down

Later on:

- You need it
- Refactoring is painful

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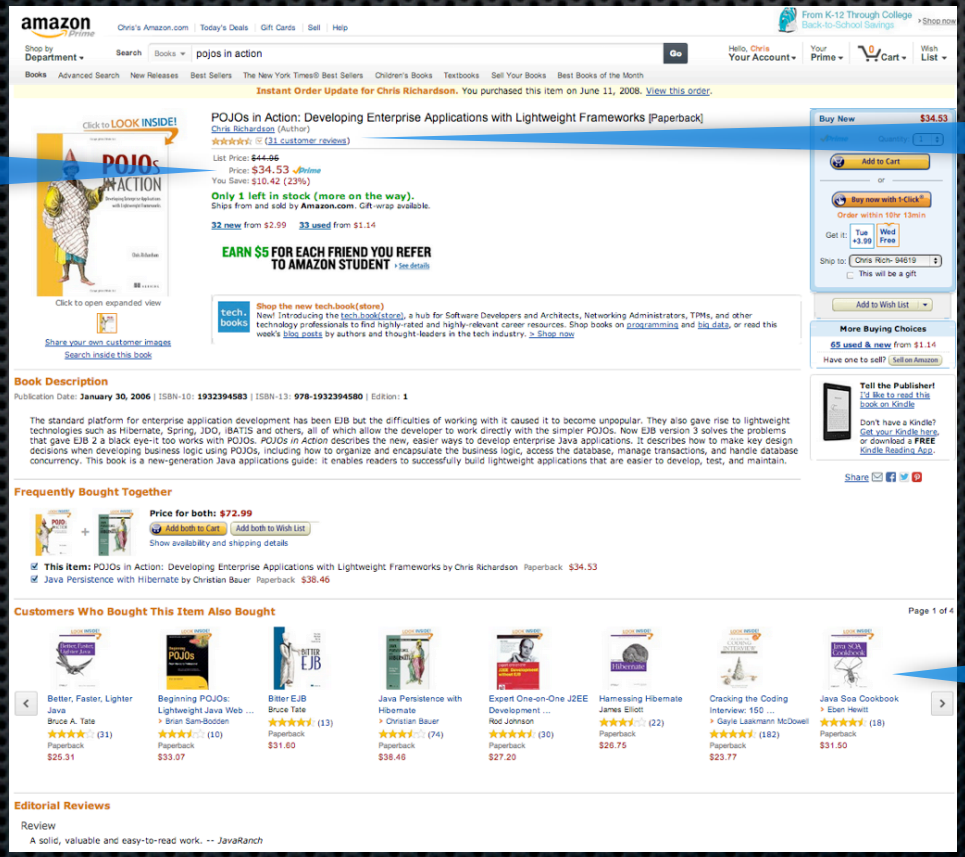
Let's imagine that you want to display a product's details...

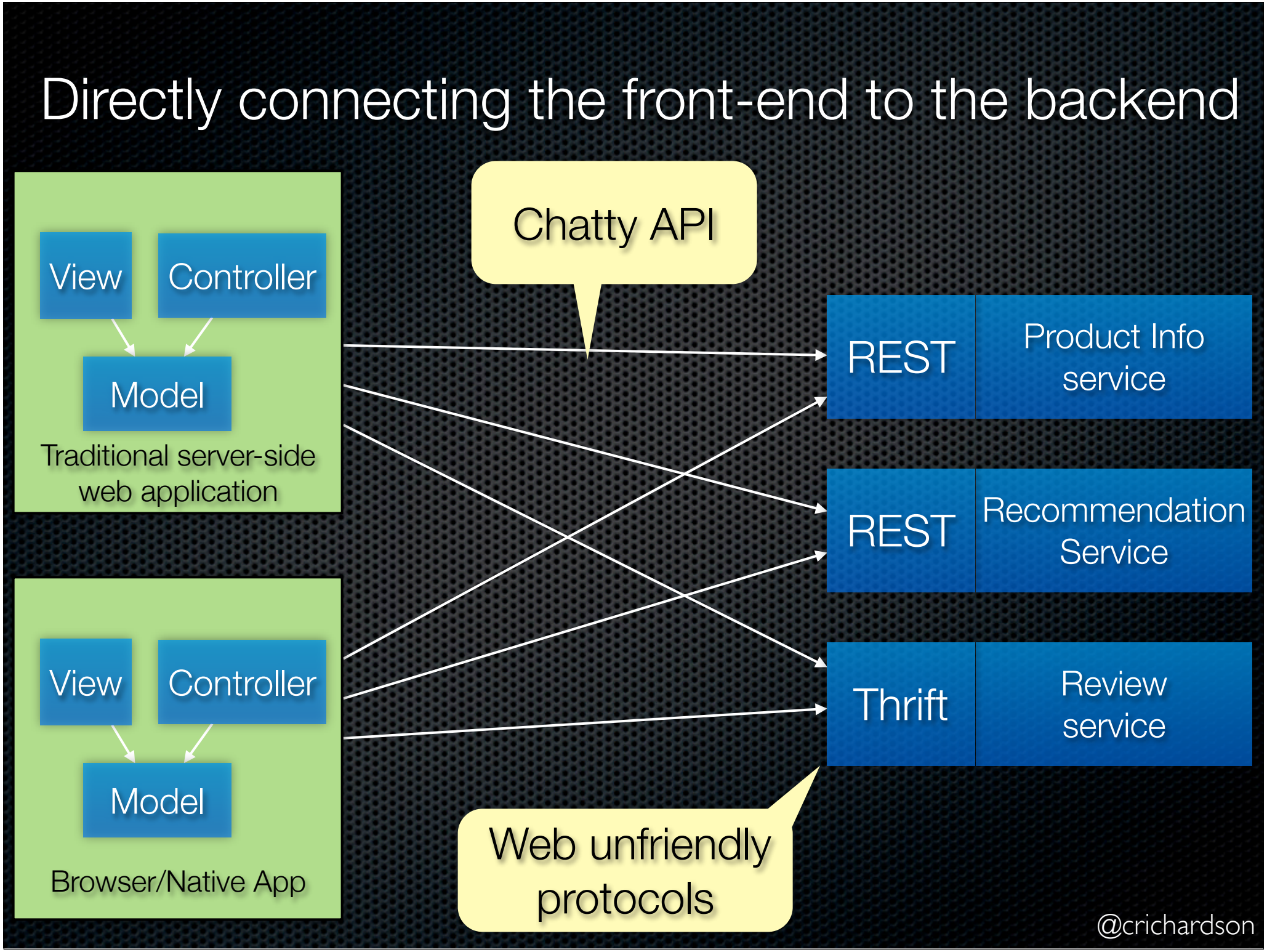
Product Info



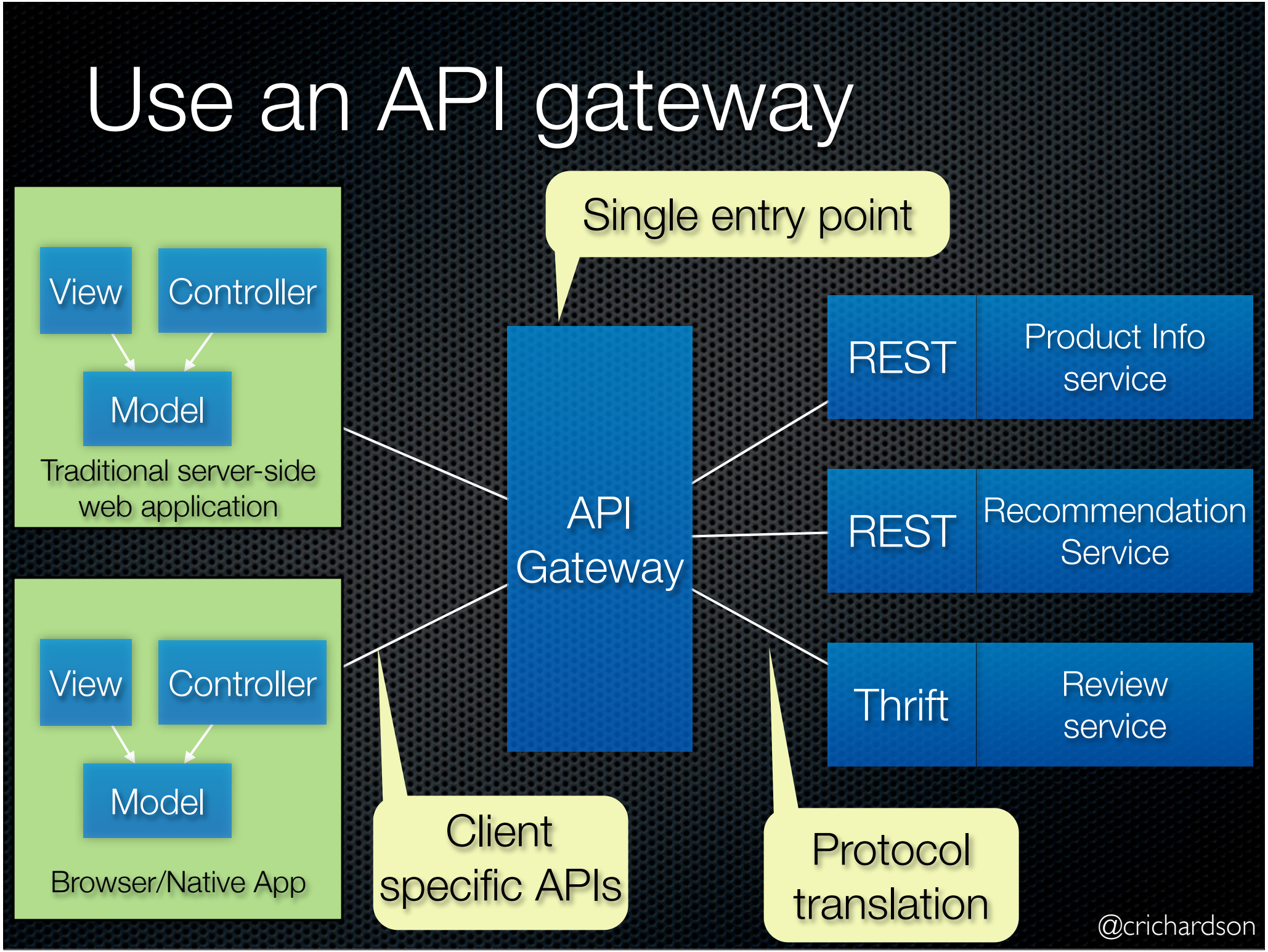
Reviews

Recommendations

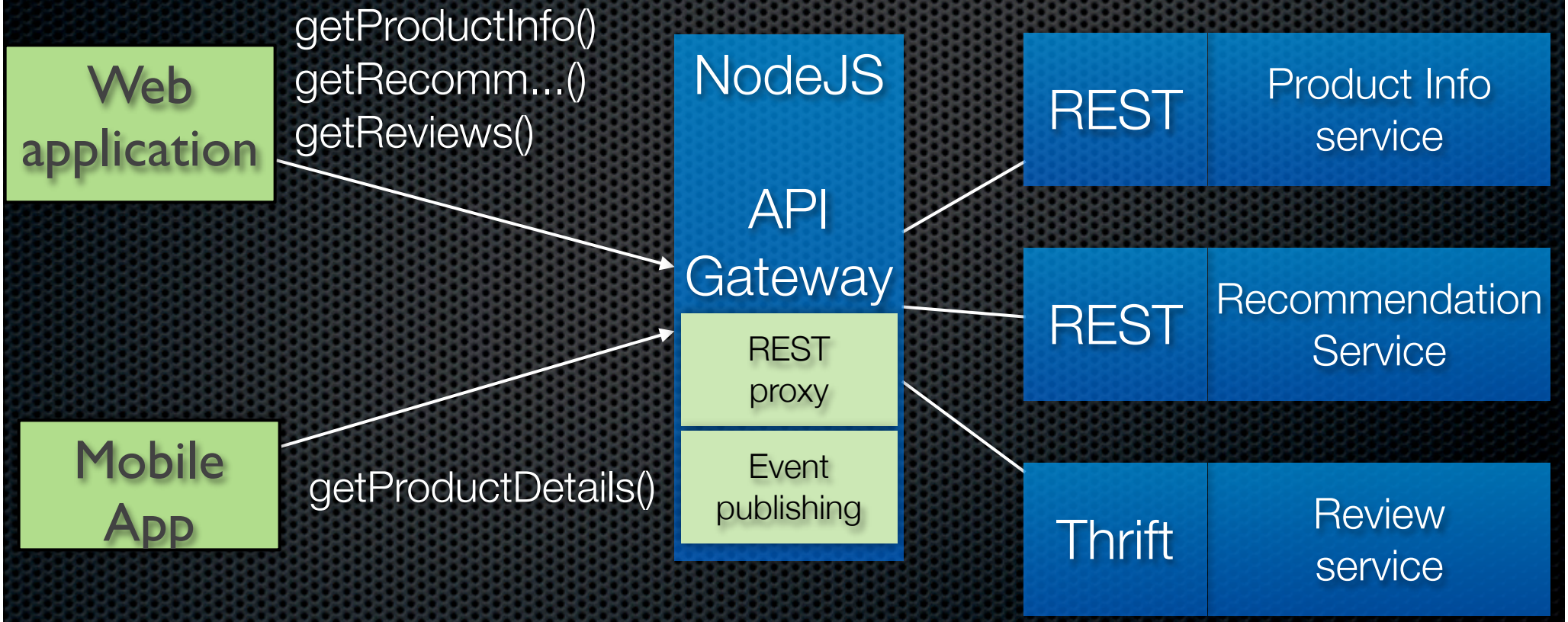
Directly connecting the front-end to the backend



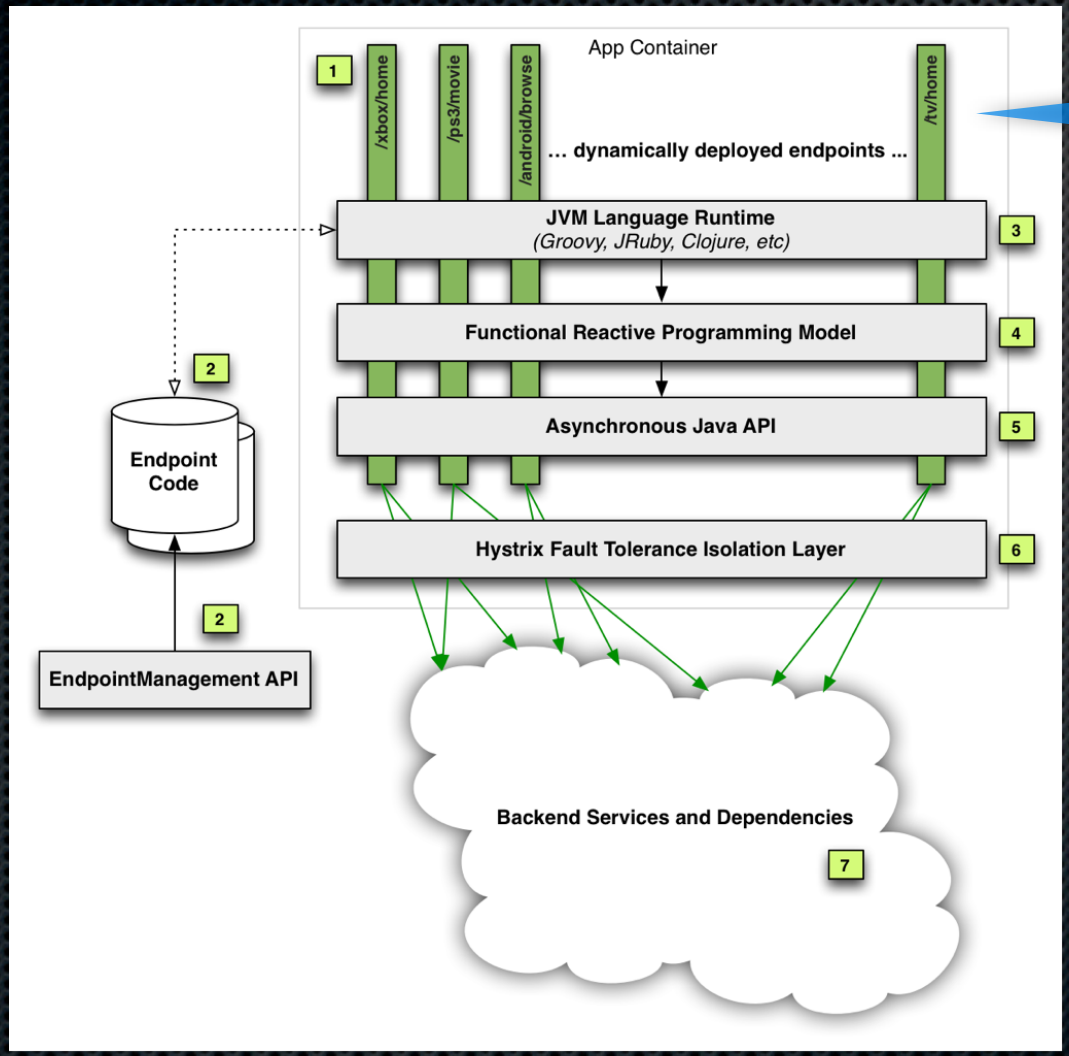
Use an API gateway



Optimized client-specific APIs



Netflix API Gateway



Device specific end points

http://techblog.netflix.com/2013/01/optimizing-netflix-api.html

API gateway design challenges

- Performance and scalability
  - Non-blocking I/O
  - Asynchronous, concurrent code
- Handling partial failures
  - ....

http://techblog.netflix.com/2012/02/fault-tolerance-in-high-volume.html

Useful frameworks for building an API gateway

- JVM:
  - Netty, Vertex
  - Netflix Hystrix
  - ...
- Other:
  - NodeJS

Agenda

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Inter-service communication options

- Synchronous HTTP ⇔ asynchronous AMQP
- Formats: JSON, XML, Protocol Buffers, Thrift, ...

Asynchronous is preferred
JSON is fashionable but binary format is more efficient

Pros and cons of messaging

Pros

- Decouples client from server
- Message broker buffers messages
- Supports a variety of communication patterns

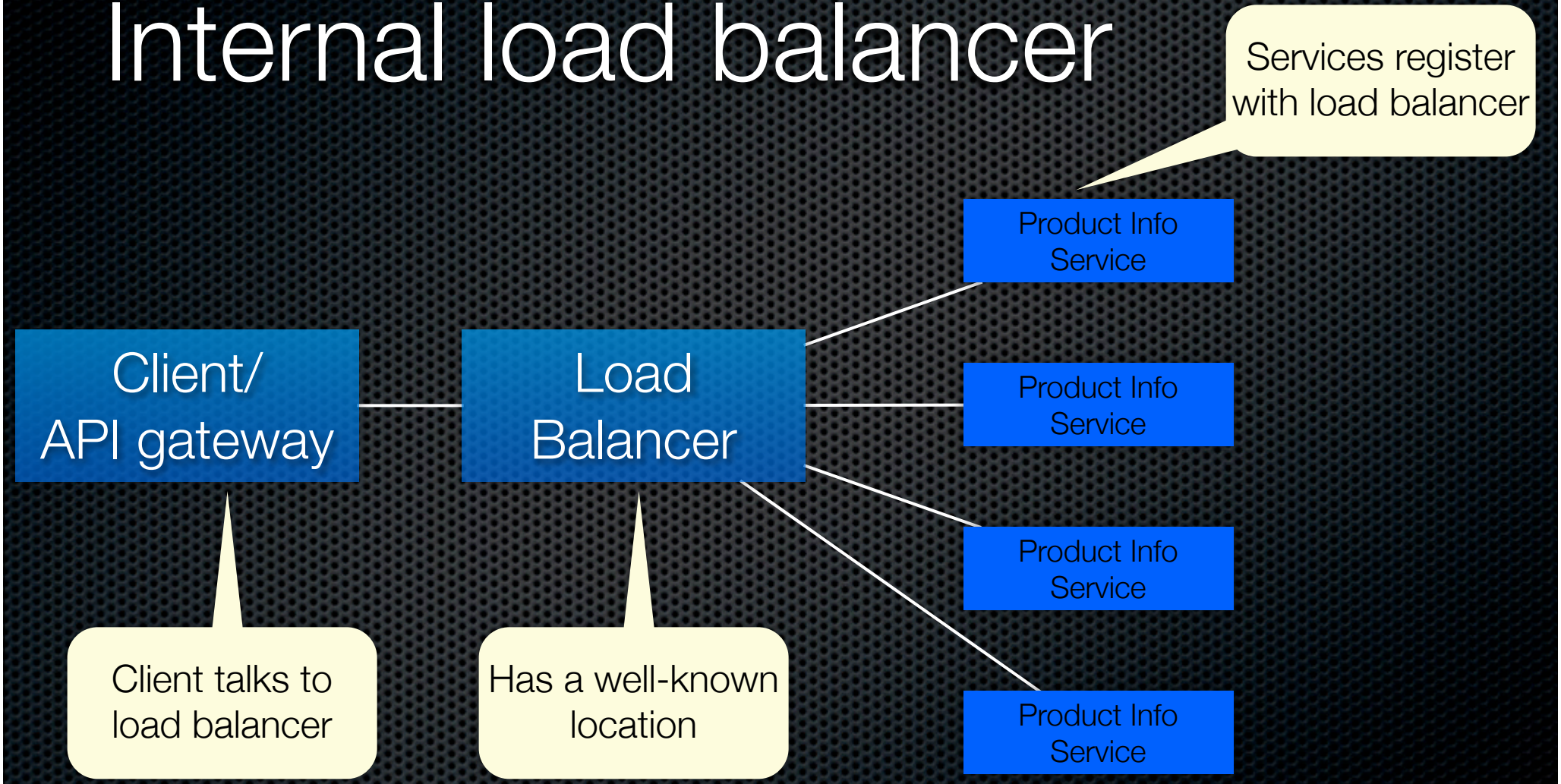
Cons

- Additional complexity of message broker
- Request/reply-style communication is more complex

Pros and cons of HTTP

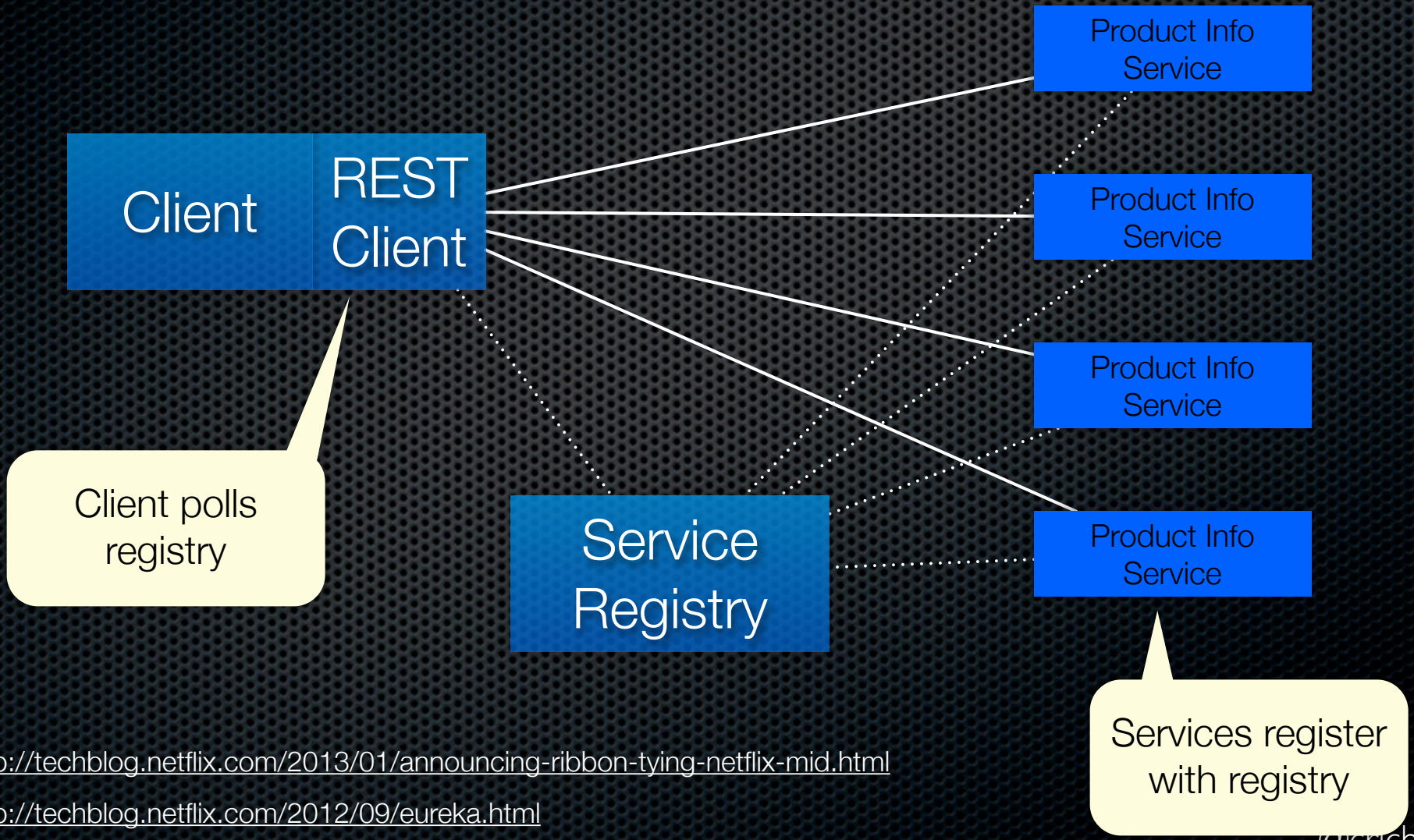
- Pros
  - Simple and familiar
  - Request/reply is easy
  - Firewall friendly
  - No intermediate broker
- Cons
  - Only supports request/reply
  - Server must be available
  - Client needs to discover URL(s) of server(s)

Discovery option #1: Internal load balancer



http://docs.aws.amazon.com/ElasticLoadBalancing/latest/DeveloperGuide/USVPC_creating_basic_lb.html

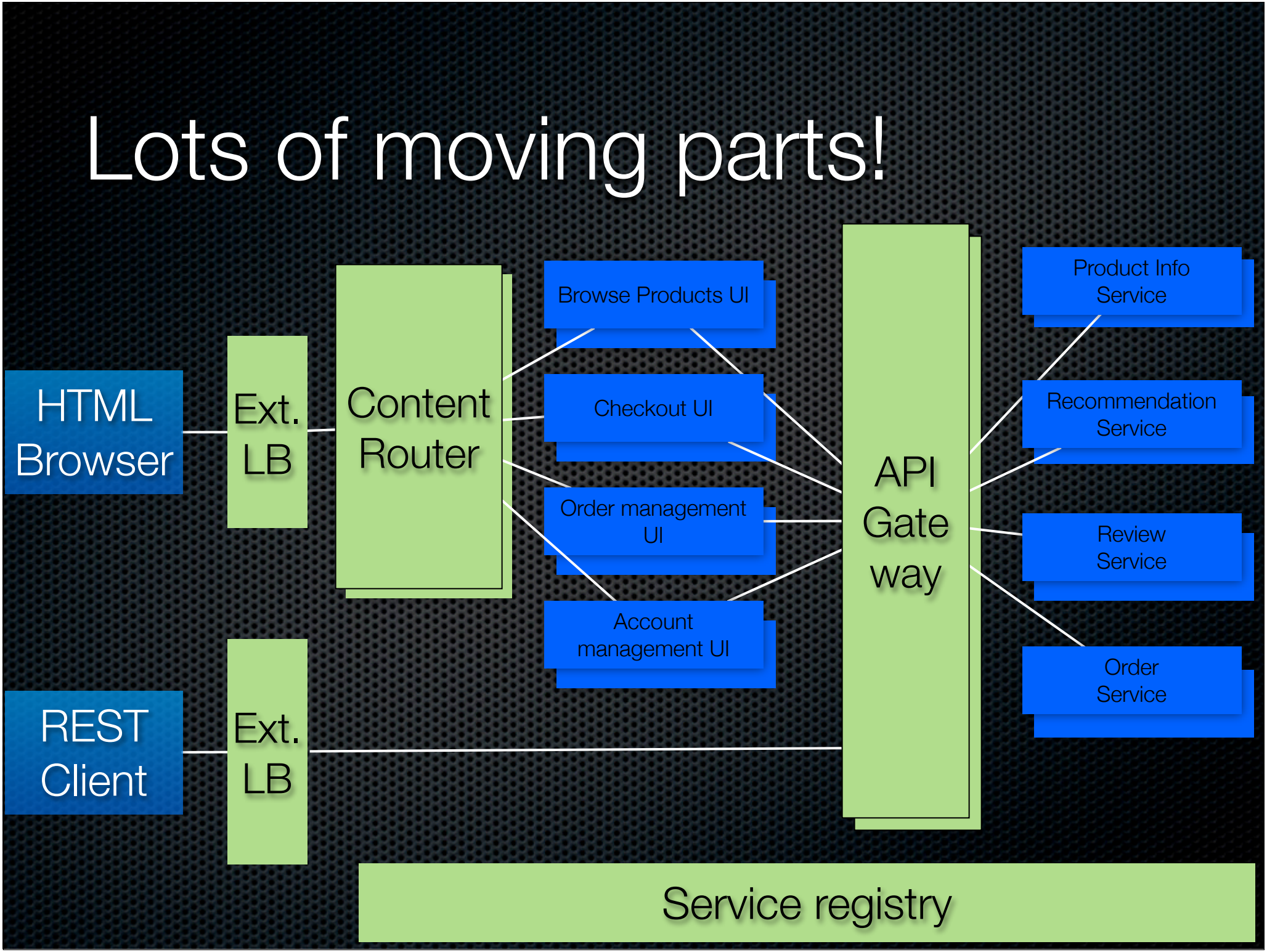
Discovery option #2: client-side load balancing



http://techblog.netflix.com/2013/01/announcing-ribbon-tying-netflix-mid.html

http://techblog.netflix.com/2012/09/eureka.html

Lots of moving parts!

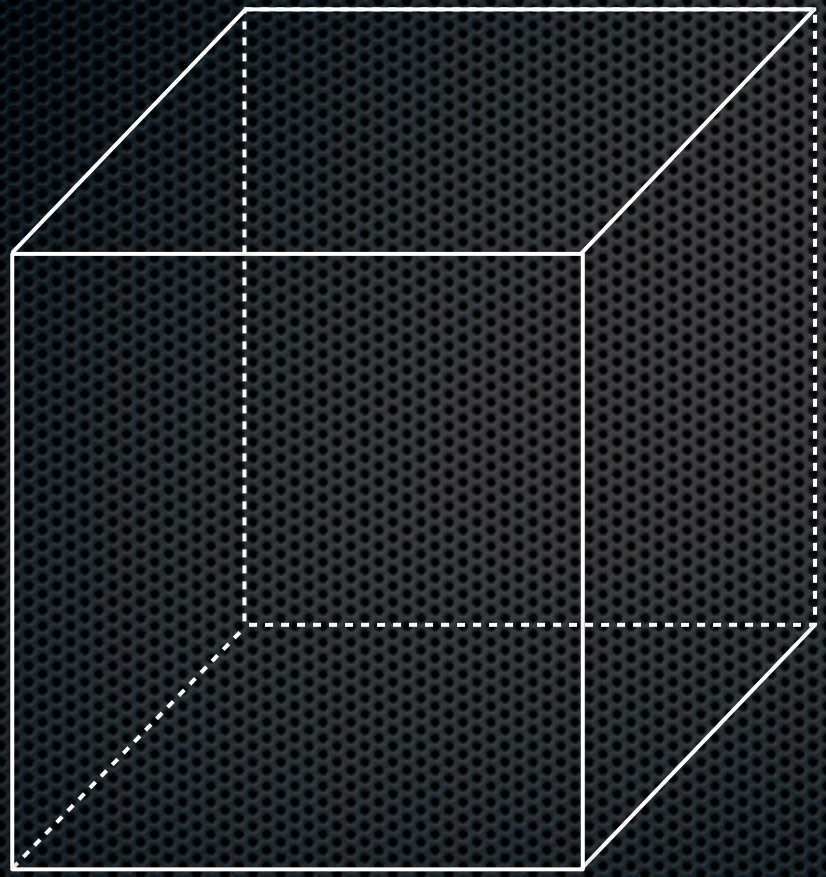


Summary

Monolithic applications are simple to develop and deploy

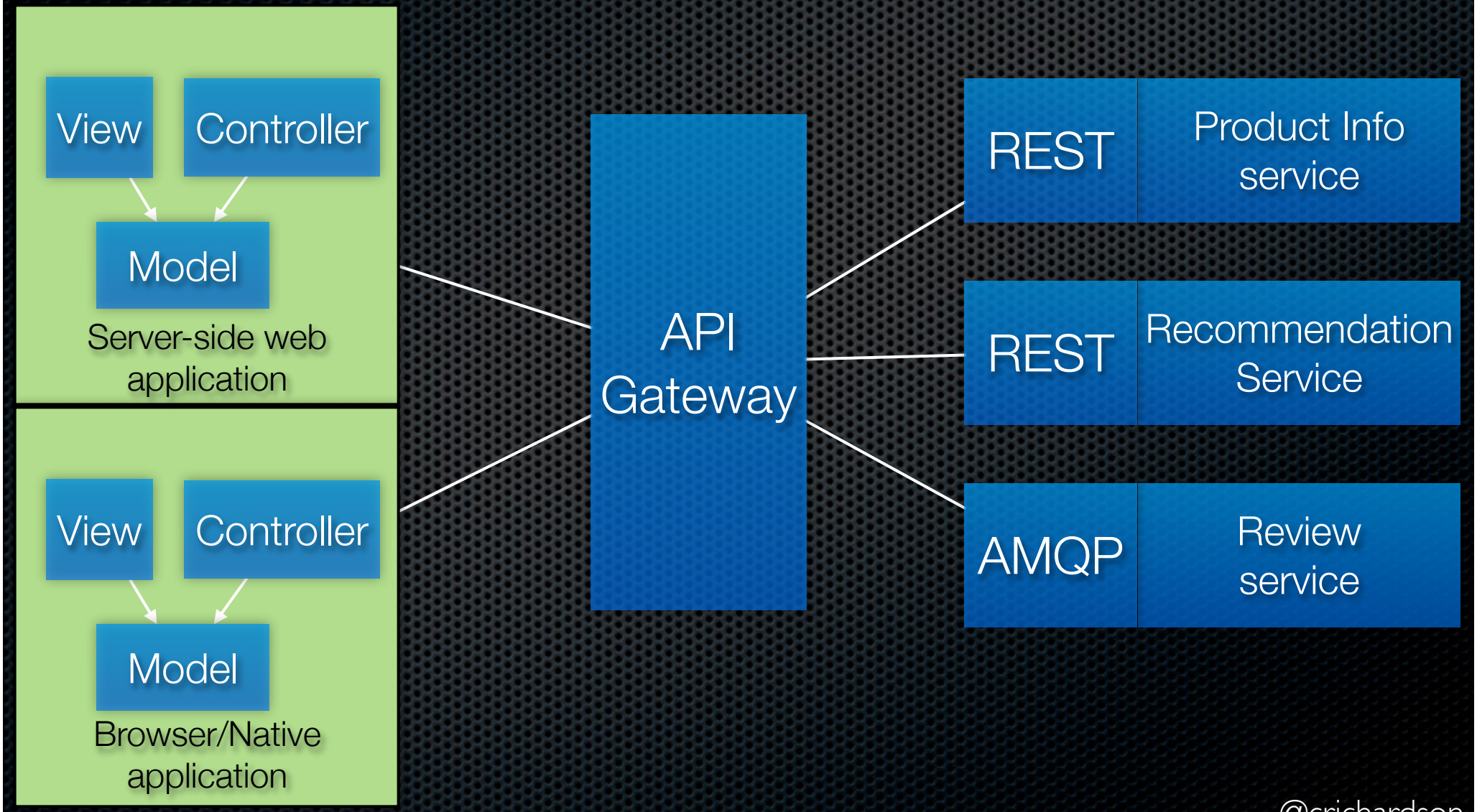
BUT have significant drawbacks

Apply the scale cube

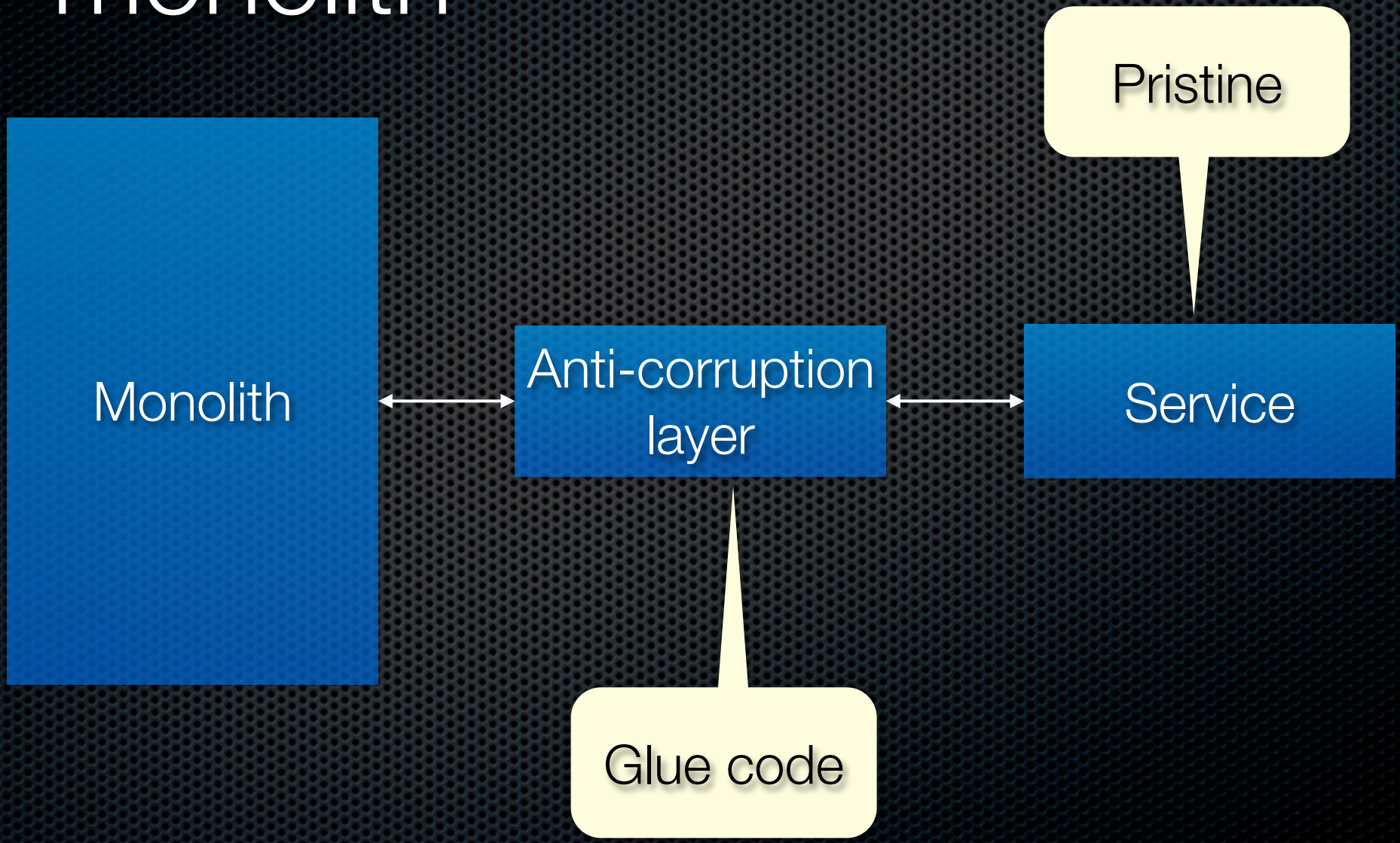


- Modular, polyglot, and scalable applications
- Services developed, deployed and scaled independently

Use a modular, polyglot architecture



Start refactoring your monolith



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Building microservices with Scala, functional domain models and Spring Boot


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Questions?
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