# Cloud Native Architecture Patterns and Katas

## GIDS 2018

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http://www.mattstine.com

# Introduction

# Class Overview

**By the end of this workshop, you'll understand:**

- The business drivers influencing companies to leverage Continuous Delivery, DevOps, and Cloud Native architectures.
- The unique characteristics of cloud infrastructure and how architectures can exploit these characteristics.
- How to work with an evolving cloud native architectural pattern language called "Bricks and Mortar."

# Class Overview

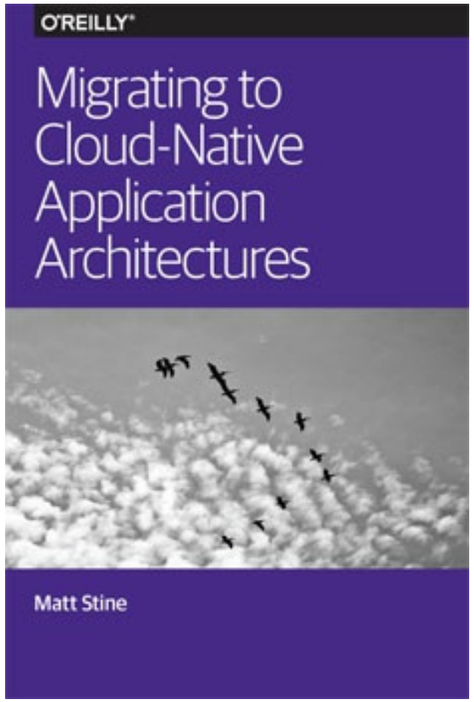
## And you'll be able to:

- Articulate the high-level narrative of cloud native architecture and why it is important to your business.
- Articulate the paradigm shift involved in cloud native architectural thinking.
- Describe the cloud native architectural patterns, what problems they solve, the pros and cons of various implementation approaches, and the relationships between the patterns.
- Apply cloud native architecture patterns to various practice “katas” to prepare for future use on real projects.

# Your Instructor

- 18 years in the Enterprise IT industry
- 6 years as a Cloud Platform and Application Architect
- Frequent speaker on the conference circuit
- Host of the Software Architecture Radio podcast
  http://softwarearchitecturerad.io

# Your Instructor




http://www.oreilly.com/programming/free/migrating-cloud-native-application-architectures.csp

# Class Components

- Lecture
- Q&A Sessions
- Architecture Kata Sessions

# Class Logistics

- We're scheduled to run from 9:30 until 17:00.
- 15 minute breaks at 11:00 and 15:15
- Lunch is served from 12:45 to 13:45

# Agenda

- Class Introduction
  9:30 - 9:35
- The Business Drivers for Architectural Change
  9:35 - 9:50
- A High-Level Overview of Continuous Delivery and DevOps
  9:50 - 10:05
- The Unique Characteristics of Cloud Infrastructure
  10:05 - 10:20
- Cloud Native Architecture Concepts
  10:20 - 10:40

# Agenda

- Introduction to the Brick and Mortar Pattern Language
  10:40 - 10:50
- Externalized Configuration Pattern
  10:50 - 11:00
- Break
  11:00 - 11:15
- Externalized State Pattern
  11:15 - 11:25
- Externalized Channels Pattern
  11:25 - 11:35

# Agenda

- Runtime Reconfiguration Pattern
  11:35 - 11:45
- Concurrent Execution Pattern
  11:45 - 11:55
- Brick Telemetry Pattern
  11:55 - 12:05
- Q&A Session: Morning Topics
  12:05 - 12:25
- Service Discovery Pattern
  12:25 - 12:35

# Agenda

- Architecture Katas Set Up
  12:35 - 12:45
- Lunch
  12:45 - 13:45
- Brick Kata: Preparation and Discussion
  13:45 - 14:30
- Brick Kata: Peer Review
  14:30 - 14:55
- Edge Gateway Pattern
  14:55 - 15:05

# Agenda

- Fault Tolerance Pattern
  15:05 - 15:15
- Break
  15:15 - 15:30
- Event-Driven System Pattern
  15:30 - 15:40
- Contract Management Pattern
  15:40 - 15:50
- Integration Telemetry Pattern
  15:50 - 16:00

# Agenda

- Mortar Kata: Preparation and Discussion
  16:00 - 16:45
- Mortar Kata: Peer Review
  16:45 - 17:10

# The Business Drivers for Architectural Change

# Disruption

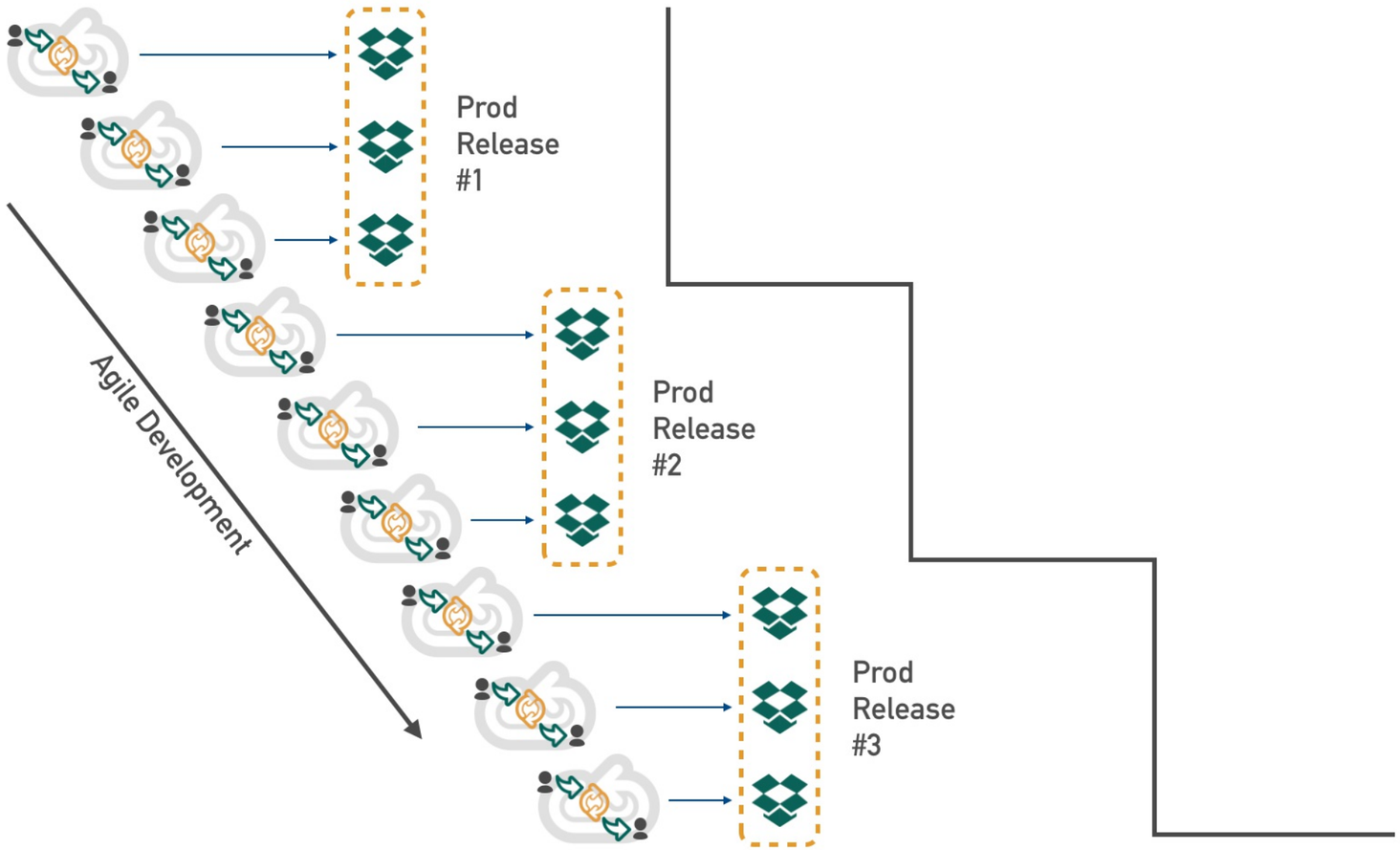
*Software is eating the world.*

- Mark Andressen

# Disruptive Characteristics

- Software is primary engagement model
- New and innovative business models
- Fast and frequent deliveries
- Hypothesis-driven development

Agility




The Waterscrumfall

# Waterscrumfall Consequences

- Slow Delivery
- Large Batch Sizes
- Infrequent Feedback
- Increased Waste

# Digital Transformation

# Disruptive companies are also approaching resiliency differently.

# Stop trying to prevent mistakes.

# Embrace failure.

# From MTBF to MTTR

# We need better tools and techniques.

# Visibility

# Fault Isolation

# Fault Tolerance

# Scalability

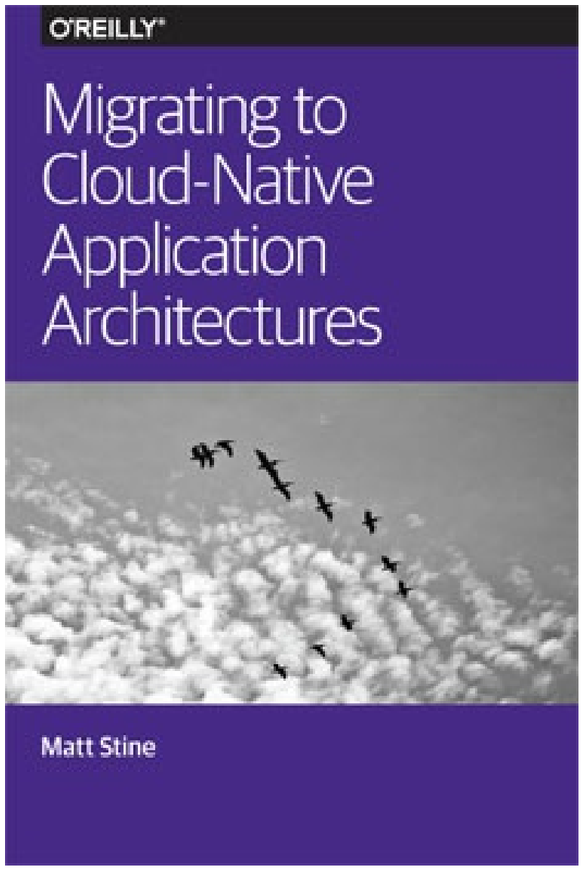
# Automated Recovery

# A High-Level Overview of DevOps and Continuous Delivery

# THE GREAT CONFLICT

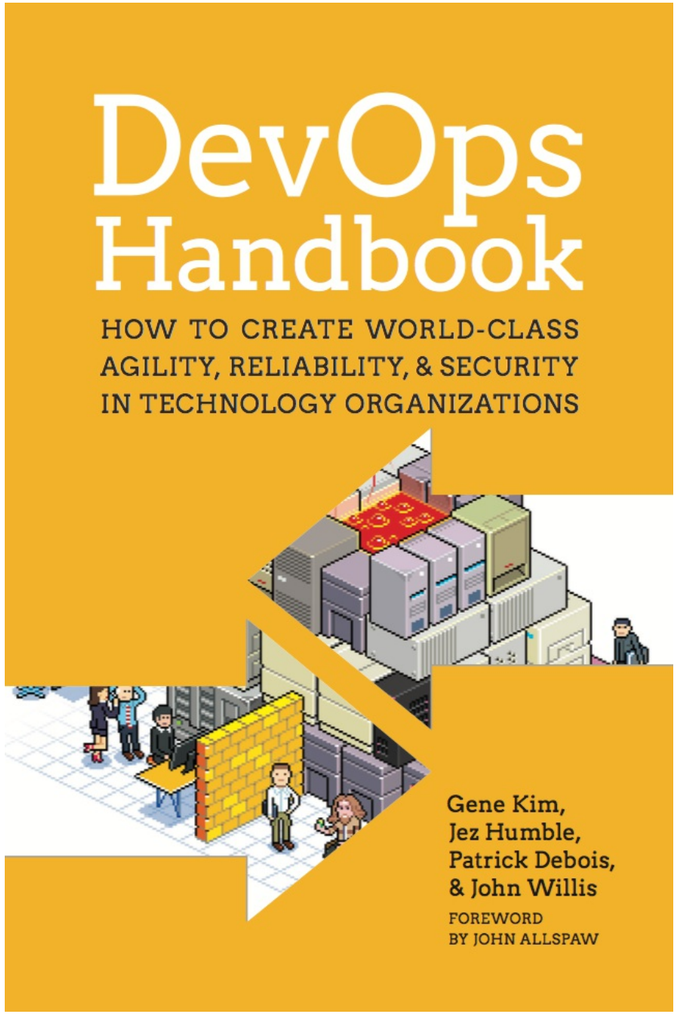
# My Definition:

*DevOps represents the idea of tearing down organizational silos and building shared toolsets, vocabularies, and communication structures in service of a culture focused on a single goal: delivering value rapidly and safely.*



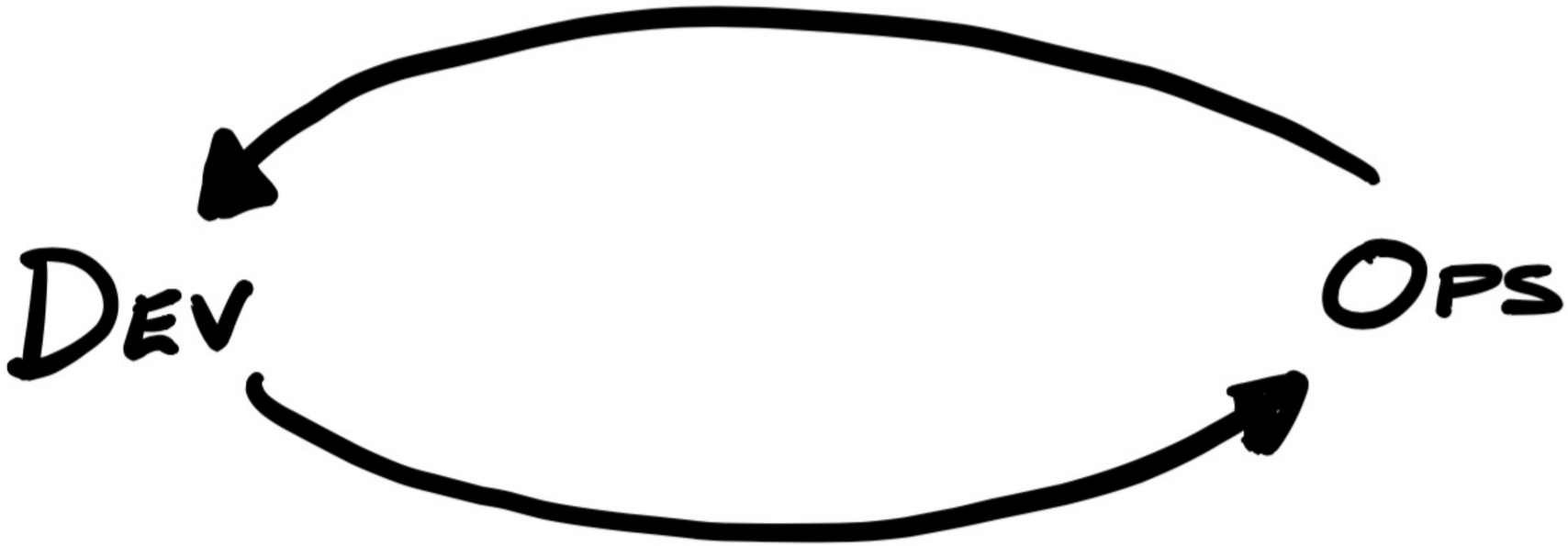
# THE THREE WAYS

DevOps


DevOps
Handbook
HOW TO CREATE WORLD-CLASS
AGILITY, RELIABILITY, & SECURITY
IN TECHNOLOGY ORGANIZATIONS
Gene Kim,
Jez Humble,
Patrick Debois,
& John Willis
FOREWORD
BY JOHN ALLSPAW

# The First Way: **Flow**

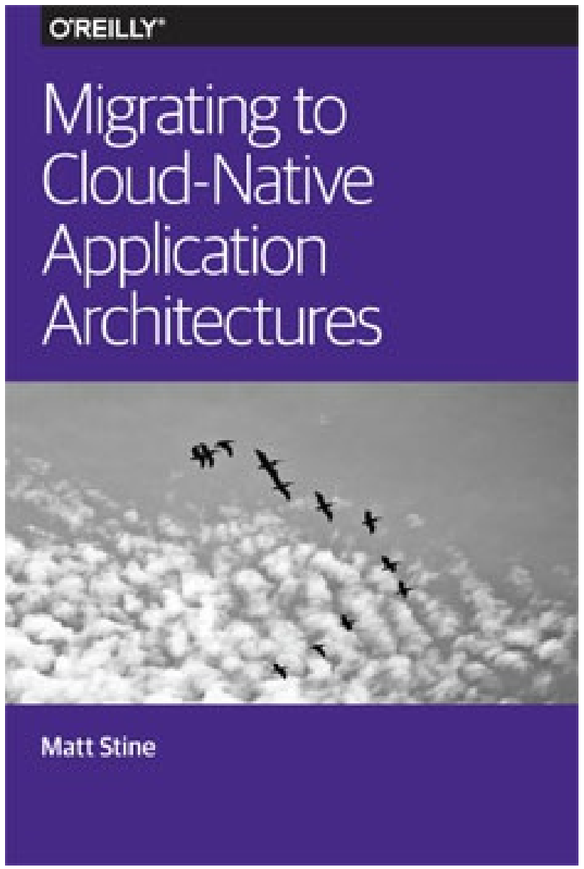
# The Second Way: **Feedback**



# The Third Way:
# **Continual Learning and Experimentation**

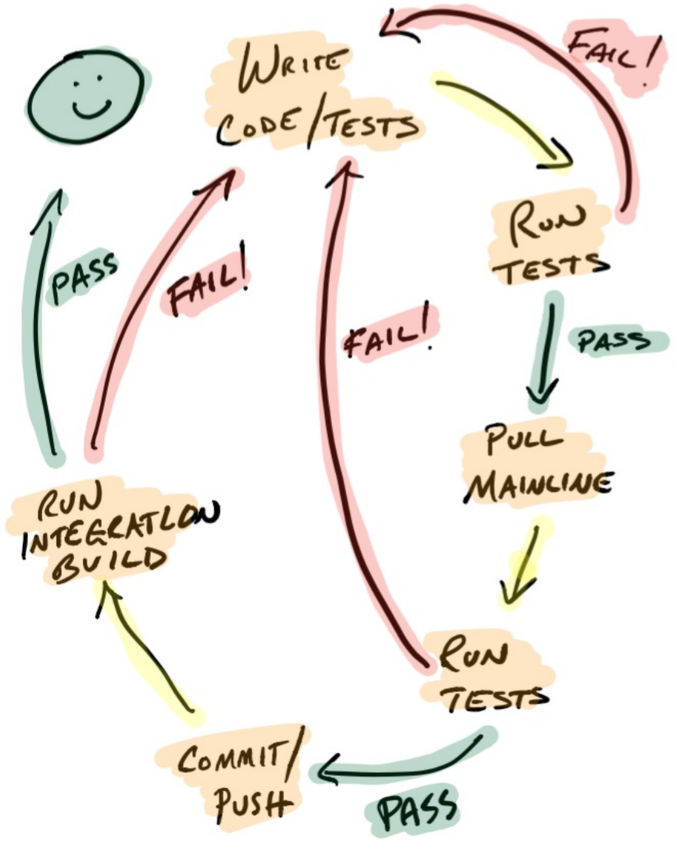
# My Definition:

*Technically supporting the concept to cash lifecycle by proving every source code commit to be deployable to production in an automated fashion.*



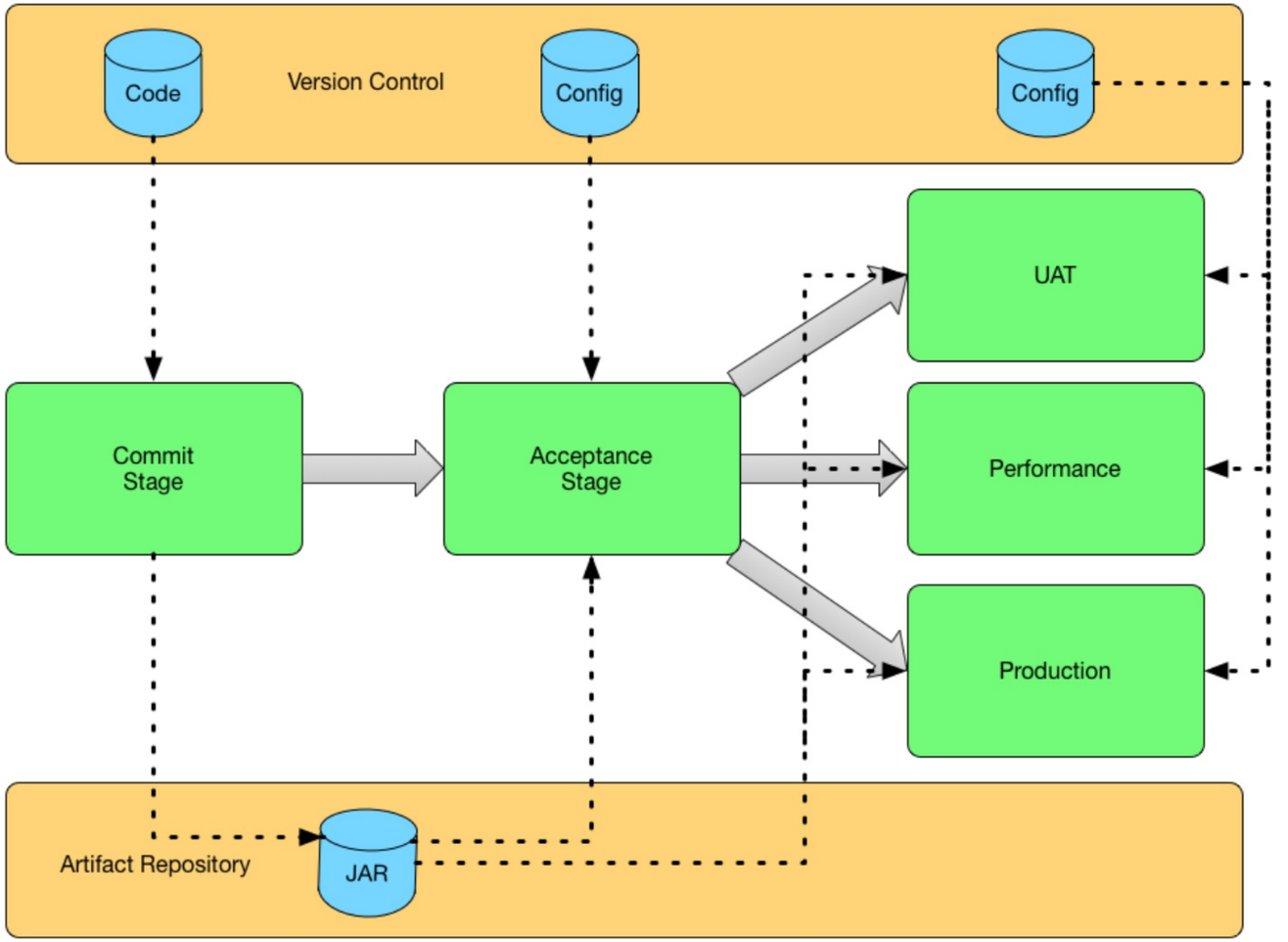
# Ingredients

- Configuration Management
- Continuous Integration
- Automated Testing




CI Developer Workflow

Continuous Delivery

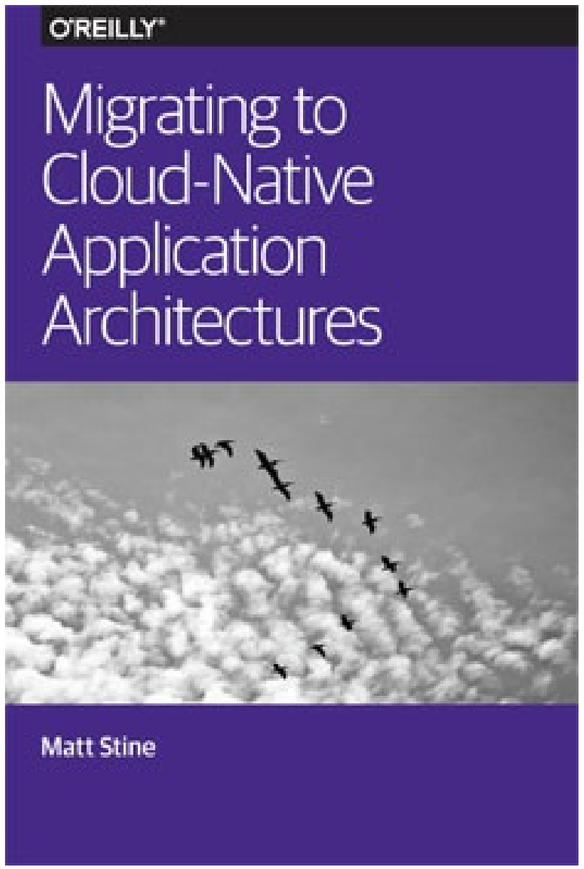



The Deployment Pipeline

# The Unique Characteristics of Cloud Infrastructure

# My Definition:

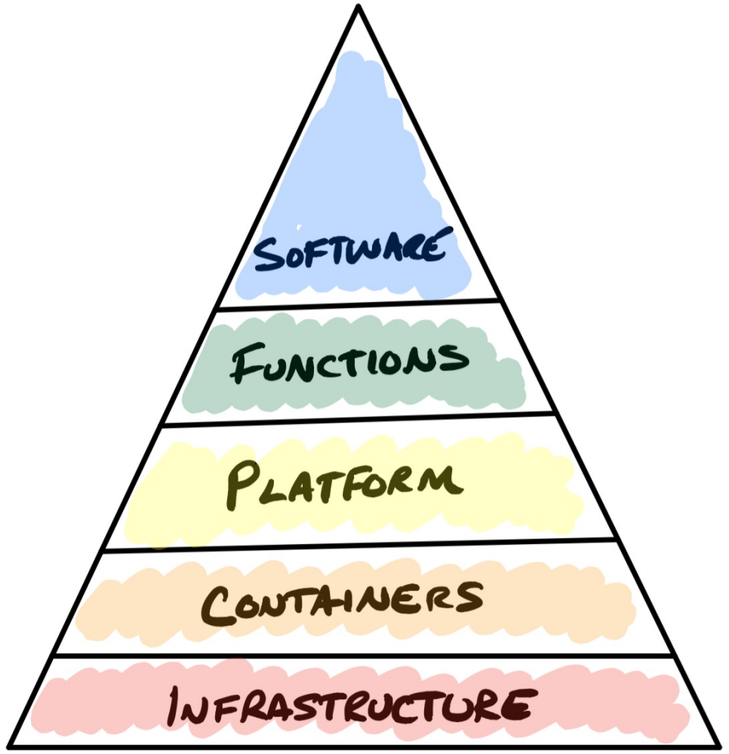
*Any computing environment in which computing, networking, and storage resources can be provisioned and released elastically in an on-demand, self-service manner.*



# Deployment Models

- Public
  - Amazon Web Services
  - Google Cloud Platform
  - Microsoft Azure
- Private
  - VMware vSphere
  - OpenStack
- Community
- Hybrid

# Service Models




The *aaS Pyramid

# API Driven

- Automation
- Audit
- Authorization
- Accounting

# Speed

If you need a component, create it!

- Load Balancers
- Databases (SQL/NoSQL)
- Message Queues
- Private Networks
- Storage Volumes

# Speed

Can eliminate:

- Ticket Systems
- Approval Processes
- Waiting Queues
- Configuration Errors

# Speed

*As fast as you can design the system architecture that you need, you can usually provision and begin using it.*

# Elastic

*Goodbye Capacity Planning!*

# Elastic

## Capacity Planning

- Peer into the crystal ball...
- "What's the most capacity we'll need?"
- Guess incorrectly...
  - Blow available capacity on Black Friday
  - Hundreds of idle CPUs

# Elastic

*As demand increases, we simply expand capacity by provisioning more resources to service that demand.*

# Elastic

*As demand decreases, we simply contract capacity by returning resources to the pool.*

# Cloud Native Architecture Concepts

# Modularity

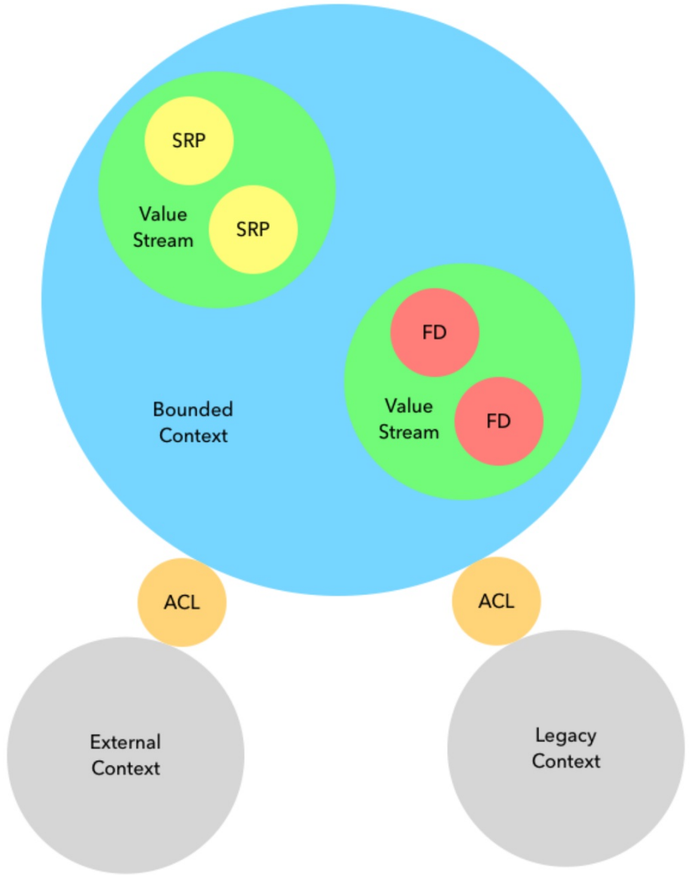
# Think About the Three Ways


We want a *quantum* of this experience.

# Decomposition Strategies

## What's yours?

- Bounded Contexts
- Value Streams
- Single Responsibility Principle
- Failure Domains
- Anti-Corruption Layers




Strategies are not mutually exclusive!

# So What About Modularity?

- Loose Coupling
- High Cohesion
- Encapsulation
- Well-Defined Interface

# Gratuitous Nod to Microservices!


If a microservice isn't giving you *Three Ways Value*, you probably don't need it.

# Conway’s Law

*Any organization that designs a system (defined broadly) will produce a design whose structure is a copy of the organization's communication structure.*

If your architectural and and organizational decomposition strategies don’t align well, then **CONWAY WILL FIGHT YOU**!

# Observability

# Think About the Three Ways


We need feedback to create a safer system of work and to (in)validate our hypotheses.

# See Failure When It Happens

# Measure Everything

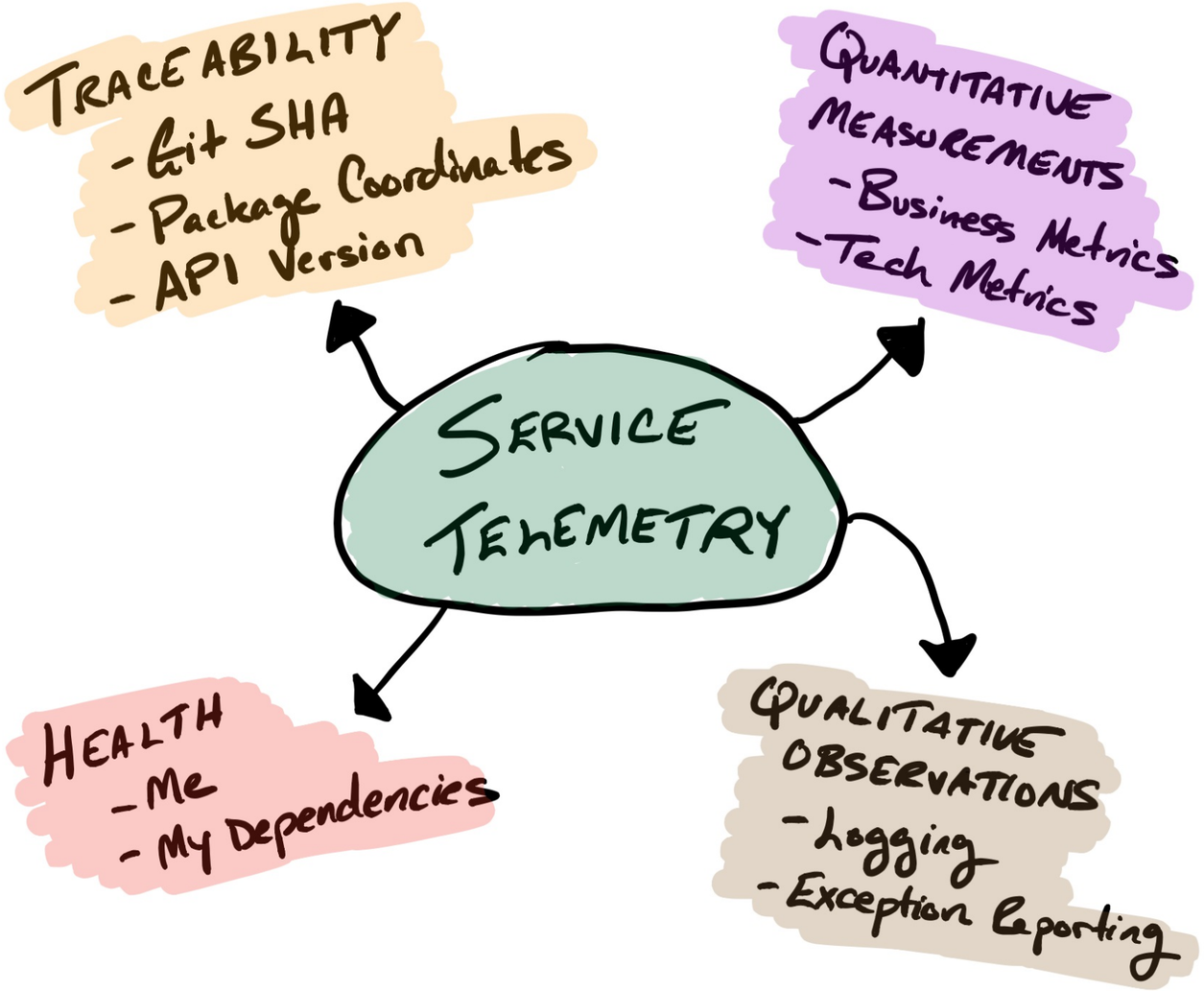
# What is Normal?

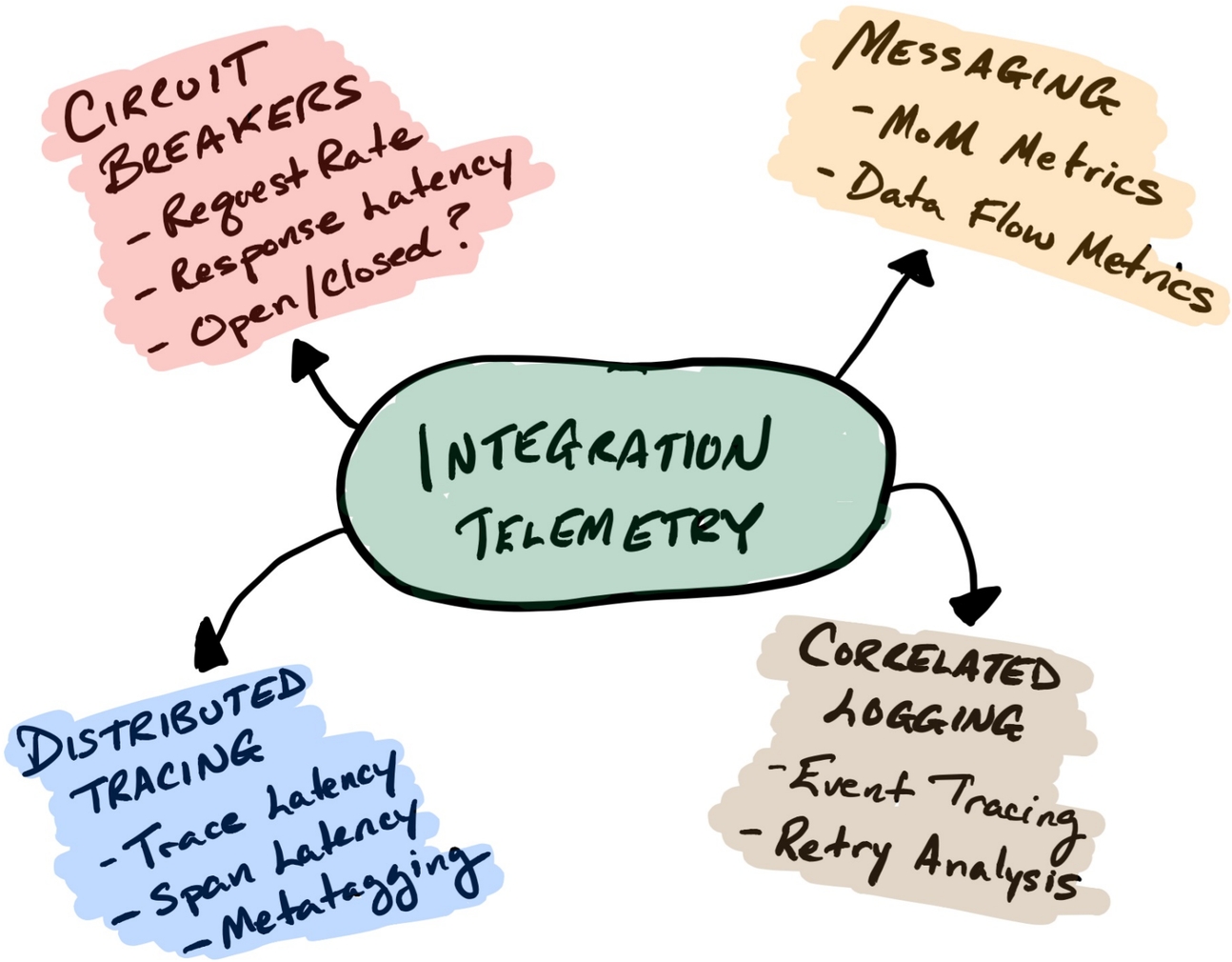
- Values
- Rates of Change
- Mean?
- P95/99/99.9?

# What is Normal?

| Site | # of requests | page loads that would experience the 99%'lie [(1 - (.99 ^ N)) * 100%] |
|---|---|---|
| amazon.com | 190 | 85.2% |
| kohls.com | 204 | 87.1% |
| jcrew.com | 112 | 67.6% |
| saksfifthavenue.com | 109 | 66.5% |
| -- | -- | -- |
| nytimes.com | 173 | 82.4% |
| cnn.com | 279 | 93.9% |
| -- | -- | -- |
| twitter.com | 87 | 58.3% |
| pinterest.com | 84 | 57.0% |
| facebook.com | 178 | 83.3% |
| -- | -- | -- |
| google.com<br>(yes, that simple noise-free page) | 31 | 26.7% |
| google.com<br>search for "http requests per page" | 76 | 53.4% |

http://bravenewgeek.com/everything-you-know-about-latency-is-wrong


TRACEABILITY
- Git SHA
- Package Coordinates
- API Version
QUANTITATIVE MEASUREMENTS
- Business Metrics
- Tech Metrics
SERVICE TELEMETRY
HEALTH
- Me
- My Dependencies
QUALITATIVE OBSERVATIONS
- Logging
- Exception Reporting


CIRCUIT BREAKERS
- Request Rate
- Response Latency
- Open/Closed?
MESSAGING
- MoM Metrics
- Data Flow Metrics
INTEGRATION TELEMETRY
DISTRIBUTED TRACING
- Trace Latency
- Span Latency
- Metatagging
CORRELATED LOGGING
- Event Tracing
- Retry Analysis

# This is an Architectural Responsibility

- Architecture can make observability harder!
- Overhead Concerns
- Tools don't know your business.

# **NOTE:** Architecting for DevOps aids in Continuous Delivery!

# Adding some layers...

# Think About Full Lifecycle Architecture

*Architecture is abstract until it is operationalized.*

Neal Ford

# Architectures that aren't operationalized exist only on whiteboards!

- Deployability
- Testability

We'll examine these qualities by asking questions of our architectures.

# Deployability

# Have you automated **ALL** of your deployment tasks?

# Can you transform a brand new deployment environment into your running architecture without manual work?

# Can you vary configuration across environments without rebuilding code?

# Do you deploy like this **EVERYWHERE**?

# Can you do this without your users noticing?

# Testability

# Have you automated **ALL** testing tasks that you possibly can?

# Do you have to deploy all the things to test anything?

# If testing is an experiment, can you control everything except your experimental variable?

# Can you run the same tests against any environment (including production)?

# Can you verify that you continue to meet your contractual obligations?

# Cloud Capabilities

- API-driven
- Speed
- Elasticity
- Geography
- Specialized Services

# Exploiting the capabilities of Cloud can enhance our ability to practice DevOps and Continuous Delivery!

- Disposability
- Replaceability

We'll examine these qualities by asking questions of our architectures.

# Disposable

***adjective***

1. designed for or capable of being thrown away after being used or used up:
   *disposable plastic spoons; a disposable cigarette lighter.*

2. free for use; available:
   *Every disposable vehicle was sent.*

http://www.dictionary.com/browse/disposable

# Replace

***verb***

1. to assume the former role, position, or function of; substitute for (a person or thing):
   *Electricity has replaced gas in lighting.*
2. to provide a substitute or equivalent in the place of:
   *to replace a broken dish.*

http://www.dictionary.com/browse/replace

# Consequence

***noun***

1. an act or instance of following something as an effect, result, or outcome.
2. importance or significance:
   *a matter of no consequence.*

http://www.dictionary.com/browse/consequence

*Disposability*

# Can I destroy a service instance at any time without consequence?

*Disposability*

# Can I repave the entire architecture at any time without consequence?

*Disposability*

# Can I respond to changes in demand by adding or removing instances of a service without consequence?

*Replaceability*

# Can I replace a sick service instance with a brand new copy without consequence?

*Replaceability*

# Can I route traffic to any available service instance without consequence?

*Replaceability*

# If I lose an AZ or Region, can I route traffic to another without consequence?

*Replaceability*

# Can I swap between multiple implementations of the same service contract without consequence?

*Replaceability*

# Can I swap between multiple running versions of a service without consequence?

# These are Architectural Responsibilities

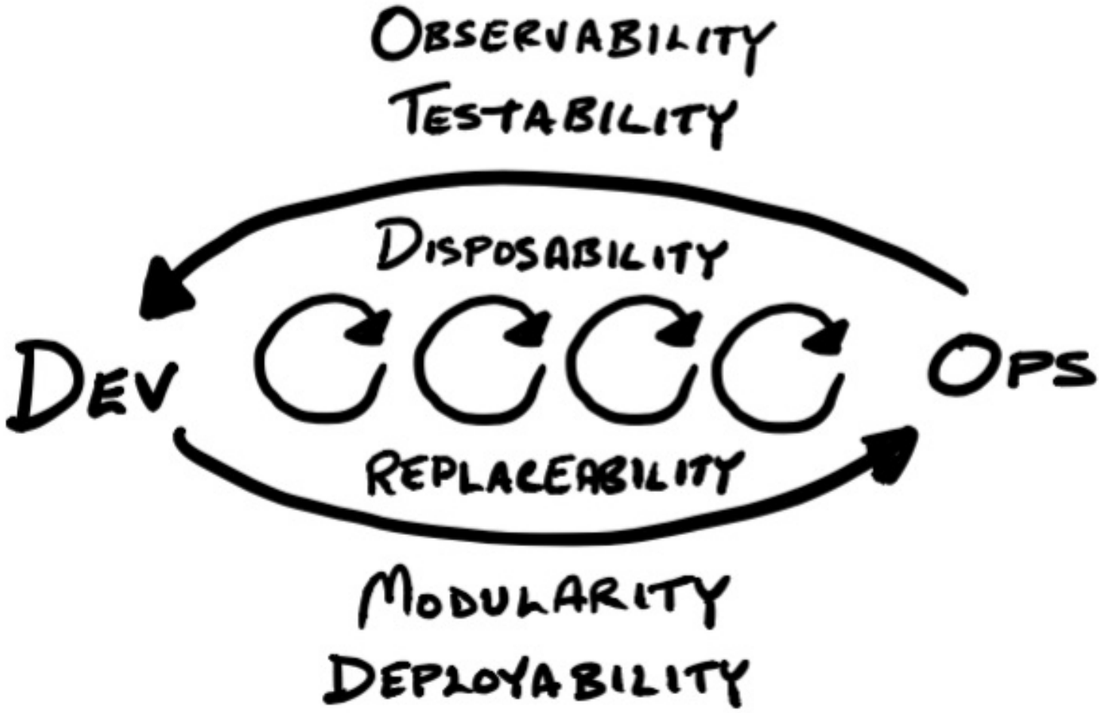
- Architecture can make disposability impossible.
- Architecture can make replaceability impossible.
- Architecture must take charge of removing the consequences of disposing and replacing service instances.

# Architectural Decision Making Can:

- Enhance or Detract from Our Ability to Practice DevOps
- Enhance or Detract from Our Ability to Practice Continuous Delivery
- Exploit or Waste the Characteristics of Cloud Infrastructure

# We could have called this ”DevOps Native” or ”Continuous Delivery Native” Architecture!

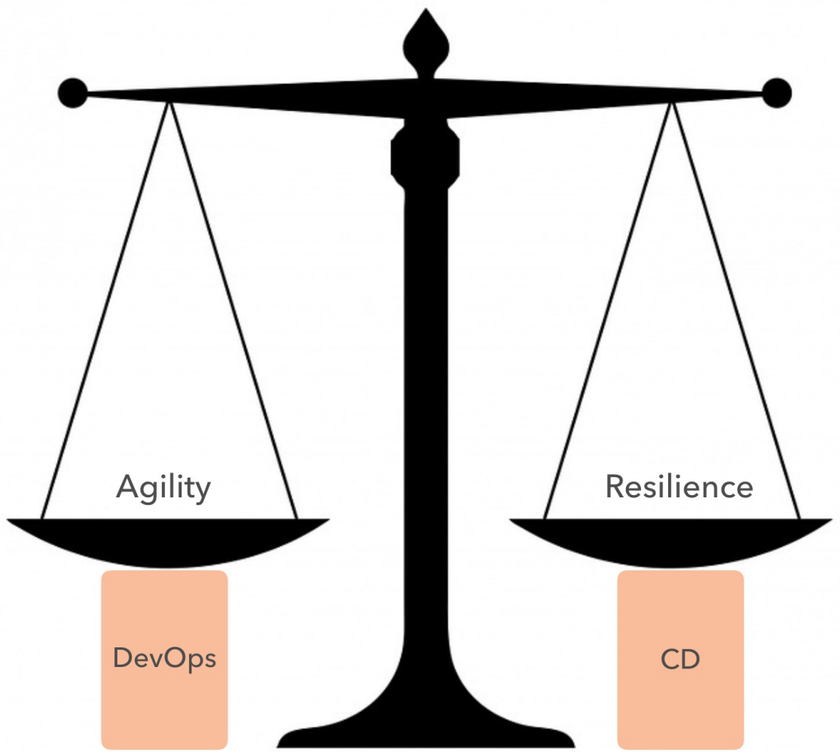
# DevOps Native Architecture



# Balancing:


Agility and Resilience

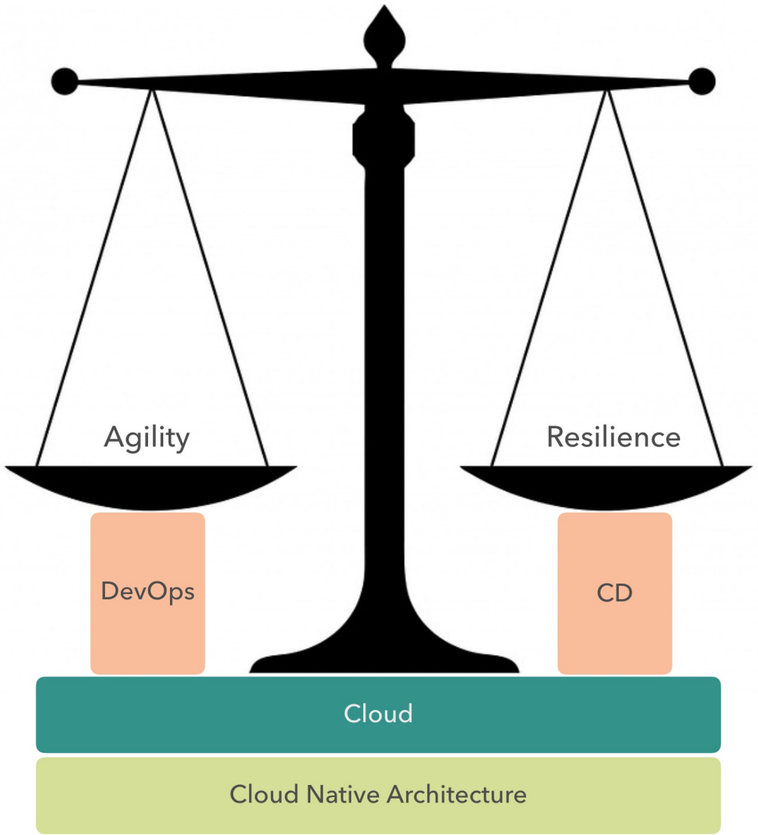
# Supported By:




DevOps and Continuous Delivery

Summary

# On a Foundation of:




Cloud and Architecture

# Introduction to the Brick and Mortar Pattern Language

*Patterns should...be described uniformly.*
*This helps us to compare one pattern*
*with another...*

*Pattern-Oriented Software Architecture, Volume 1: A System of Patterns*

*We describe design patterns using a consistent format...making design patterns easier to learn, compare, and use.*

*Design Patterns: Elements of Reusable Object-Oriented Software*

# Brick and Mortar Pattern Template

- Context

  *The basic situation in which we find ourselves working.*

- Problem

  *Presents the problem as a system forces which must be balanced.*

- Solution

  *Describes the components that make up the general solution, how they relate to one another, and their runtime interactions.*

# Brick and Mortar Language Structure

- Brick Patterns
  *Patterns for constructing individual (micro)services.*
- Mortar Patterns
  *Patterns for composing bricks into complete distributed systems.*

# Brick Patterns

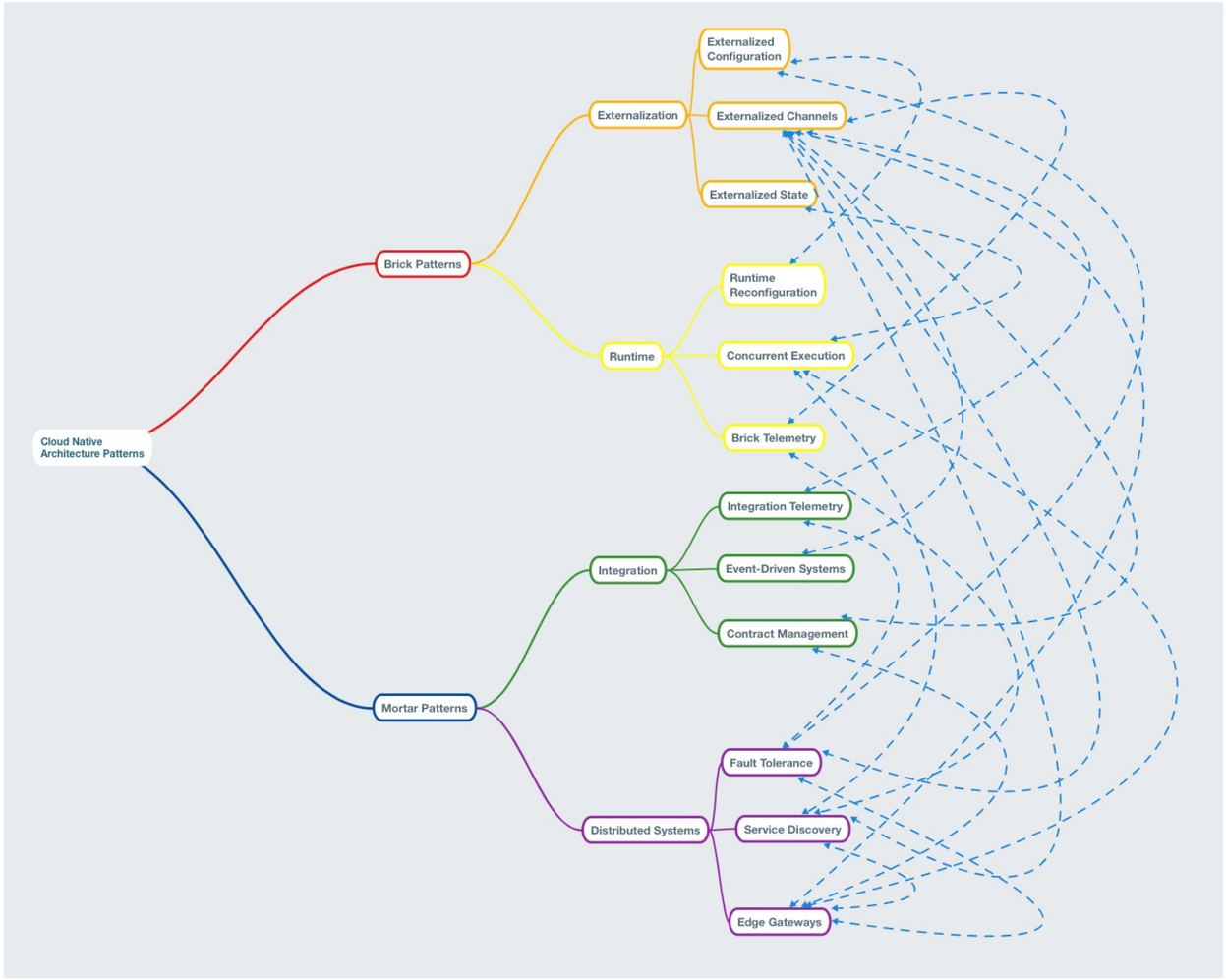
- Externalization Patterns
  *Structural patterns for creating deployable, disposable, and replaceable bricks.*
  - Externalized Configuration
  - Externalized State
  - Externalized Channels
- Runtime Patterns
  *Behavioral patterns for creating deployable, replaceable, and observable bricks.*
  - Runtime Reconfiguration
  - Concurrent Execution
  - Brick Telemetry

# Mortar Patterns

- Distributed Systems Patterns
  *Composition patterns addressing common distributed systems challenges.*
  - Service Discovery
  - Edge Gateway
  - Fault Tolerance
- Integration Patterns
  *Composition patterns addressing integration and observability challenges.*
  - Event-Driven System
  - Contract Management
  - Integration Telemetry

Overview

# Brick and Mortar Language Relationships



# Externalized Configuration

# Context

*An application's configuration will vary independently from its code throughout its lifecycle.*

# Problem

*Traditional techniques for managing configuration tightly couple these two orthogonal concepts.*

# Forces

- Different environments will have different configuration settings:
  - resource handles to the database (e.g. a JDBC URL)
  - credentials to external services (e.g. Amazon S3)
  - per-deploy values such as the canonical hostname (e.g. blog-test.example.com vs. blog-prod.example.com)
  - features that are toggled on or off

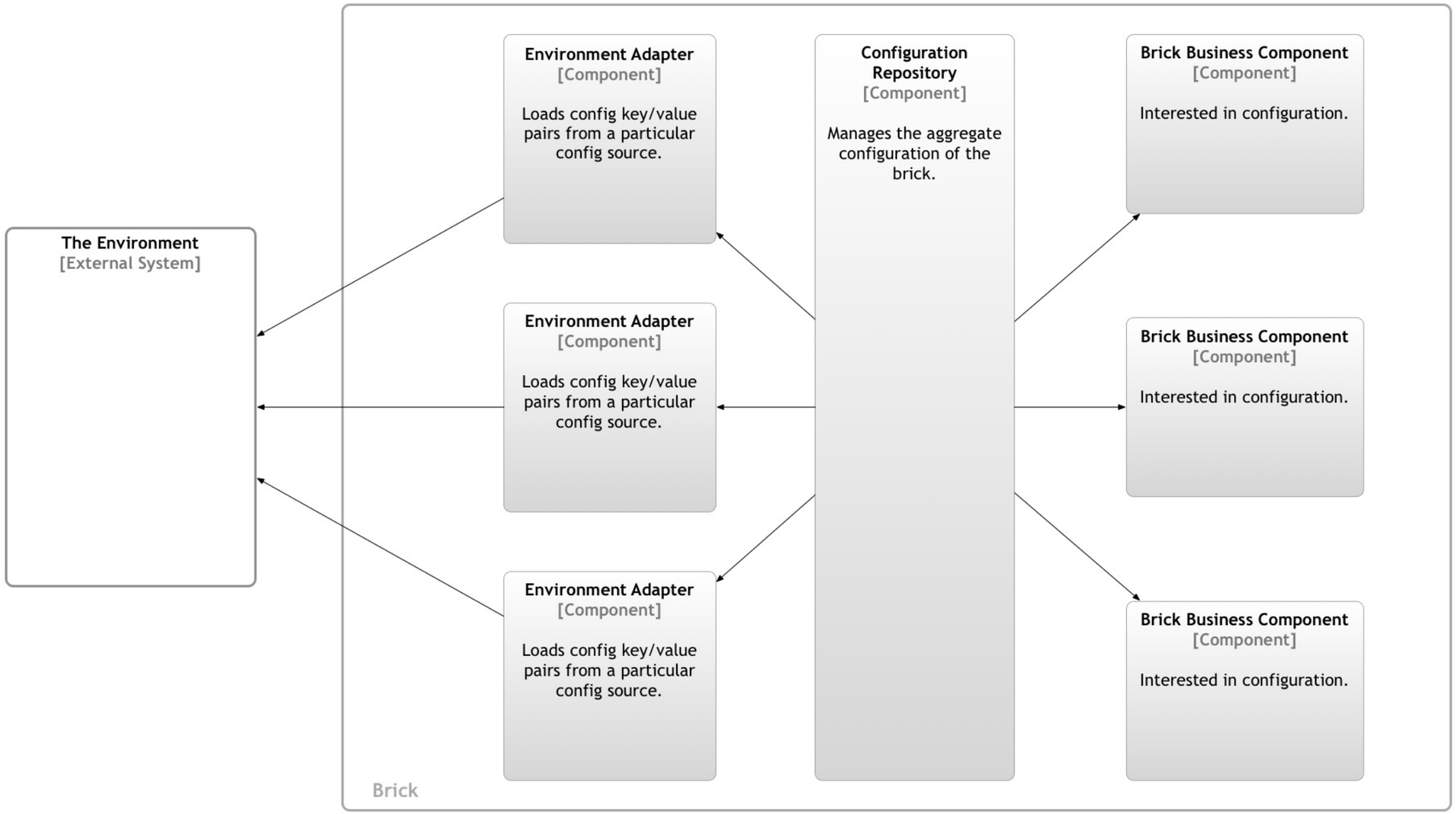
# Forces

- Configuration is often bundled within deployment artifacts (e.g. Java properties files).
- Build processes often modify configuration based on arguments.
- The Deployment Pipeline should only build each deployment artifact once, and deploy the same artifact to multiple environments.

# Components

- The Environment
  *Sources of configuration name/value pairs*
- Environment Adapter
  *Component that understands a particular source of configuration and extracts name/value pairs from it*
- Configuration Repository
  *Component that manages the aggregate configuration of the brick.*
- Brick Component
  *Business component that is interested in configuration*

# Solution Structure



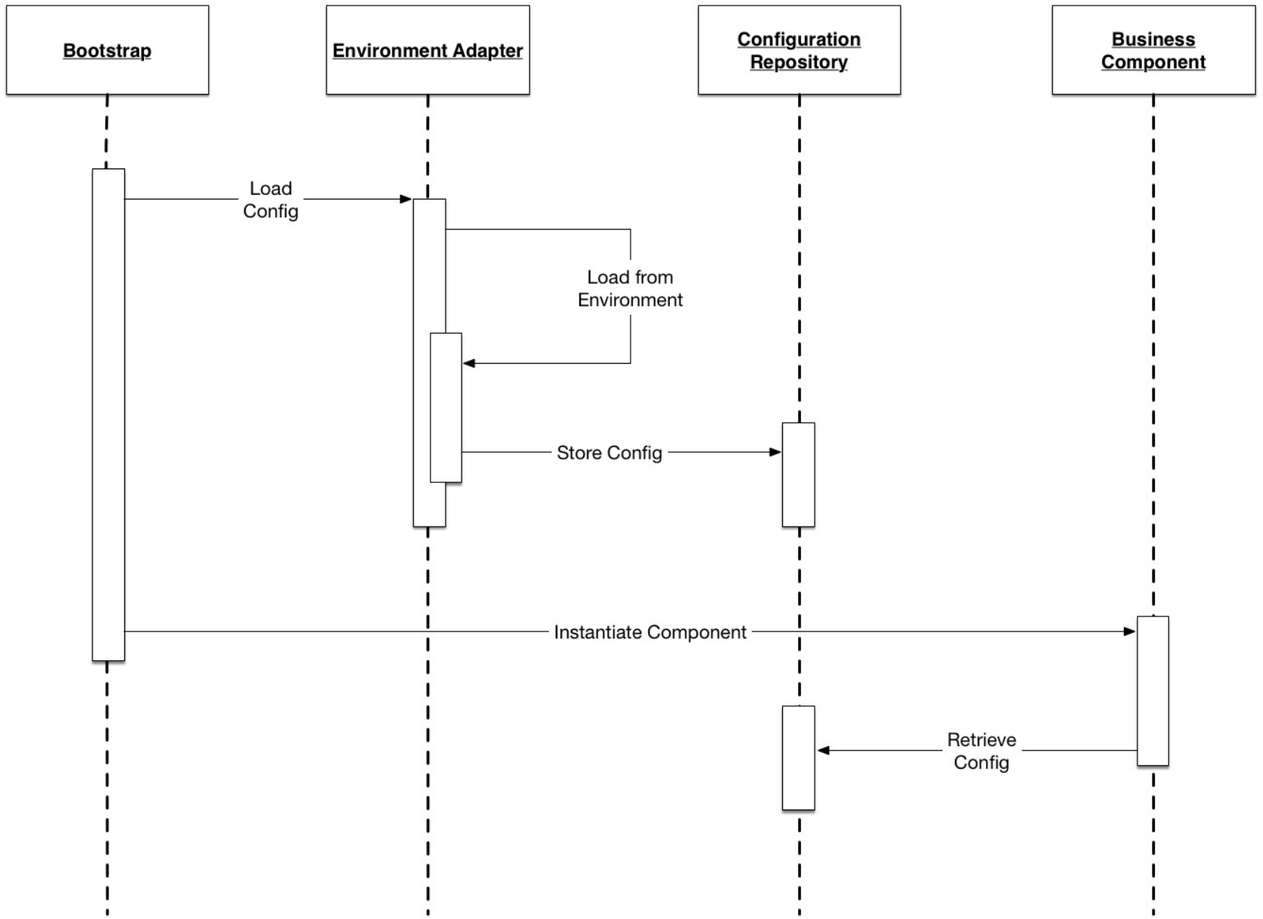

# Components and Relationships

# The Environment Adapter

## An Extensible Component

- Environment Variables
- Start Command Arguments
- Database
- Configuration Service

# Solution Dynamics




## Runtime Sequence of Events

# BREAK TIME

We will start again at 11:15!

# Externalized State

# Context

*Disposability and Replaceability require the elimination of "snowflake deployments" from the architecture.*

# Problem

*Traditional state management techniques prevent us from achieving "phoenix deployments."*

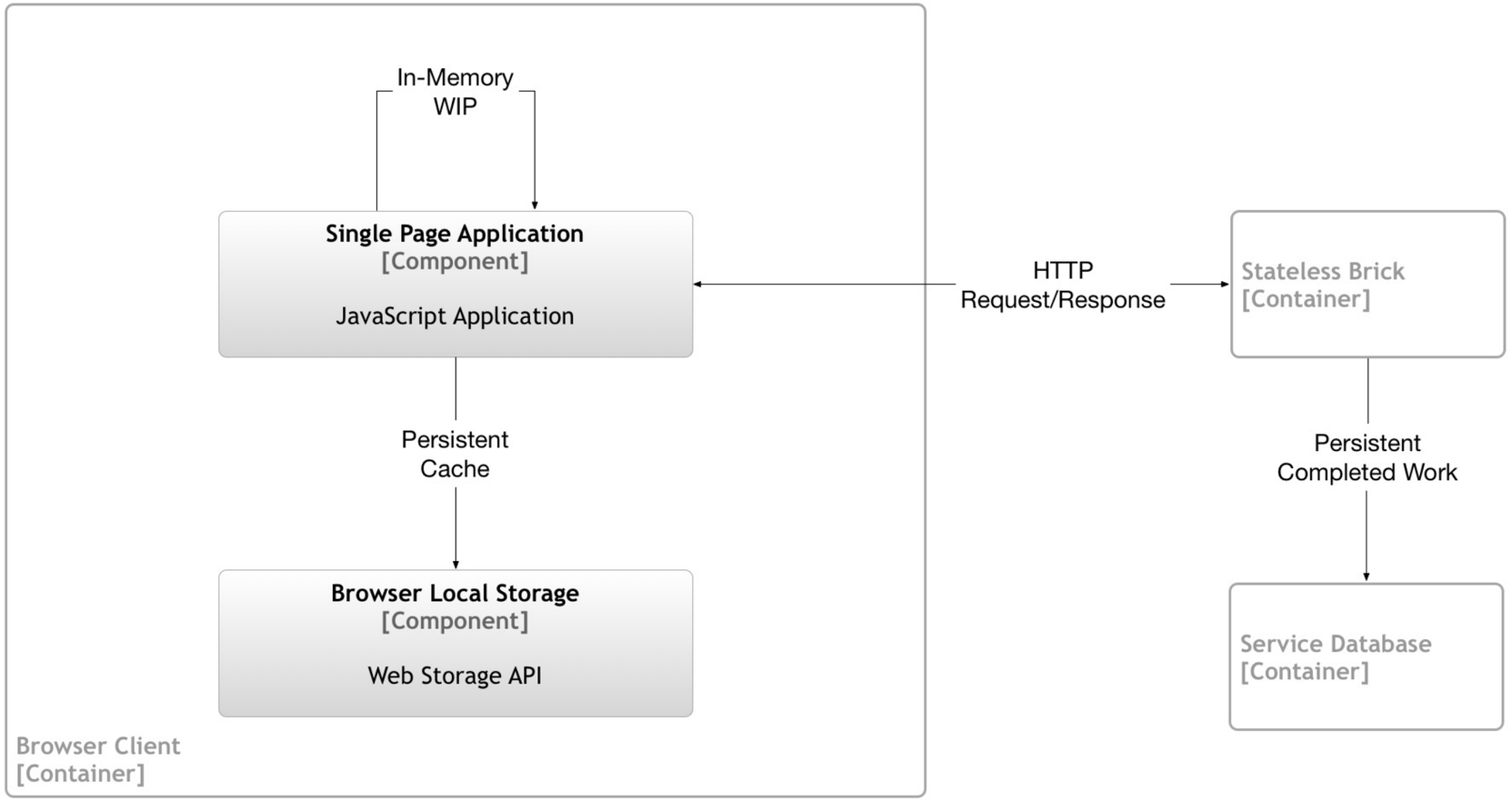
# Forces

- Early web architectures emphasized server-side state management:
  - Fat Clients to Thin Clients
  - Vertically Scaled Cache Management
  - Stateful Scaffolding on Stateless Protocol (HTTP)

# Forces

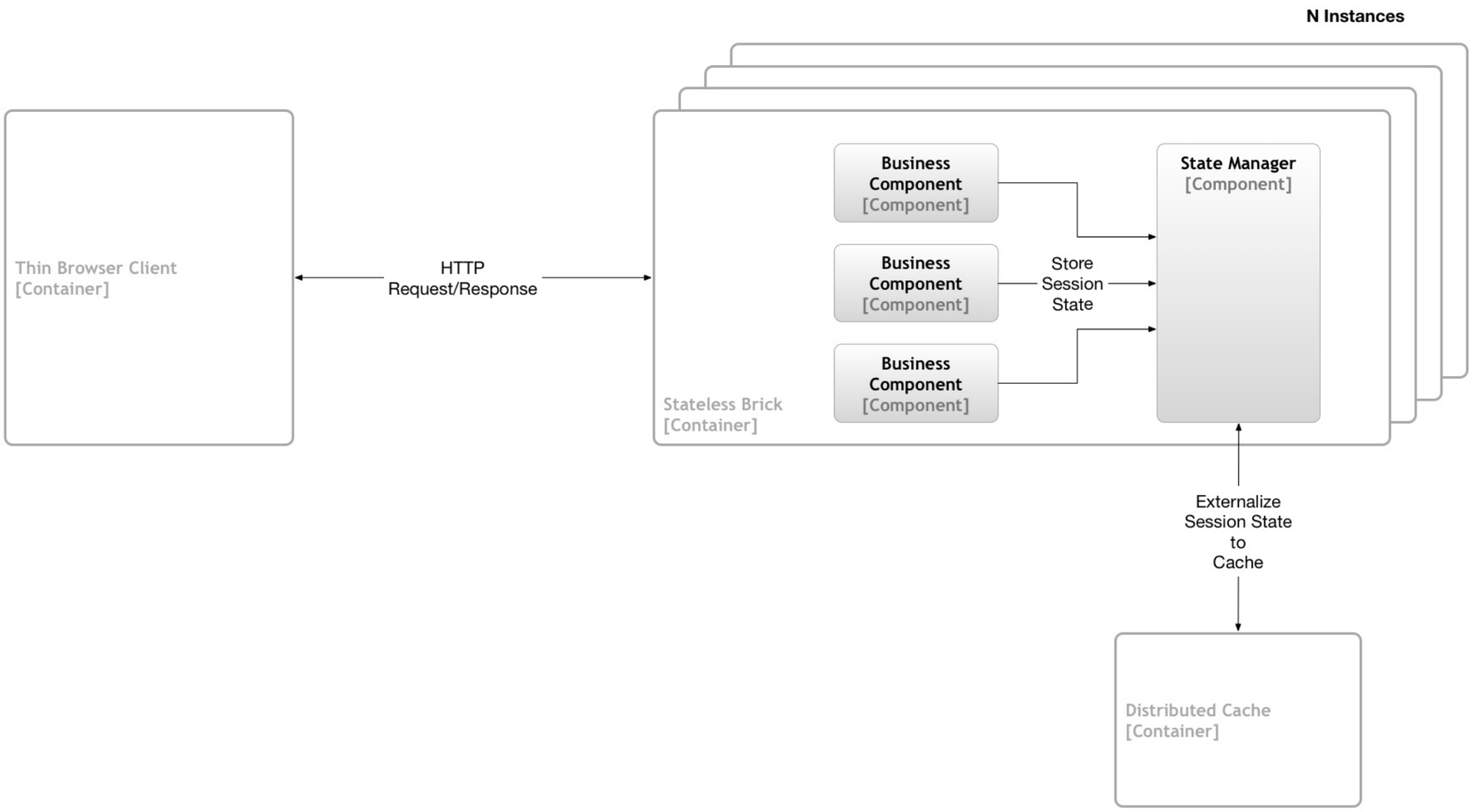
- Cloud Infrastructure:
  - Resource Limited Horizontal Scale
  - Limited Load Balancer Support for Sessions
  - Limited (No) Support for Persistent Local Disk

Solution Structure



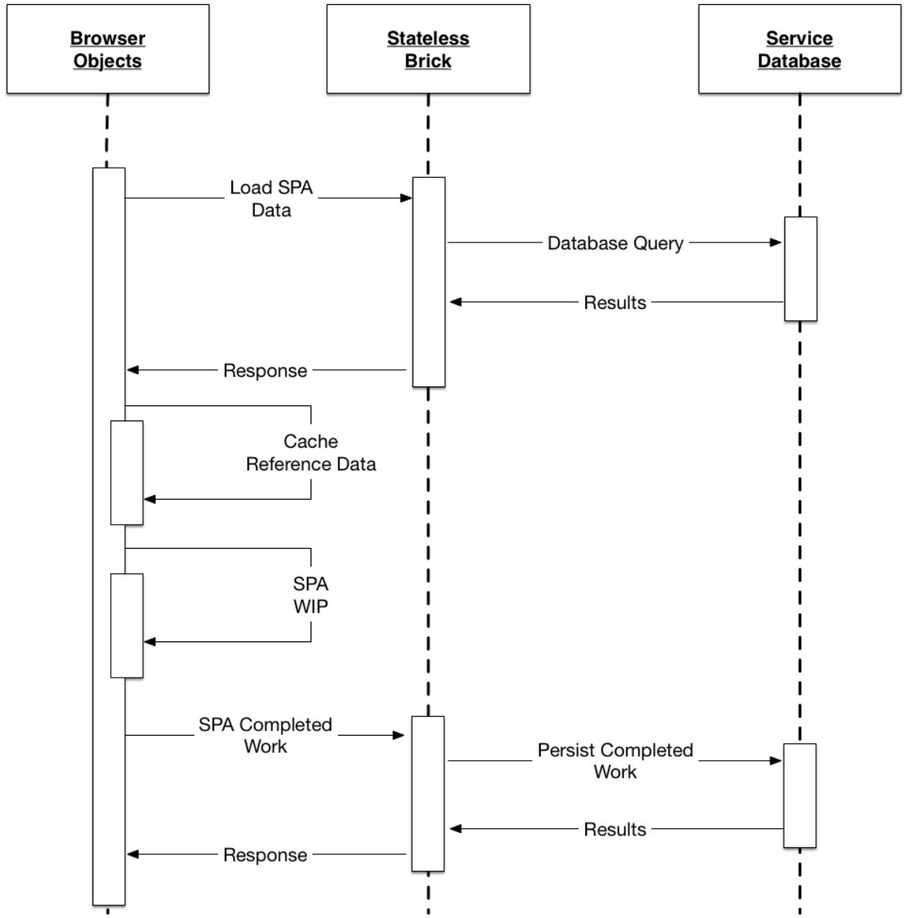

Single-Page Application Variant

Solution Structure



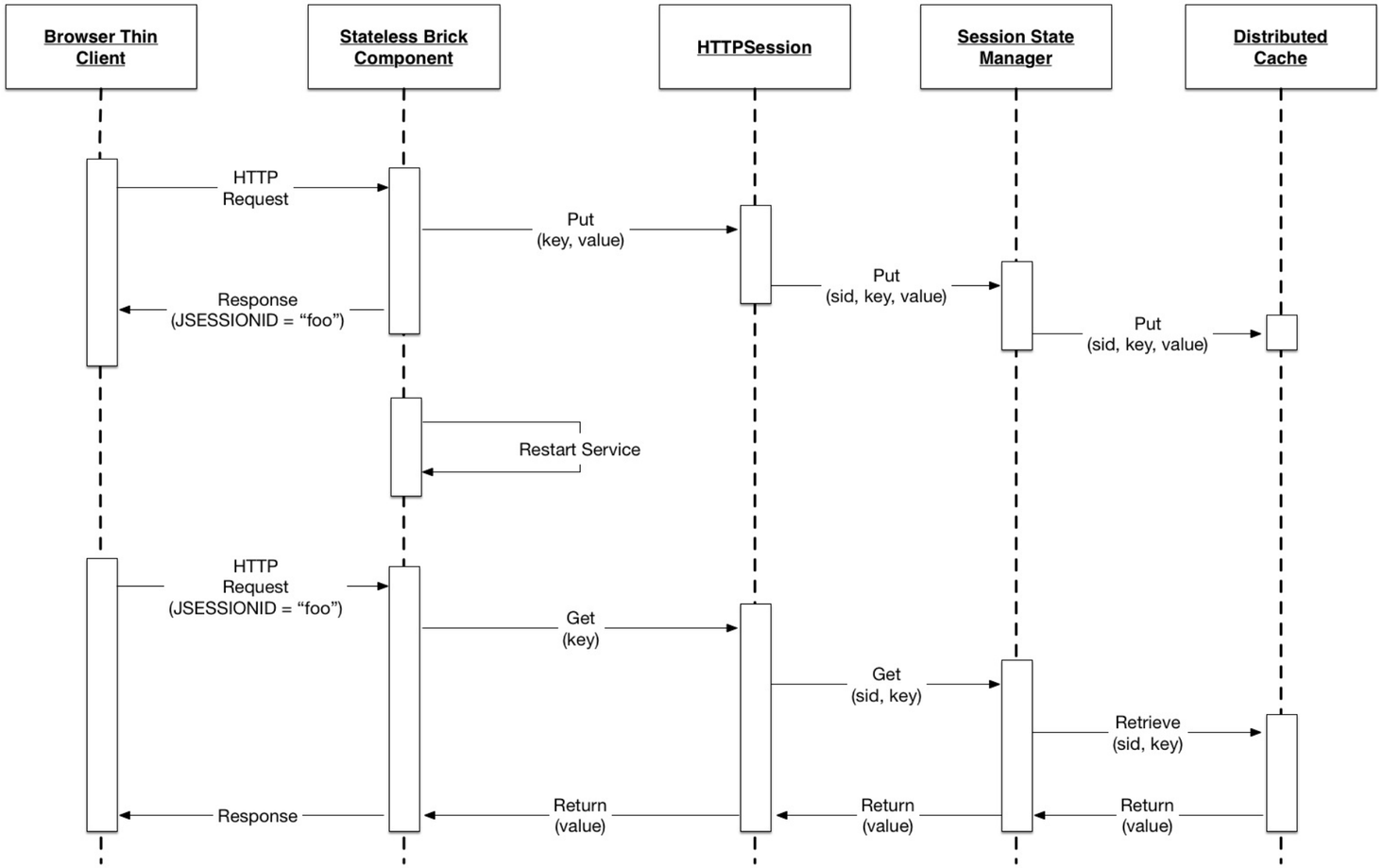

Externalized Session Variant

# Solution Dynamics




## Single-Page Application Variant

# Solution Dynamics




Externalized Session Variant

# Externalized Channels

# Context

*We want to be able to opportunistically evolve and recompose our systems as business drivers change.*

# Problem

*Interleaving details of intercomponent communication with business logic makes it difficult to leverage functions/data streams in unplanned ways.*

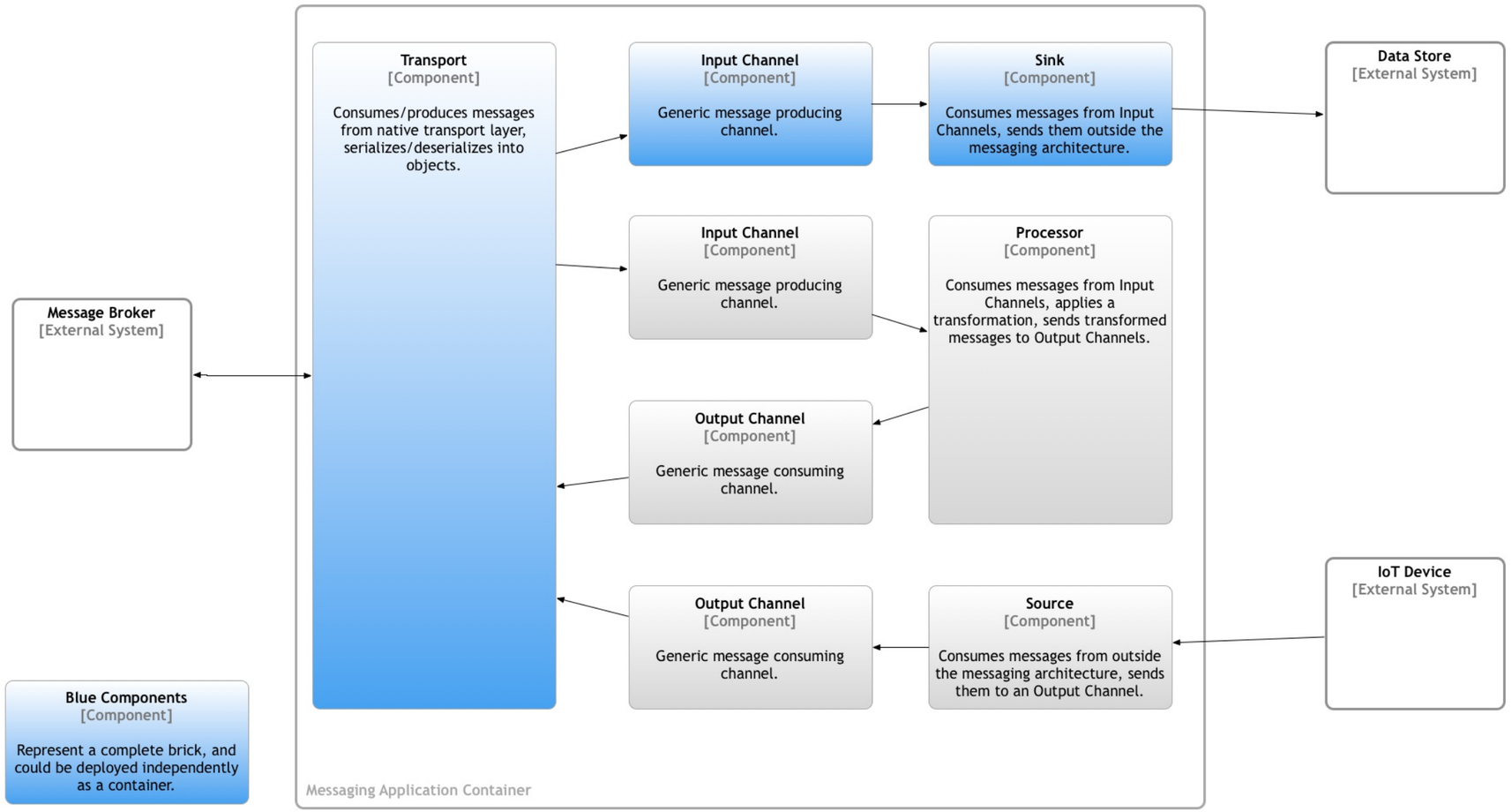
# Forces

- Business processes and components are often reusuable in other contexts.
- Business processes and components are independent of:
  - Wire Protocol
  - Serialization Method
  - Fault Tolerance Aspects

# Forces

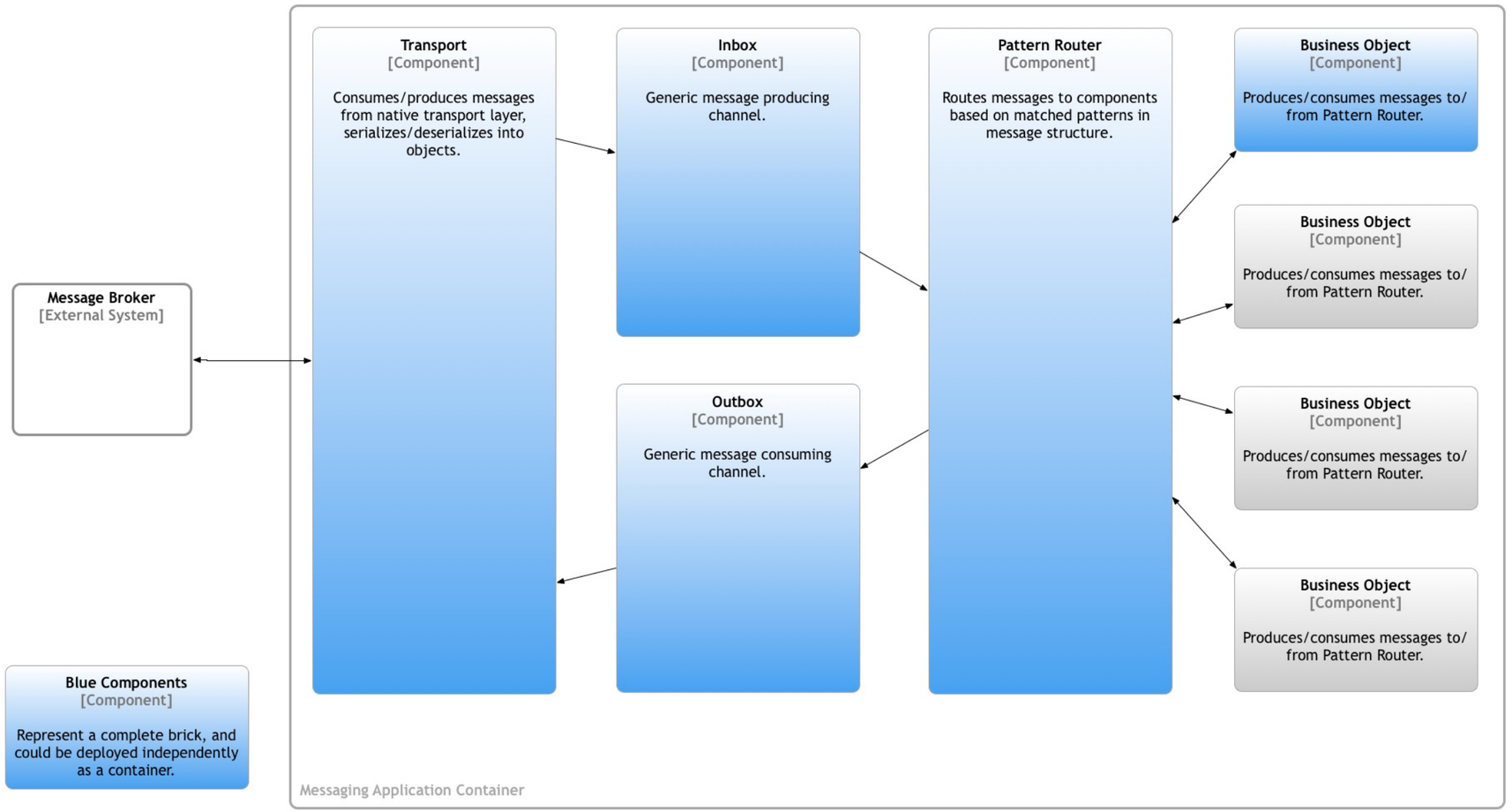
- Data streams can be "tapped" and redirected to other processes.
- Integration architectures are often "design once, change never."
- Business logic is often implemented in an integration architecture specific framework scaffold.

# Solution Structure



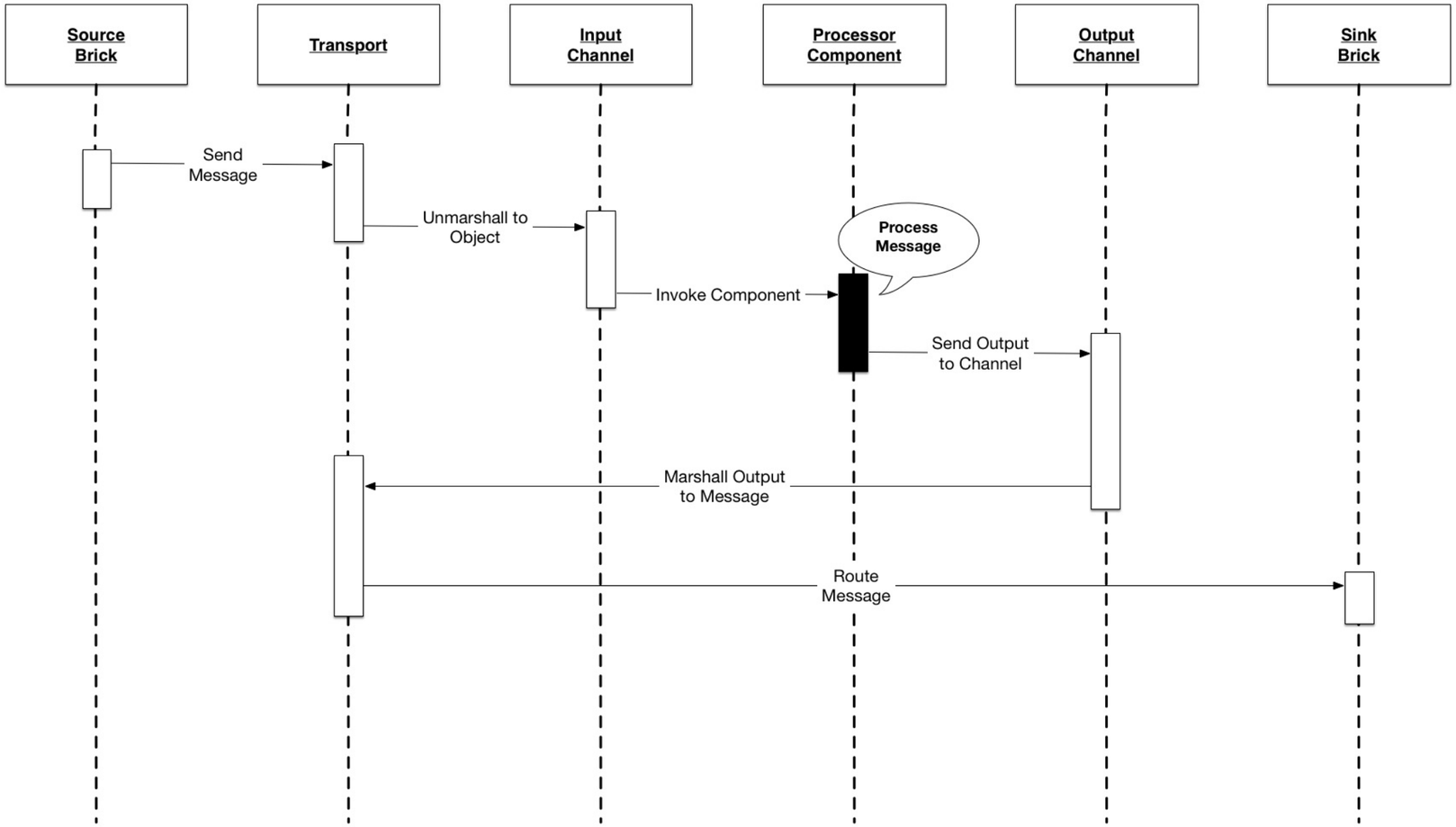

# Binder Variant (Spring Cloud Stream)

# Solution Structure



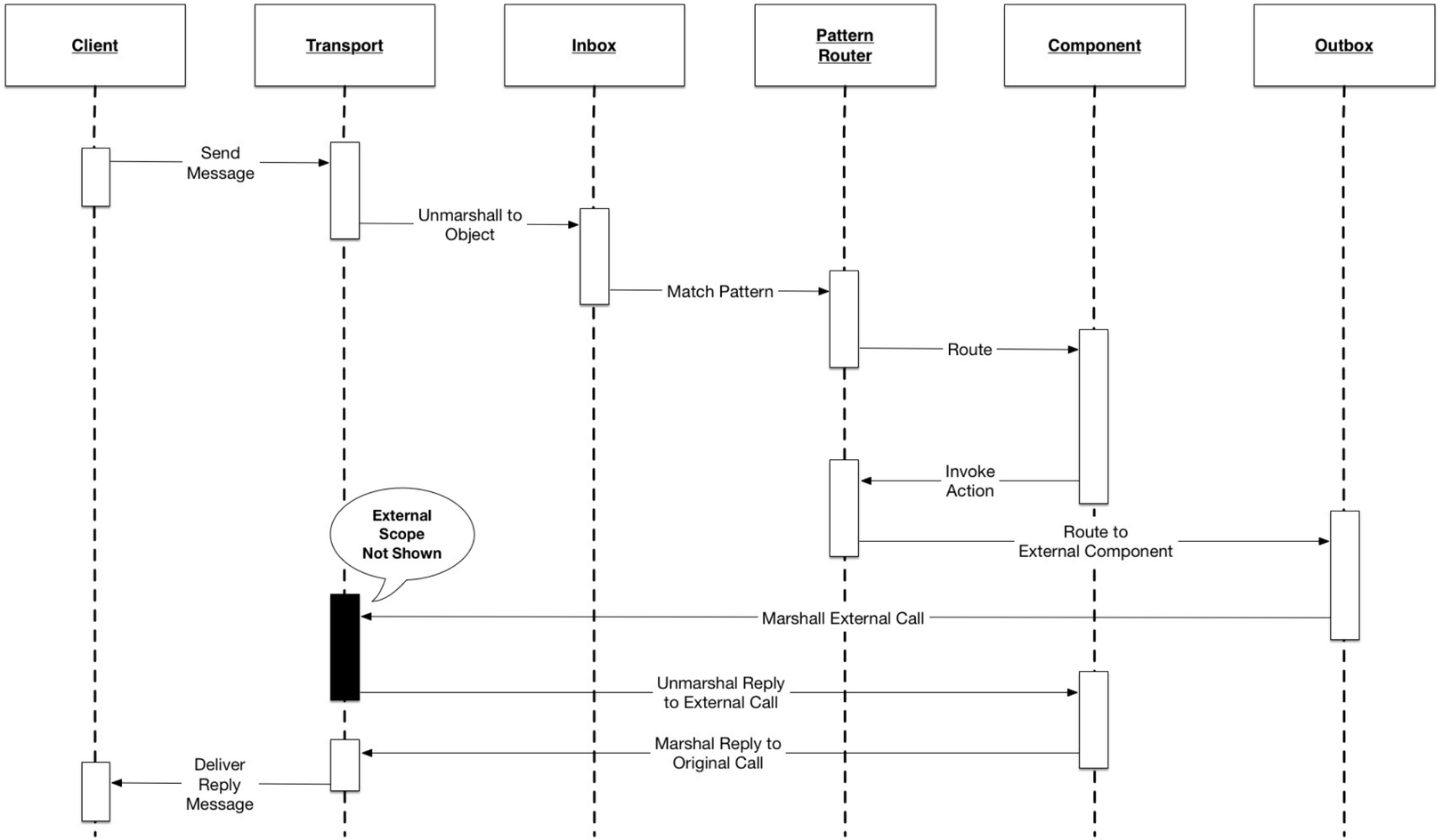

# Pattern Matching Variant (Seneca.js)

# Solution Dynamics




## Binder Variant (Spring Cloud Stream)

# Solution Dynamics




## Pattern Matching Variant (Seneca.js)

# Runtime Reconfiguration

# Context

*We want to make configuration changes at runtime that are quick and don't otherwise disturb the state of the running system.*

# Problem

*Even with **Externalized Configuration**, configuration changes are often coupled to deployment events.*

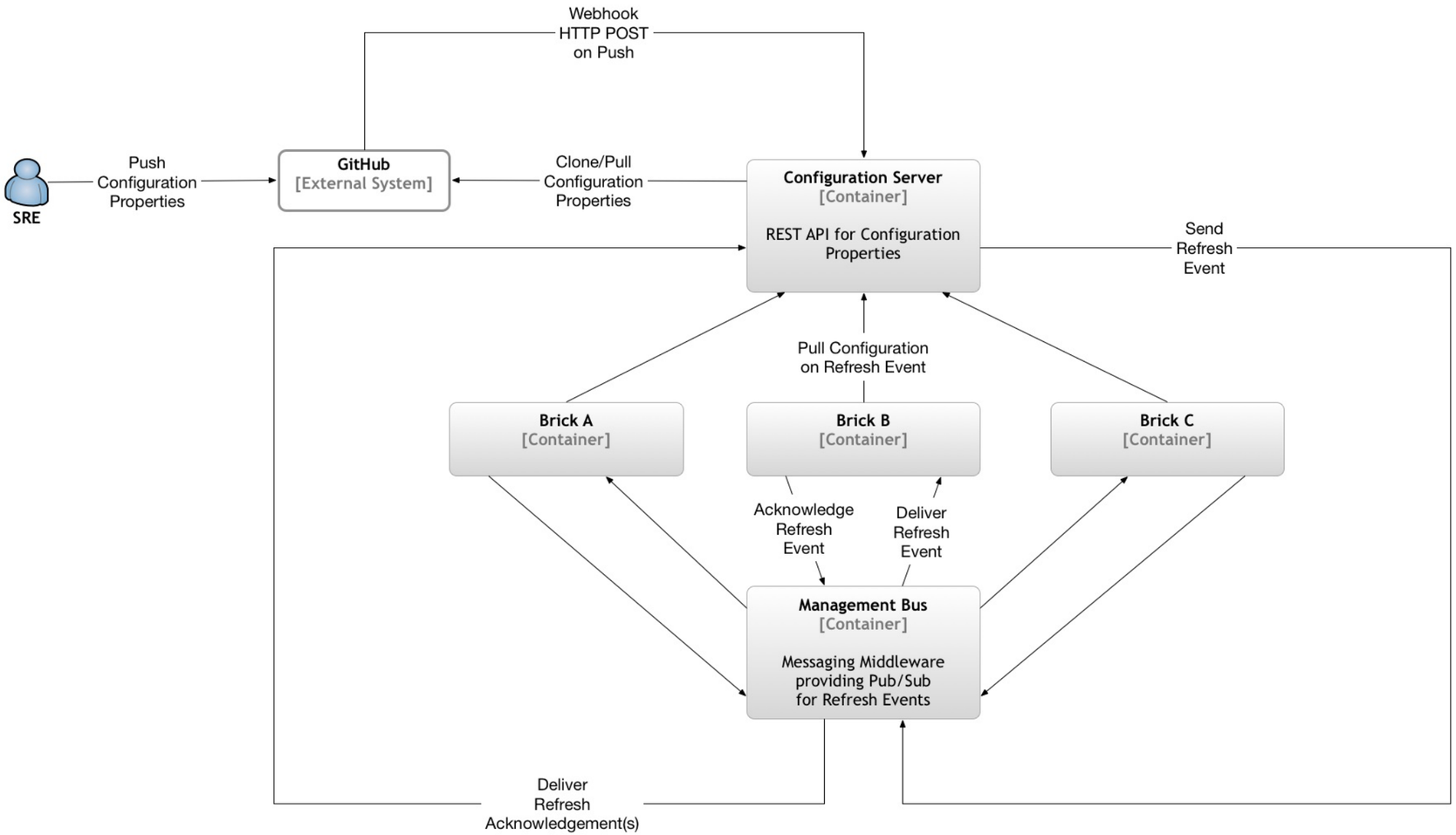
# Forces

- Configuration often happens only as a boot time event.
- Environment Variables only injected as part of a deployment event.
- Debugging often implies "turning up the volume" on observability. Sometimes we need a "pre-warmed" system to listen to.

# Forces

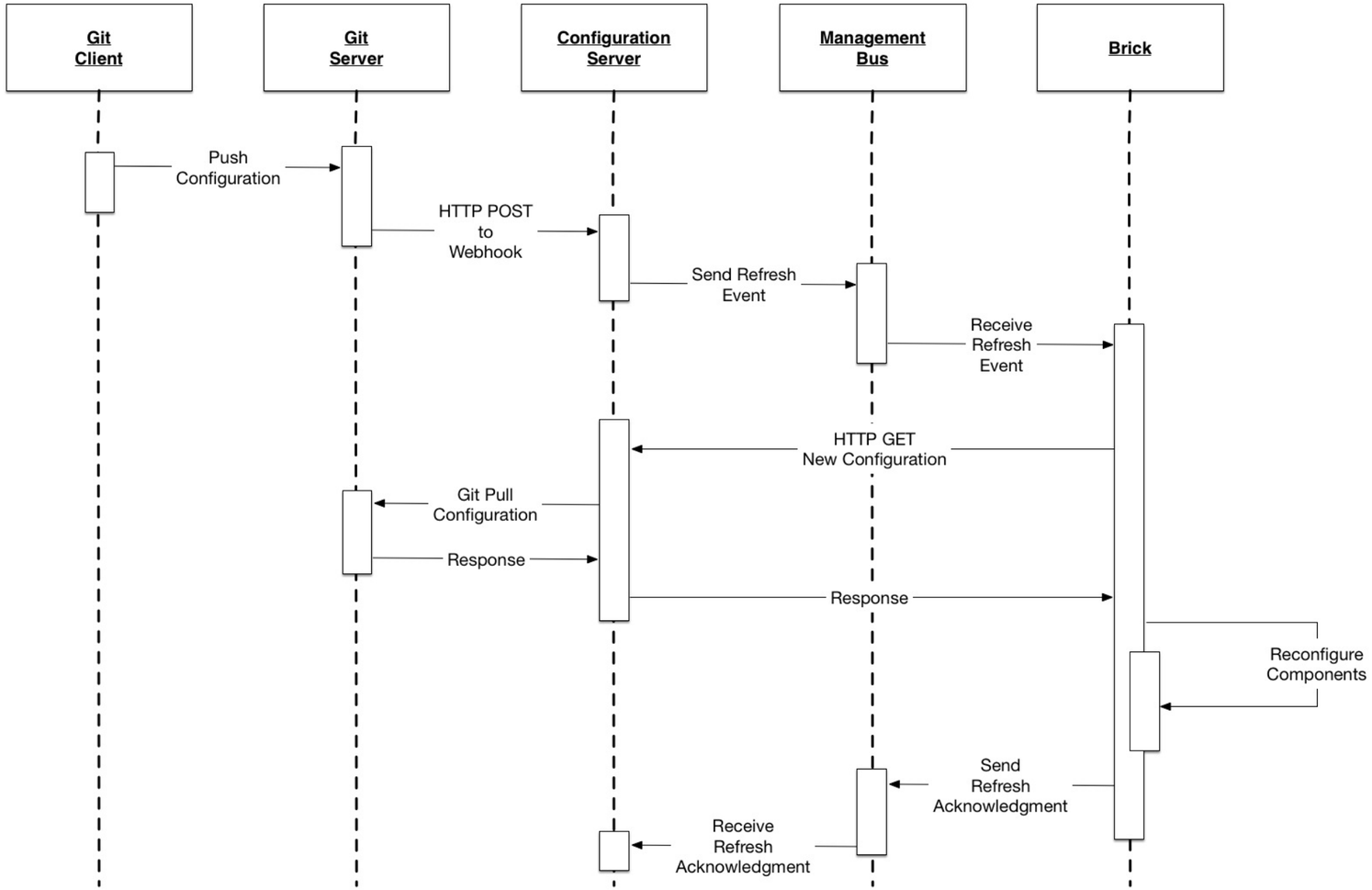
- Decoupling feature releases from deployment through feature toggles requires runtime configuration changes.
- Rotating DB credentials should be faster than (and not require) the deployment pipeline.

# Solution Structure




Config Server + Management Bus

# Solution Dynamics




Config Server + Management Bus

# Concurrent Execution

# Context

*Users want business value (features), not deployments. Experiments often require concurrent execution of multiple software versions.*

# Problem

*Traditional techniques for managing deployments require downtime events and don't support concurrent execution of multiple software versions.*

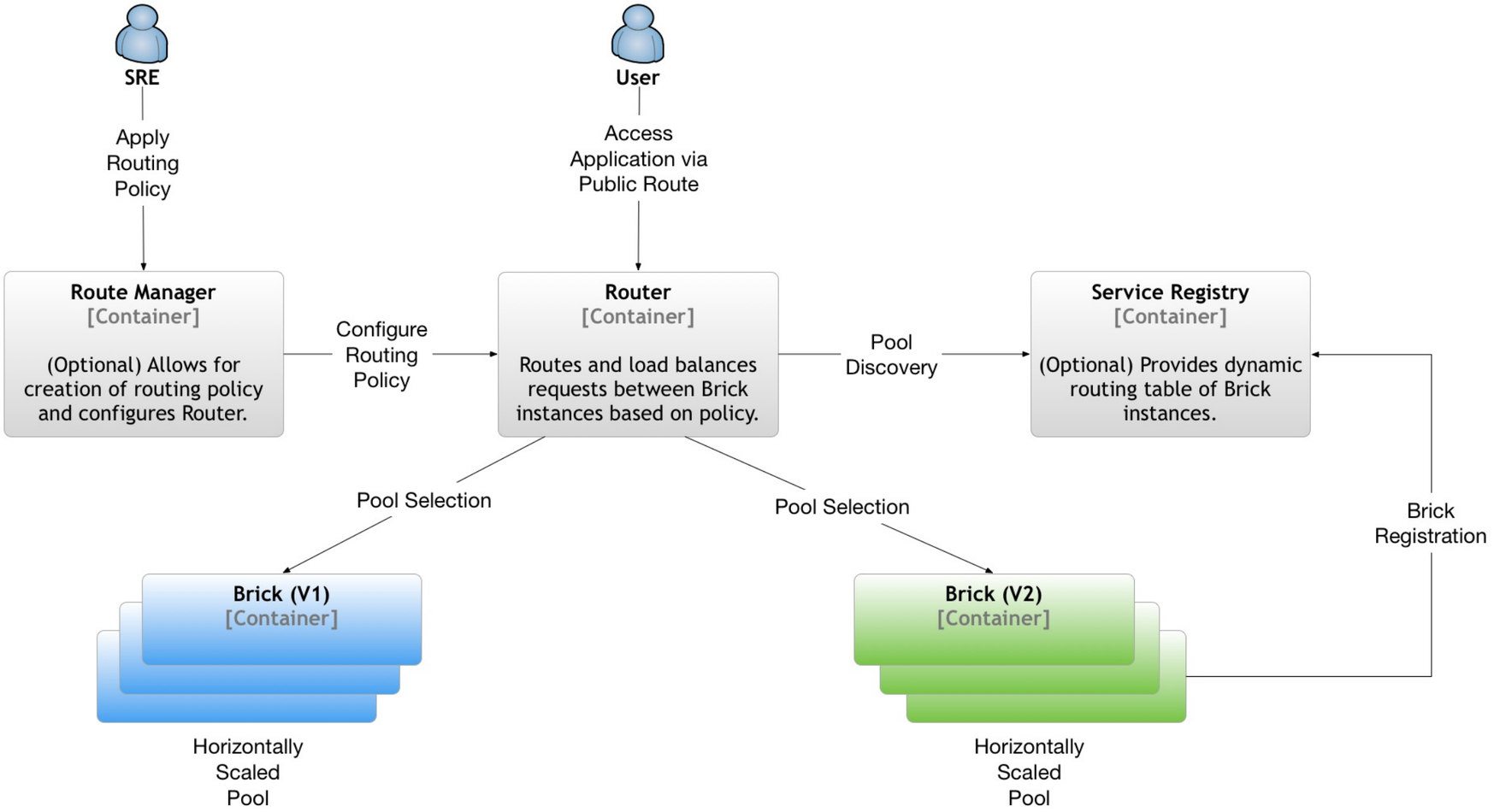
# Forces

- Feature releases are coupled to deployment events.
- Production deployments will often target a single infrastructure environment.
- Downtime events expose users to "how the sausage is made."

# Forces

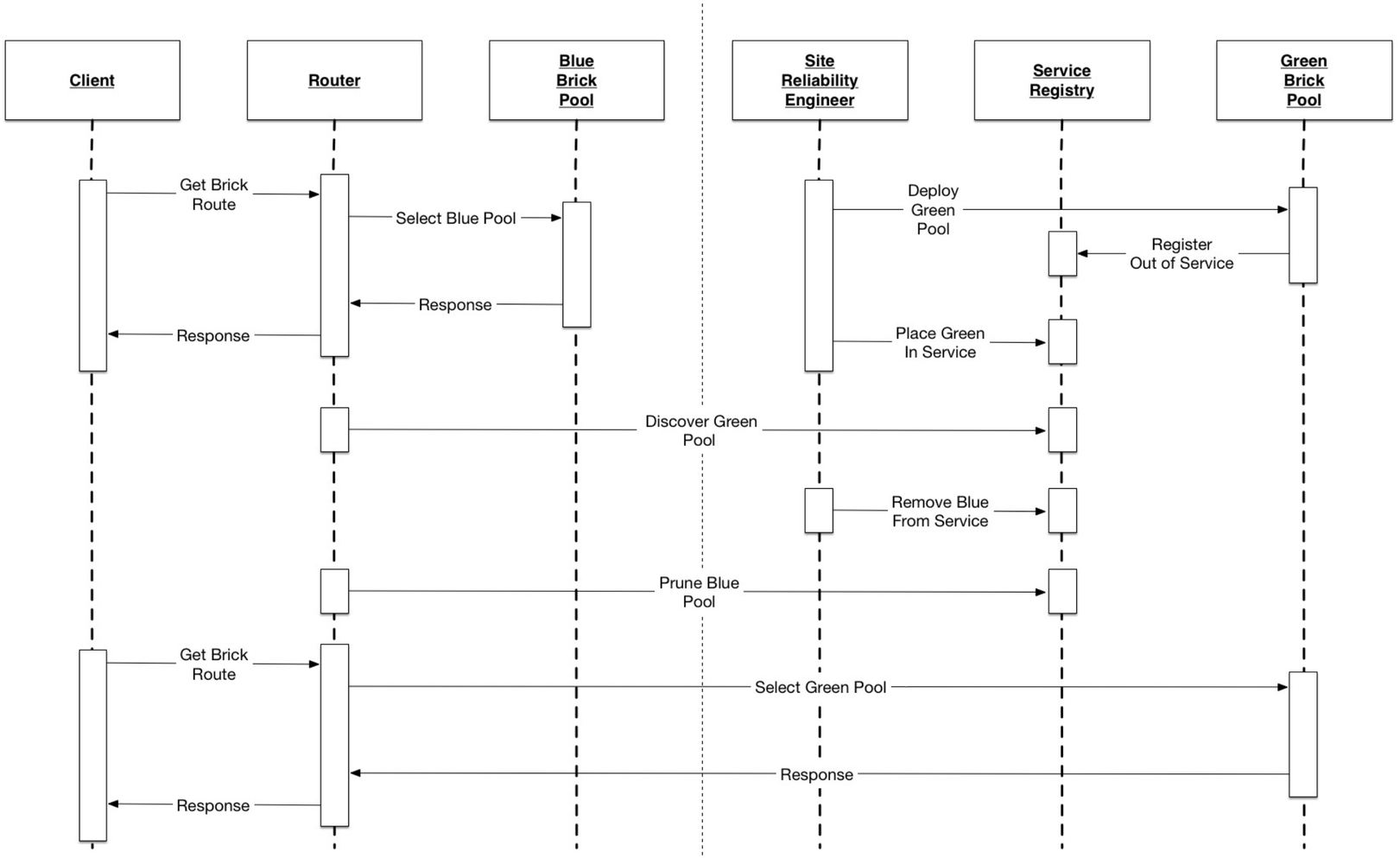
- Failed deployments exacerbate downtime events.
- Hypothesis (in)validation (e.g. A/B testing) requires selective UX.
- Selective UX in a monolithic application is complex/error prone.

# Solution Structure




# Router + Optional Components

# Solution Dynamics




Router + Service Registry

# Brick Telemetry

# Context

*Realizing the DevOps Way of Feedback requires that we have visibility into both the business value and technical behavior generated by our services.*

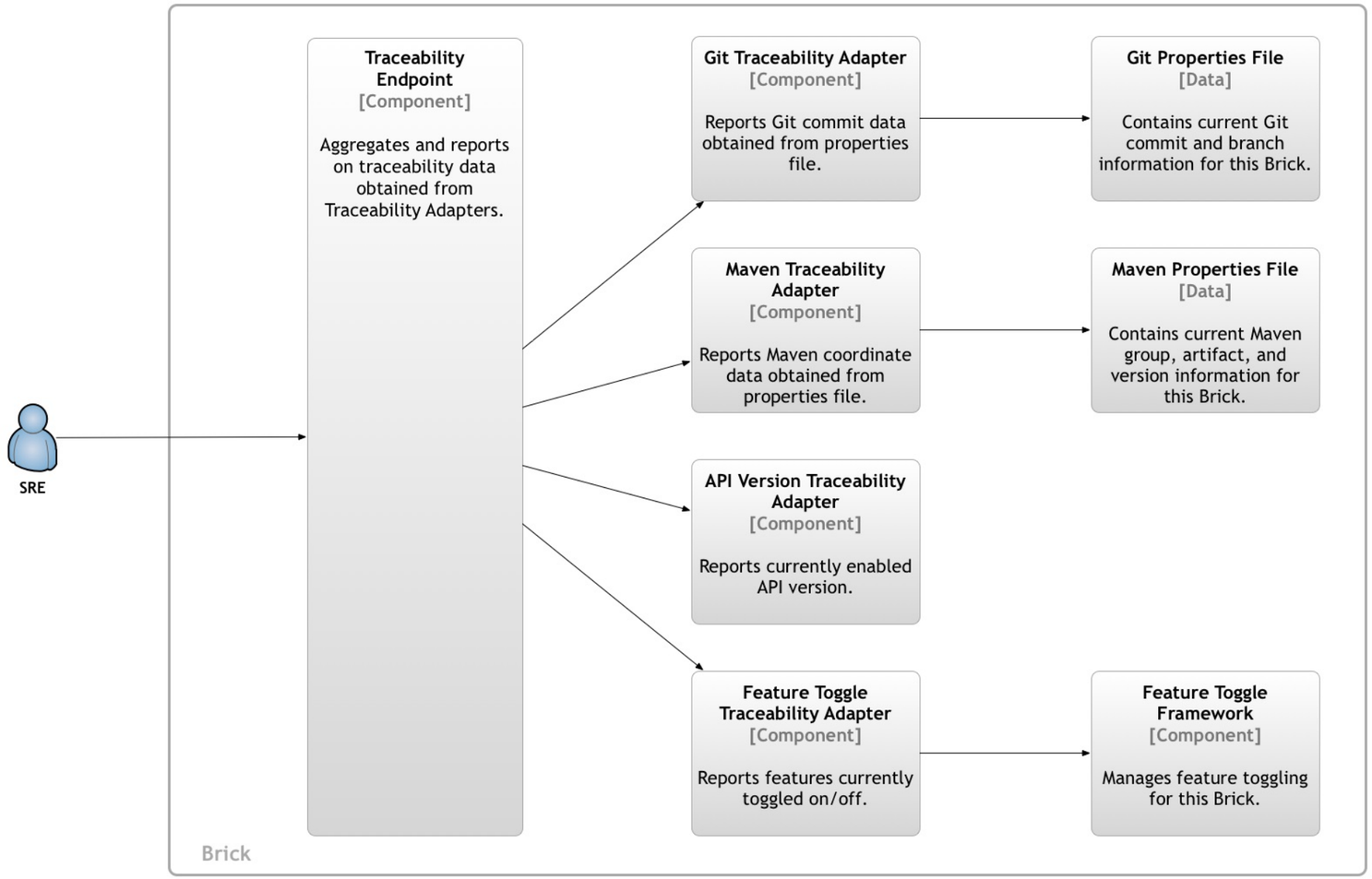
# Problem

*Common approaches to service visibility fall short of the architectural qualities that we need.*

# Forces

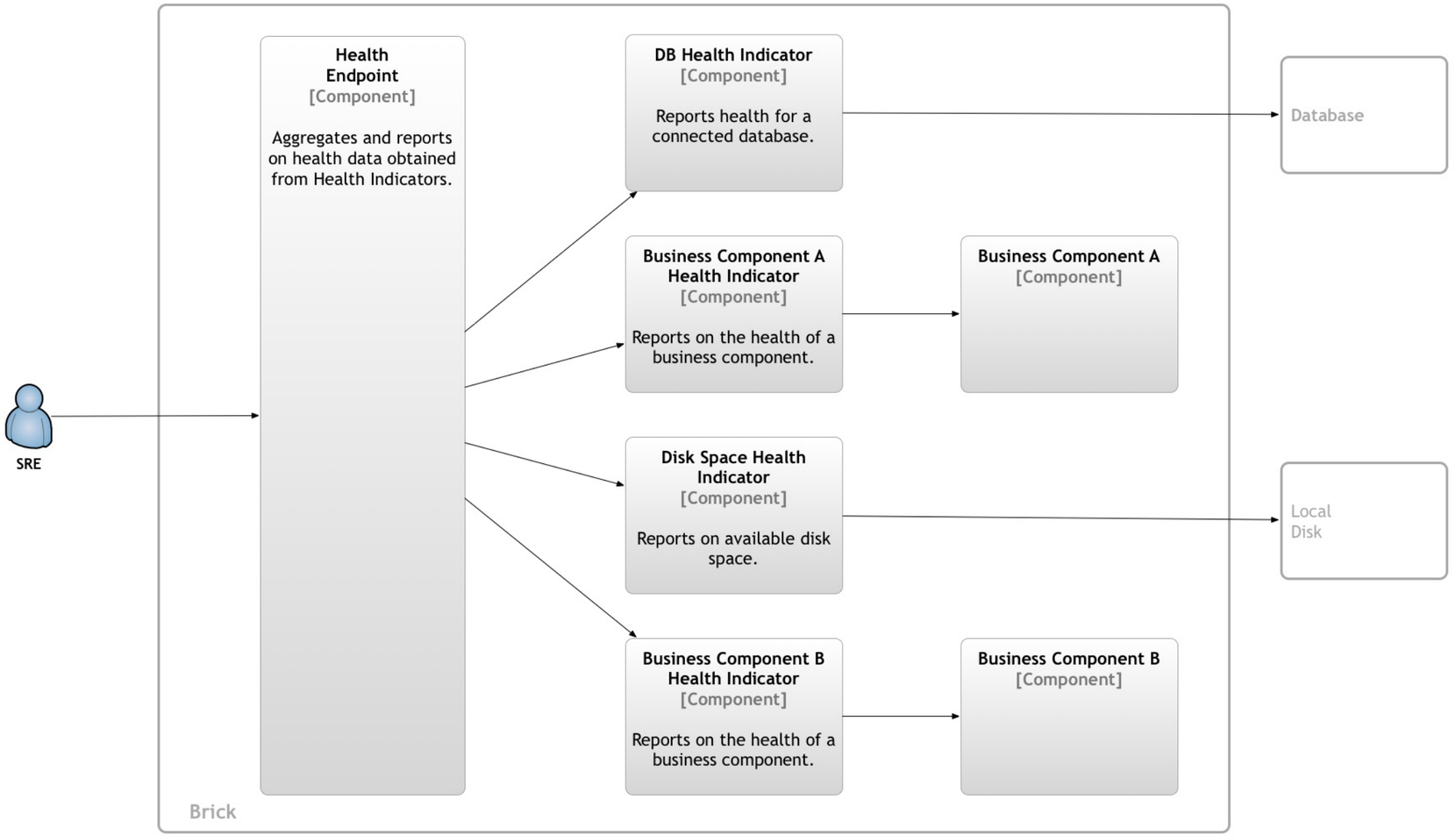
- Visibility is often accomplished via post facto application of agent-based monitoring tools.
- Agent-based monitoring tools don't understand business value.
- Determining an application's health often requires complex logic.
- Traceability of an application is difficult (or impossible) to accomplish with OTS solutions.

# Solution Structure



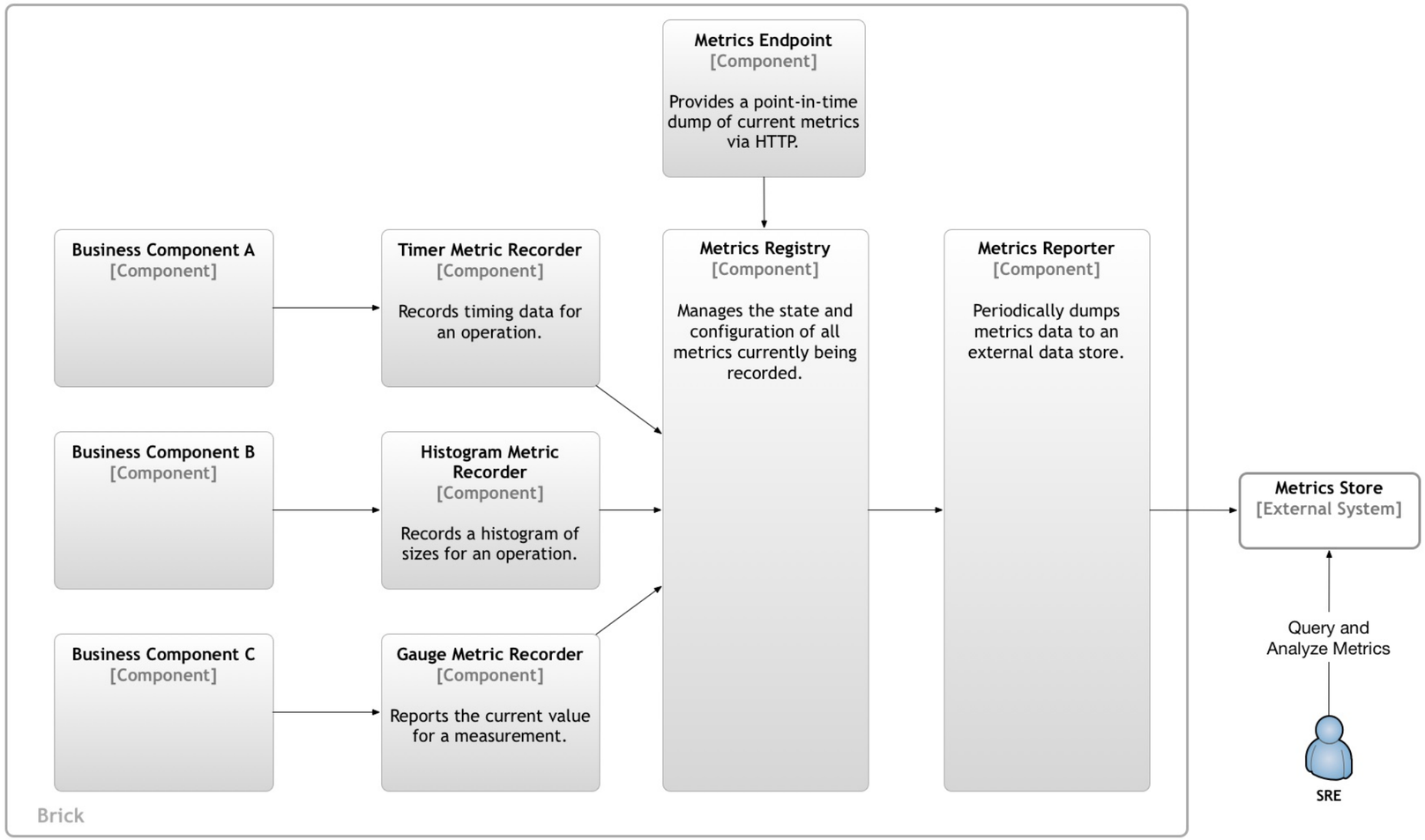

# Traceability Components

# Solution Structure



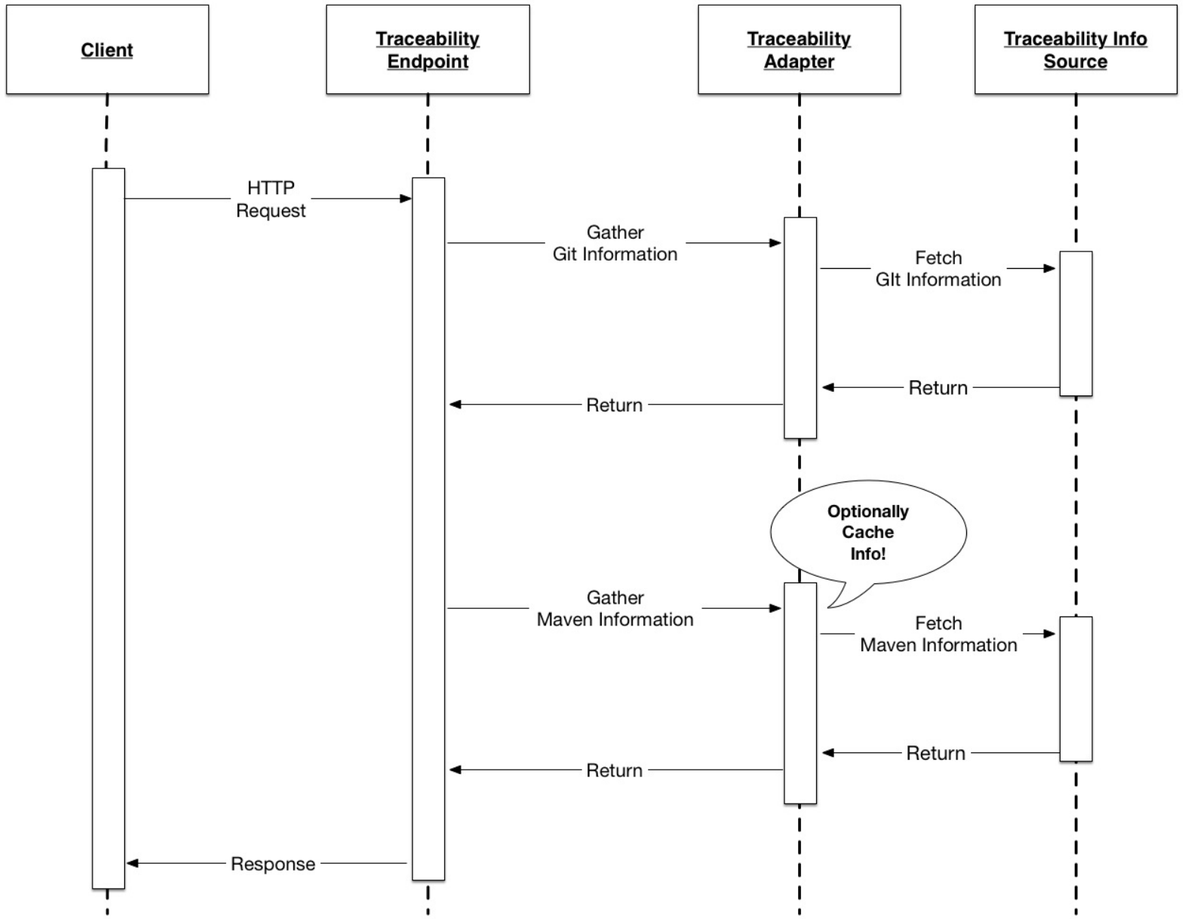

# Health Components

# Solution Structure



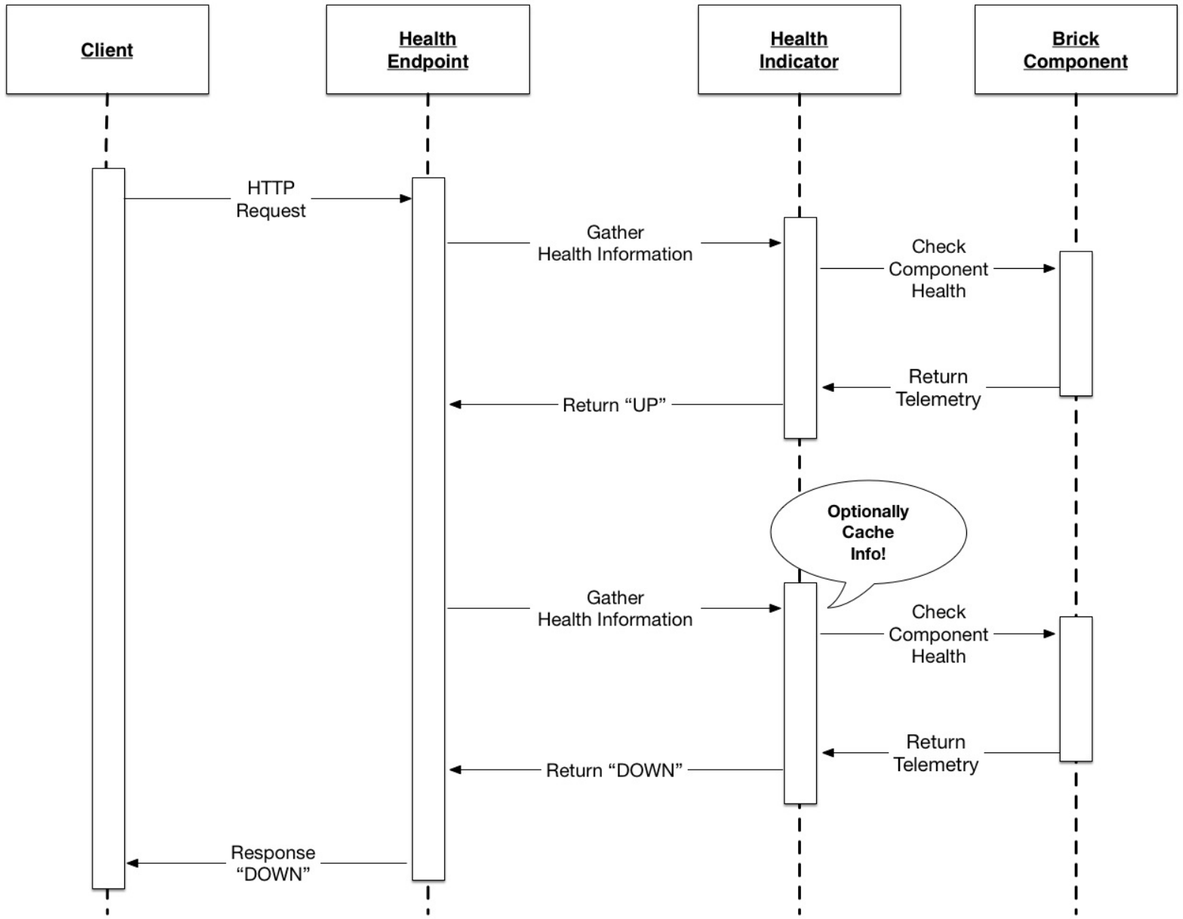

# Metrics Components

# Solution Dynamics



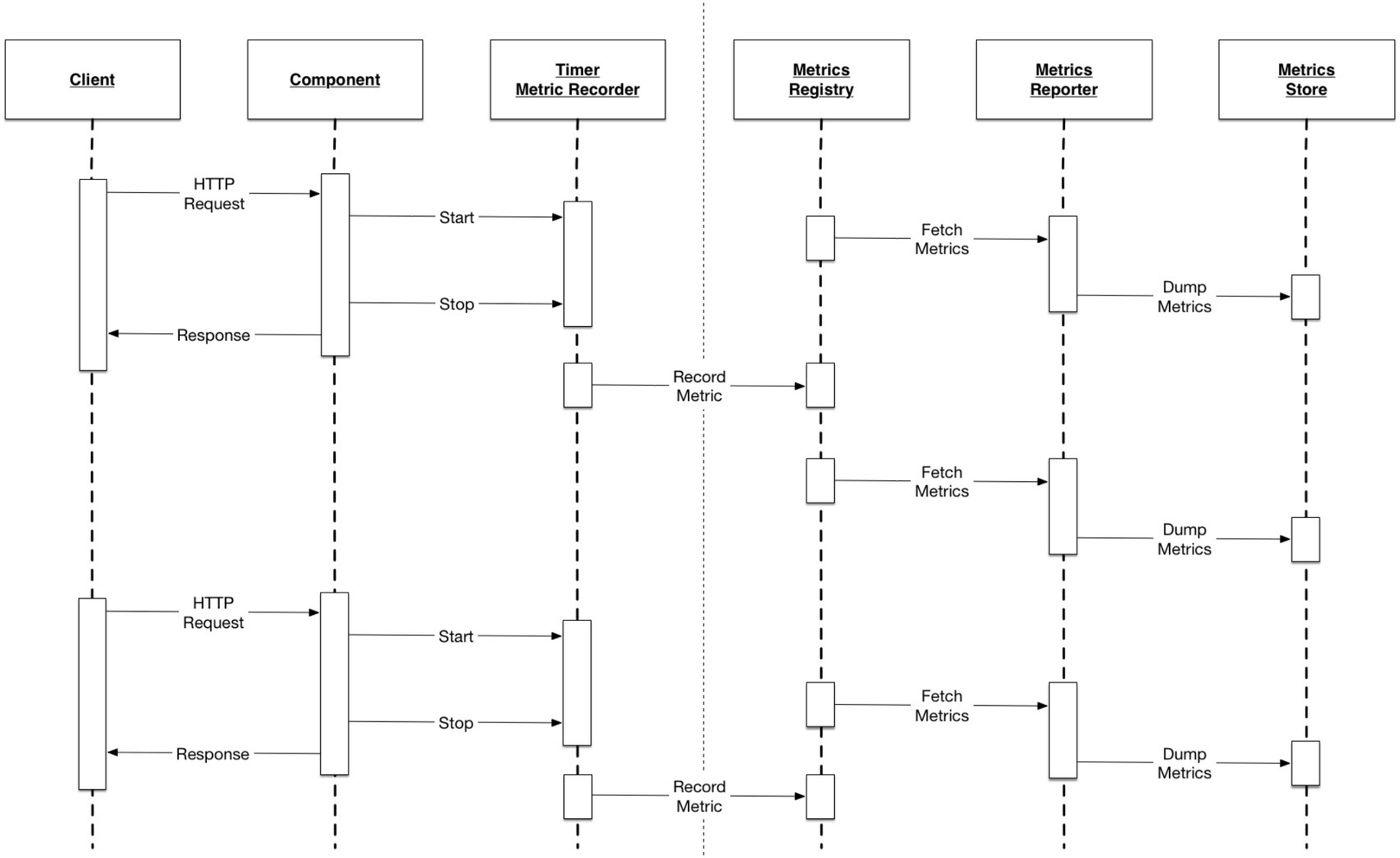

Traceability

# Solution Dynamics




# Health

# Solution Dynamics




# Metrics

# Socratic Q&A: Morning Topics

# Service Discovery

# Context

*Decomposition of architecture into services leads to increasingly more distributed systems.*

# Problem

*As systems become distributed, and as service instance lifecycles become more dynamic and independent, location of and communication with dependencies becomes more challenging.*

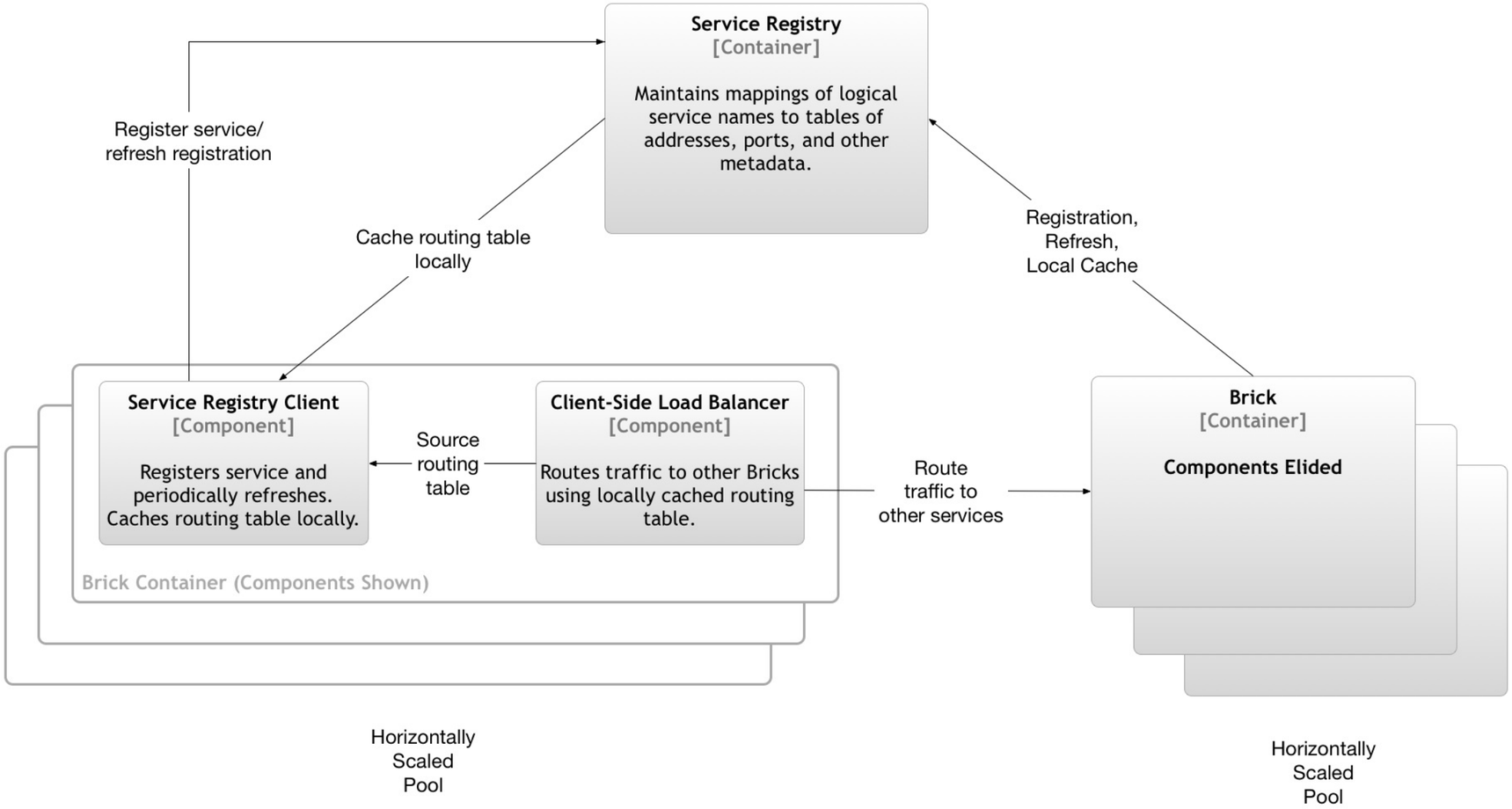
# Forces

- Cloud platforms often assign auto-generated, internal hostnames or private IP's to service instances.
- As services are scaled and unhealthy instances are replaced, the addresses of a service's instances are constantly changing.
- Binding a service to anything other than logical names for its dependencies leads to friction in the architectural lifecycle.

# Forces

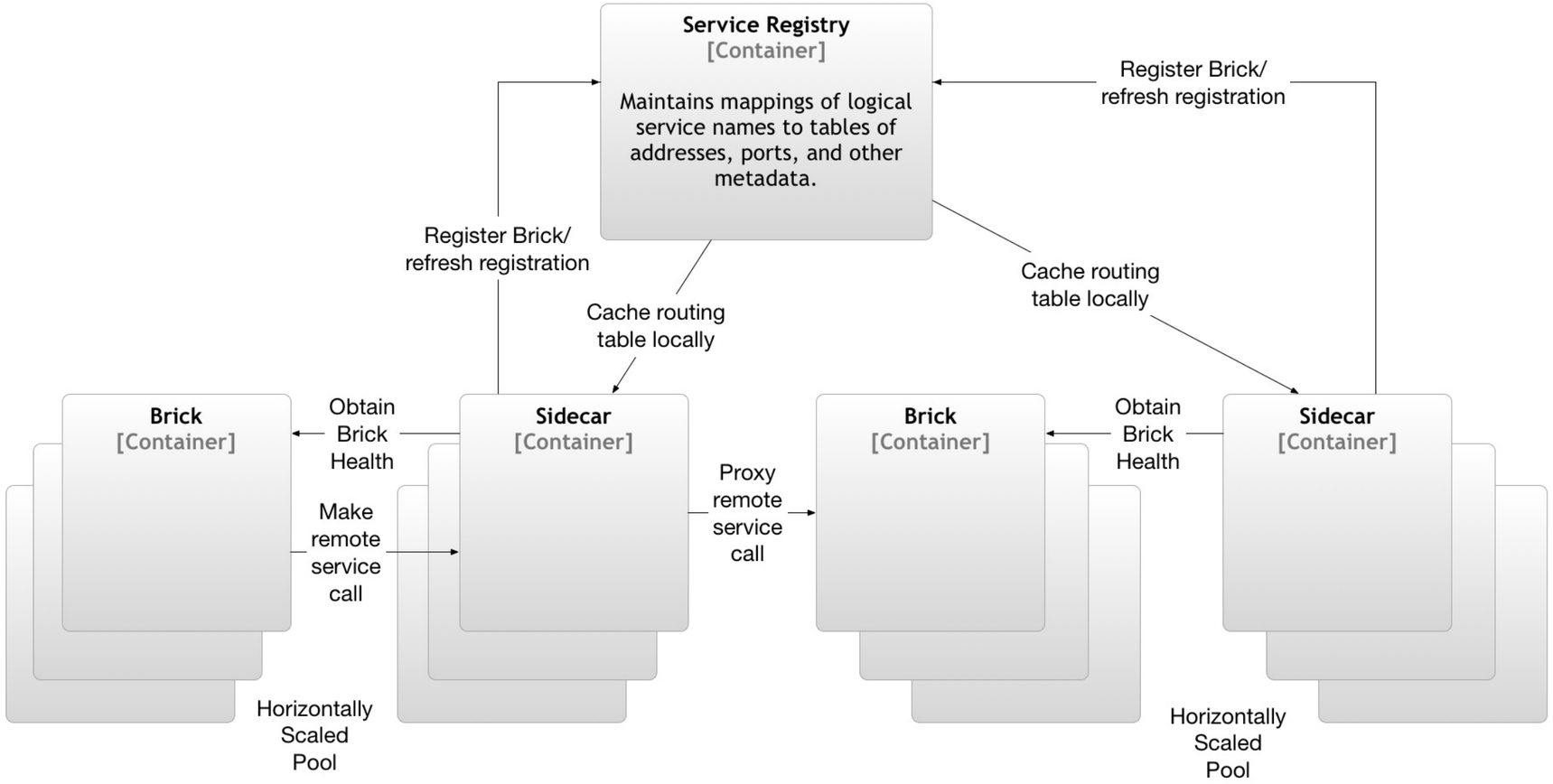
- Applying Concurrent Execution is made more difficult (or impossible) when binding services to fixed addresses for their dependencies.
- We may want to remove a service instance from the available pool but keep it running to troubleshoot a problem.

Solution Structure



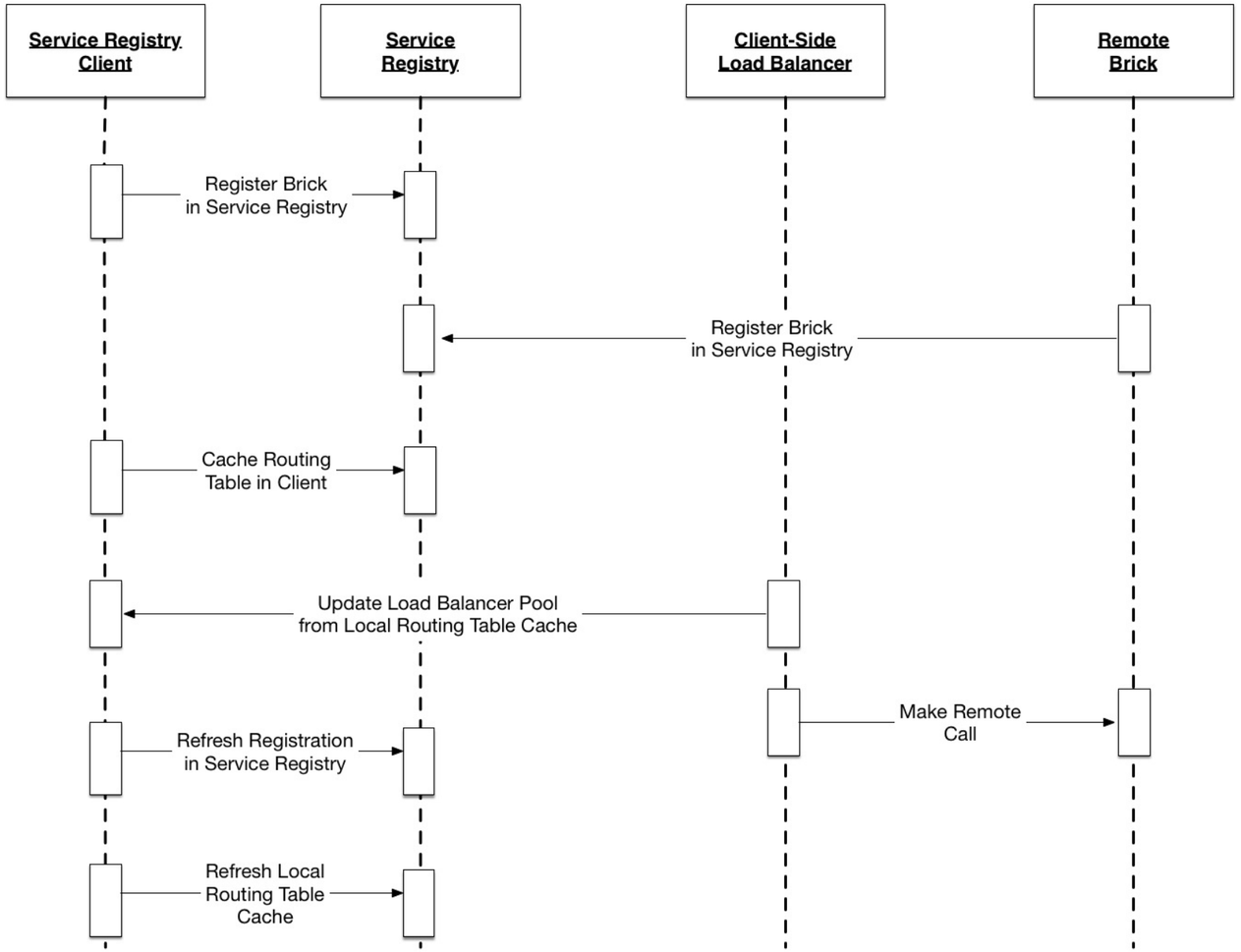

Client-Side Load Balancing Variant

Solution Structure



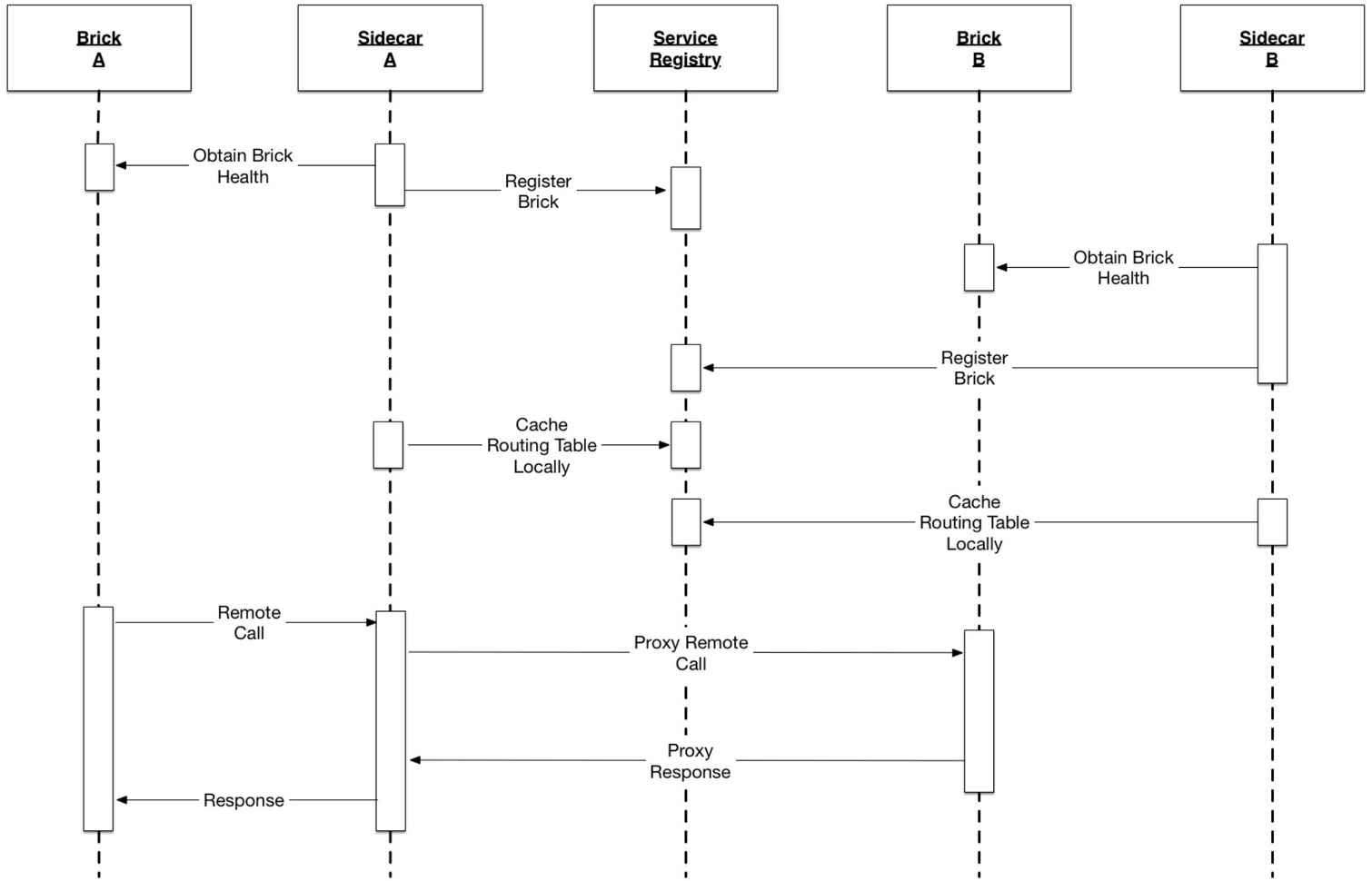

Sidecar Proxy Variant

# Solution Dynamics




## Client-Side Load Balancing Variant

# Solution Dynamics




## Sidecar Proxy Variant

# Architecture Katas Set Up

# Architectural Katas

Based on http://archkatas.herokuapp.com

- You'll divide into groups and grab supplies.
- You'll take the architectural problem and create a practice architectural solution in ~1 hour.
- You can ask me any question you have about the project.
- Any technology stack is fair game.
- You may safely make assumptions about technologies you don't know well.
- You may not assume you have hiring/firing authority over the development team.

# Architectural Katas

Making them Cloud Native

- As a company we're agreeing to guide ourselves by DevOps principles and practice Continuous Delivery.
- We have no infrastructure; we'll use one or more public cloud providers to deliver our software.
- Think deeply about your decomposition strategy and what advantages it will bring you.
- Use the CNA Patterns you know so far in order to enable your architectures to these ends.

# Where’s Fluffymon?

A service describing missing pets, pet rewards (brokered/managed by the service), and location data points (GPS) of pet sightings using augmented reality to overlay last-seen pet locations.

- Users: dozens of missing pet owners, hundreds of 'spotters' (initially), broader depending on rollout success
- Requirements:
  - users interested in finding pets register on the site
  - anyone can see a list of pets missing near to their location
  - pet finders can post 'pet found' messages (with mandatory photo proof) and collect rewards on confirmation from pet owners
  - users can comment on pet missing entries, offering data points (sighted, area checked with no results, etc)
  - mobile device accessibility

# Where's Fluffymon?

A service describing missing pets, pet rewards (brokered/managed by the service), and location data points (GPS) of pet sightings using augmented reality to overlay last-seen pet locations.

- Additional Context:
  - one of a host of AR services being launched by parent company
  - local scalability (per-city), but possibly scaling out to other cities
  - company wants to create a larger social community around pets
  - potential ad revenue from partners like pet stores have the potential to make millions

CREDIT: http://nealford.com/katas/list.html

# LUNCH

We will start the kata assignment promptly at 13:45!

# Brick Pattern Assignment

In this kata, we will focus on the Brick Patterns. You will assume that you are the architect in charge of the image management part of the solution, and you will provide a Brick architecture for the Image Management service. Your solution should consider the cloud native characteristics that will help your team build and operate that service.

# GO!

We will start peer review at 14:30!

# Peer Review

- Each group will have 5 minutes to present.
- You'll be reviewed on your solution and your answers to questions.
- Review will be: Thumbs Up/Meh/Down!
- We'll carry on these activities until we run out of time.

# Edge Gateway

# Context

*Decomposed architectures must always be recomposed. This recomposition often happens within the user interface layer of an application.*

# Problem

*Recomposing an architecture within the User Interface layer presents significant complexities that can lead to decreased agility and degraded user experience.*

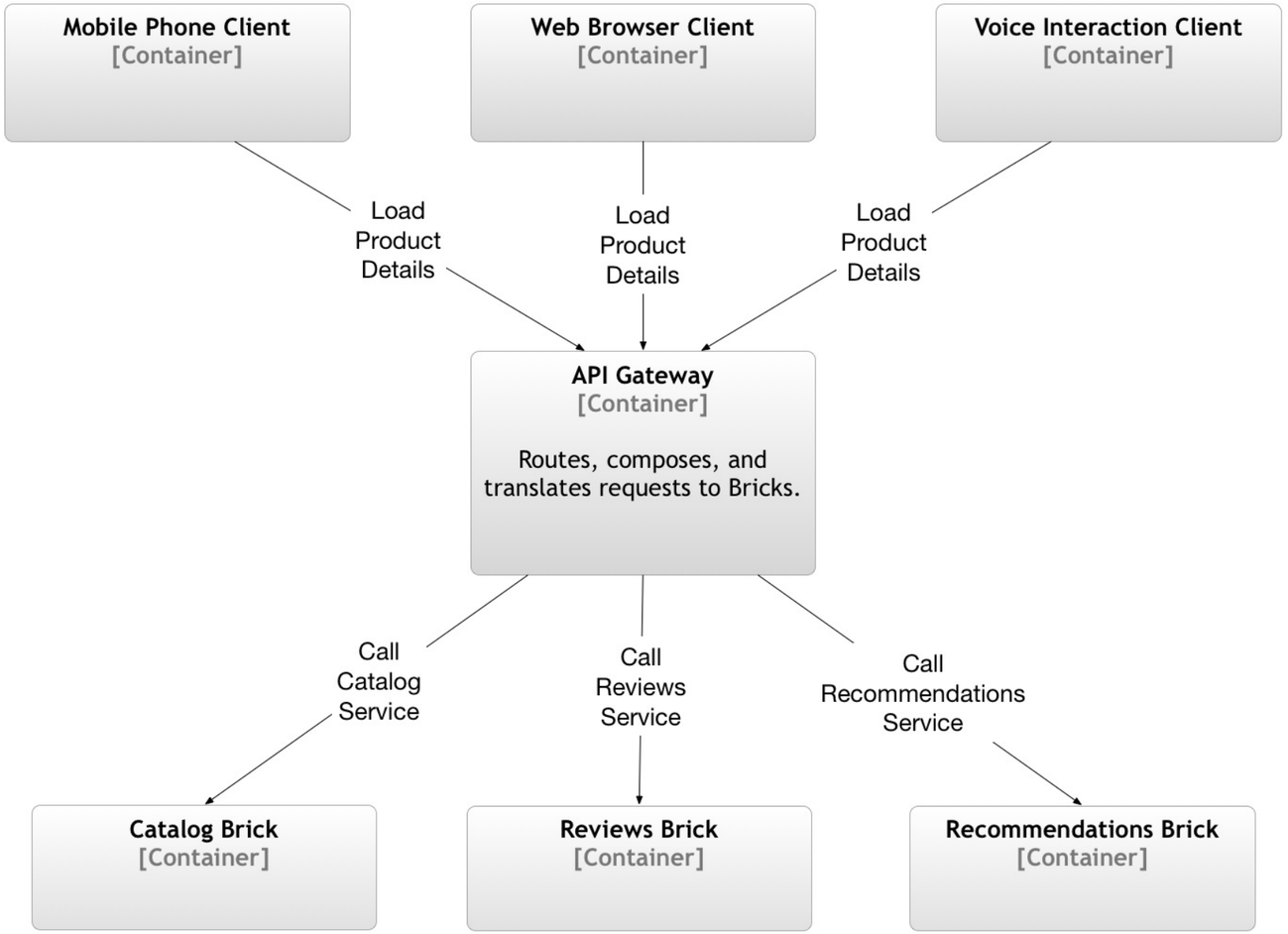
# Forces

- Systems often must support multiple user experience options (web/mobile/AVR).
- Recomposing architectures as the UI layer can require exposing the architecture to the public network.
- API needs for a mobile device are often quite different from a web UI.

# Forces

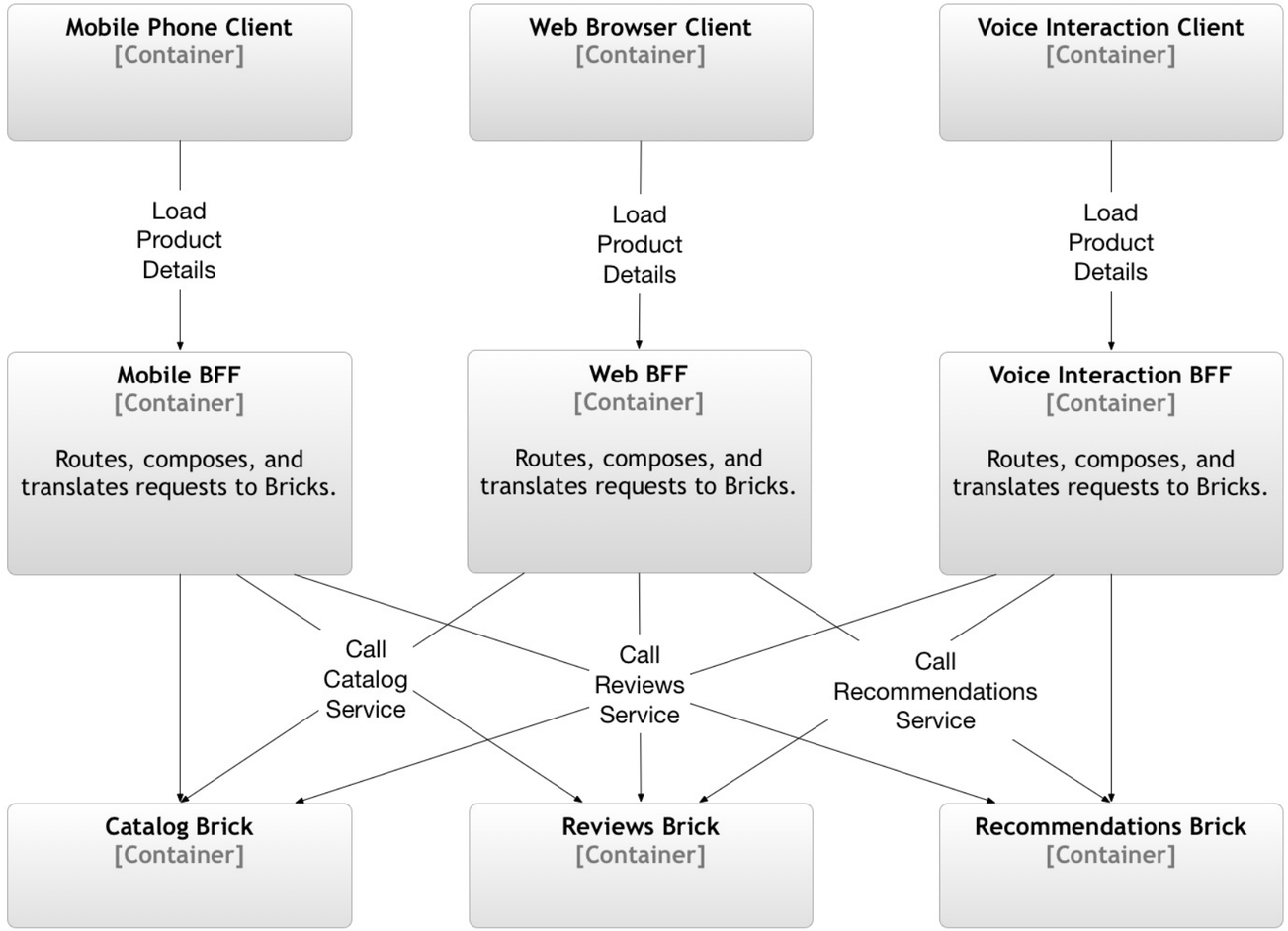
- Exposing a network graph to mobile devices can increase latency, increase data usage, and degrade battery life.
- UI platforms may not support the integration architecture used for all services.
- Native apps often have longer upgrade cycles. Recomposing the architecture there can lead to friction in the architectural lifecycle.

Solution Structure



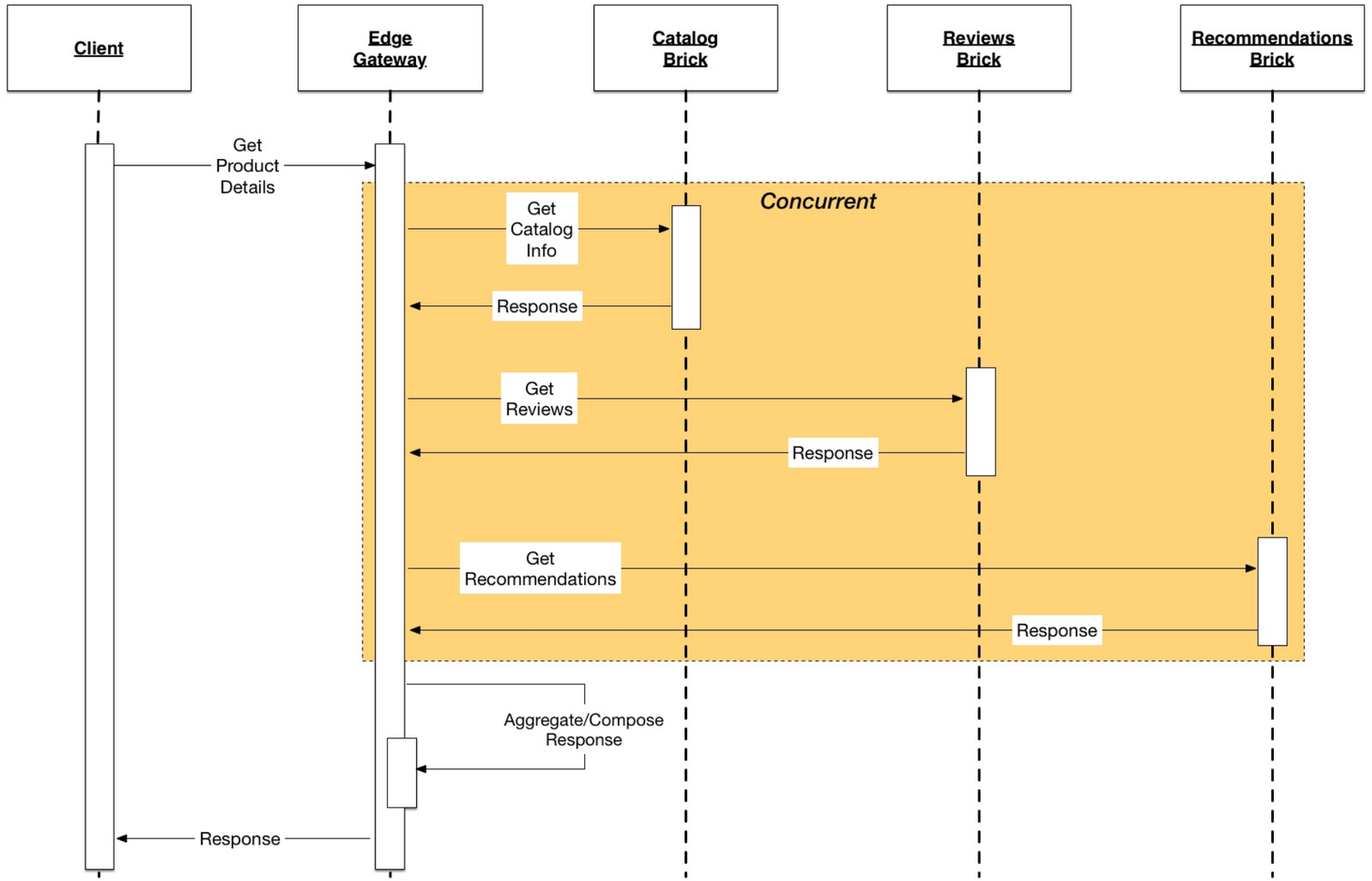

API Gateway Variant

Solution Structure




# Backend for Frontend (BFF) Variant

# Solution Dynamics




Edge Gateway (Both Variants)

# Fault Tolerance

# Context

*In order to accomplish its assigned tasks, each brick will need to communicate with other bricks, and with external systems, to which we'll collectively refer as dependencies.*

# Problem

*When a brick's dependencies become unhealthy, unreachable, or slower than normal to respond, that brick's own performance is degraded, and such degredation can potentially cascade across the entire architecture.*

# Forces

- The network is not reliable.
- Latency is non-zero and unpredictable.
- Service availability is a product of its dependencies' availabilities.

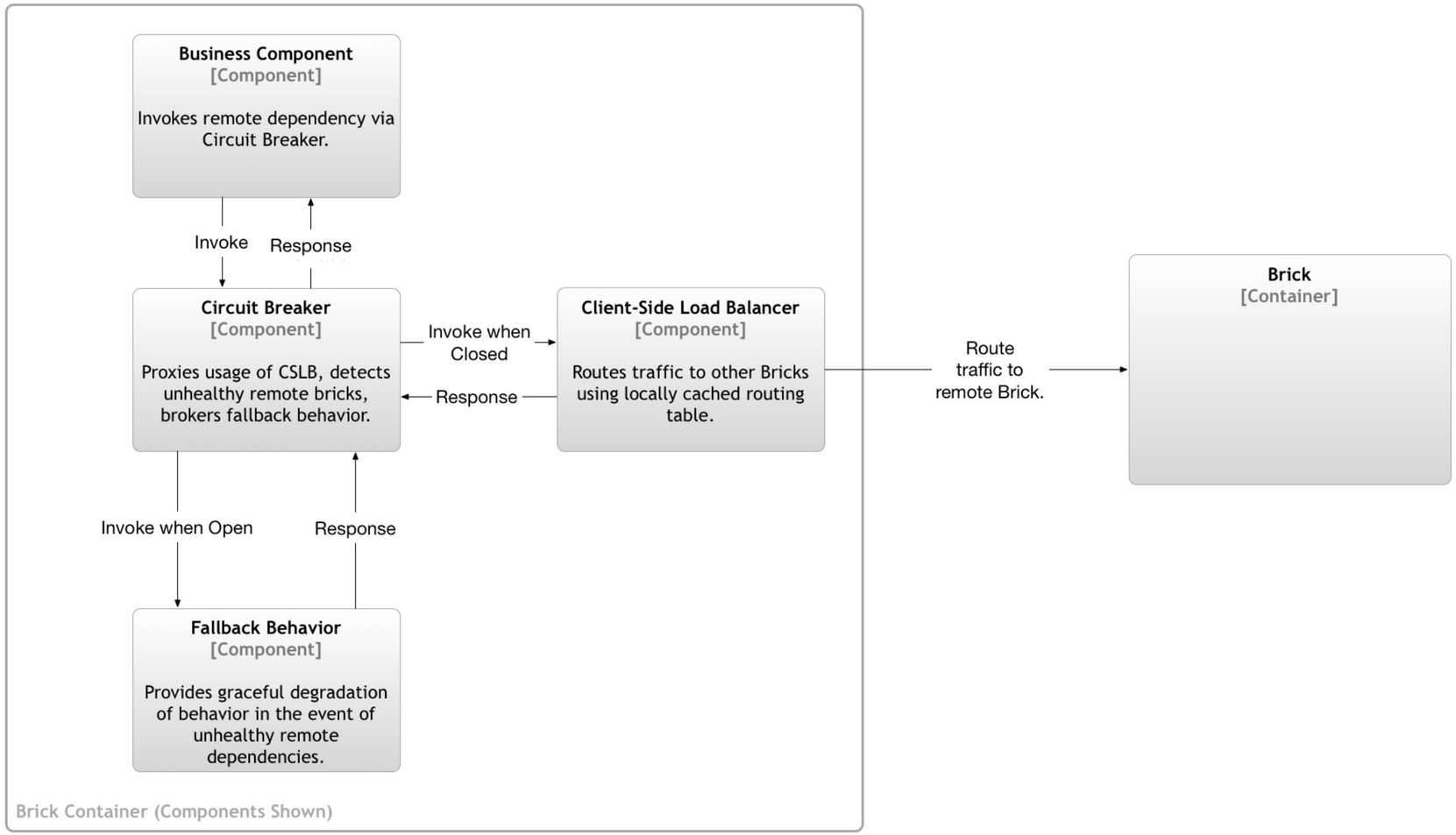
# Forces

- Failures can be transient.
- Failures can cascade.
- An incorrect or stale response is often preferable to no response.

# Variants

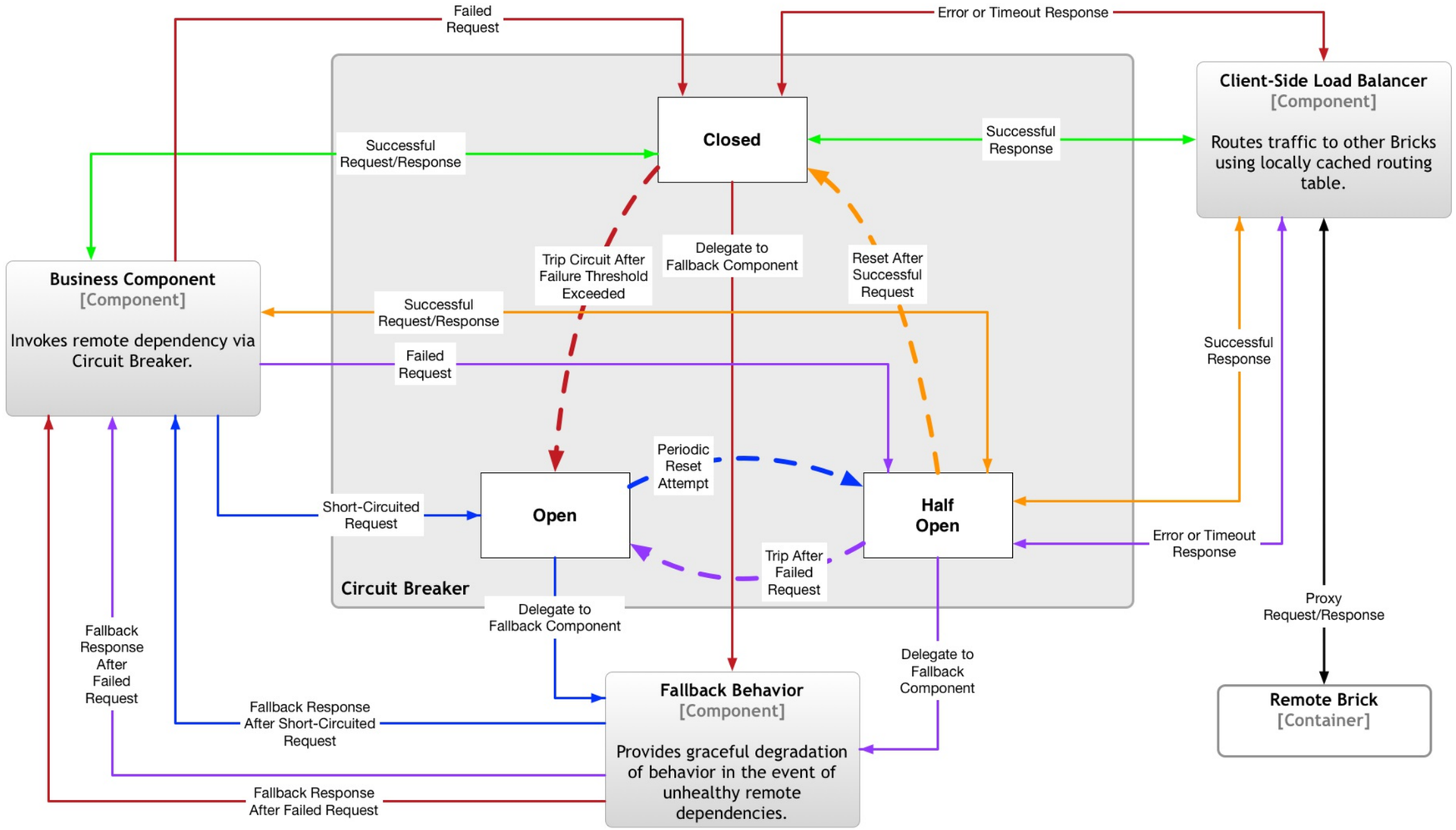
- **Timeouts**
  Set time limits for operations that may never complete.
- **Retries**
  Retry failed operations in case of intermitent failure conditions.
- **Bulkheads**
  Isolate failure modes in different bricks or other isolation zones.
- **Circuit Breakers**
  Protect a brick from unhealthy dependencies and provide graceful degradation.

Solution Structure




# Circuit Breaker Variant

Solution Dynamics




Circuit Breaker Variant

# BREAK TIME

We will start again at 15:30!

# Event-Driven System

# Context

*Distributed systems often begin with a focus on synchronous, web-based interaction.*

# Problem

*Synchronous web interactions and traditional approaches to state management often lead to intractable data management problems, especially in complex domains.*

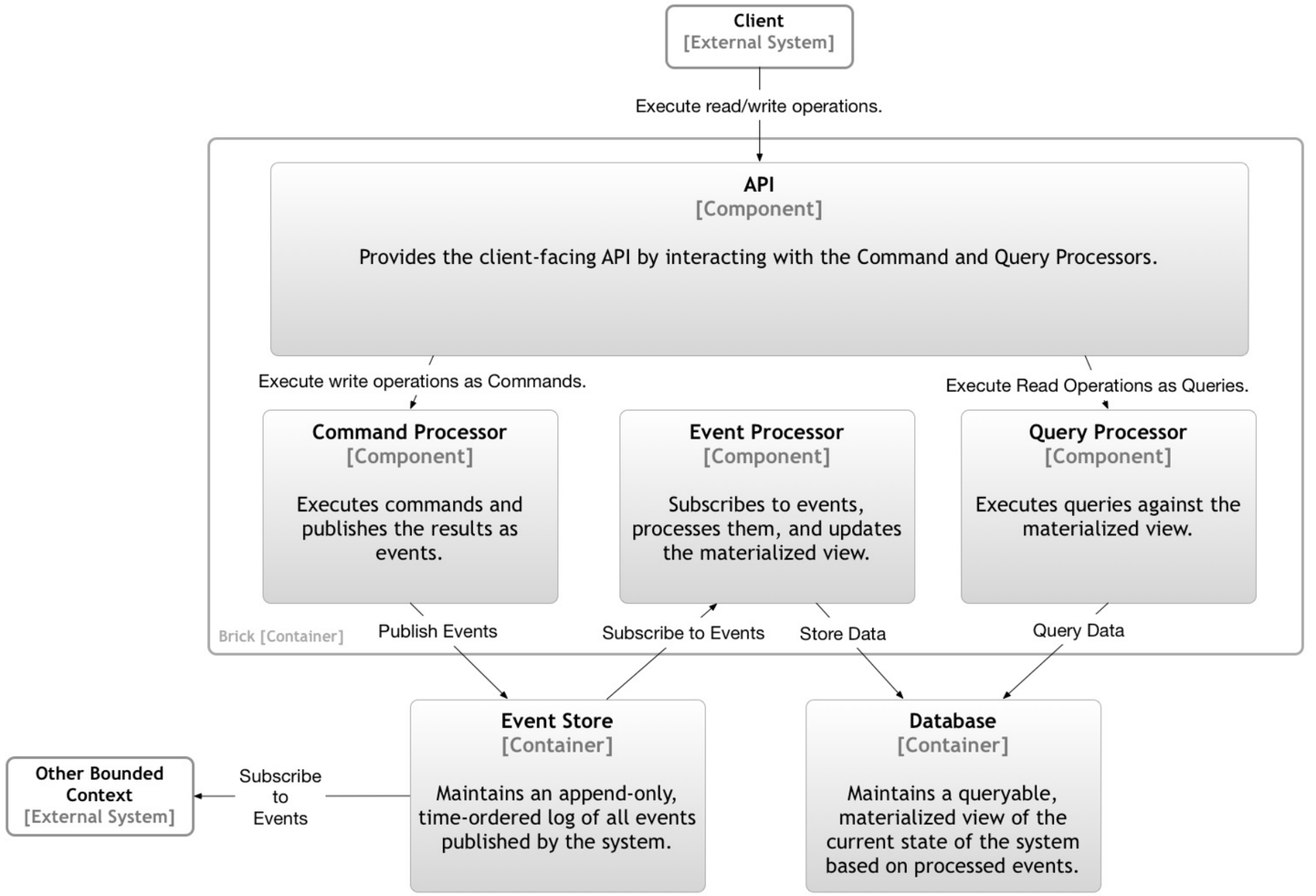
# Forces

- Proper encapsulation of a distributed node includes ownership of its state. This leads to decomposed data stores, each goverened by a single service.
- Many modern data stores sacrifice ACID transactions in order to support other desirable properties.
- Normalizing data to a single service can lead to network call proliferation for even simple operations.

# Forces

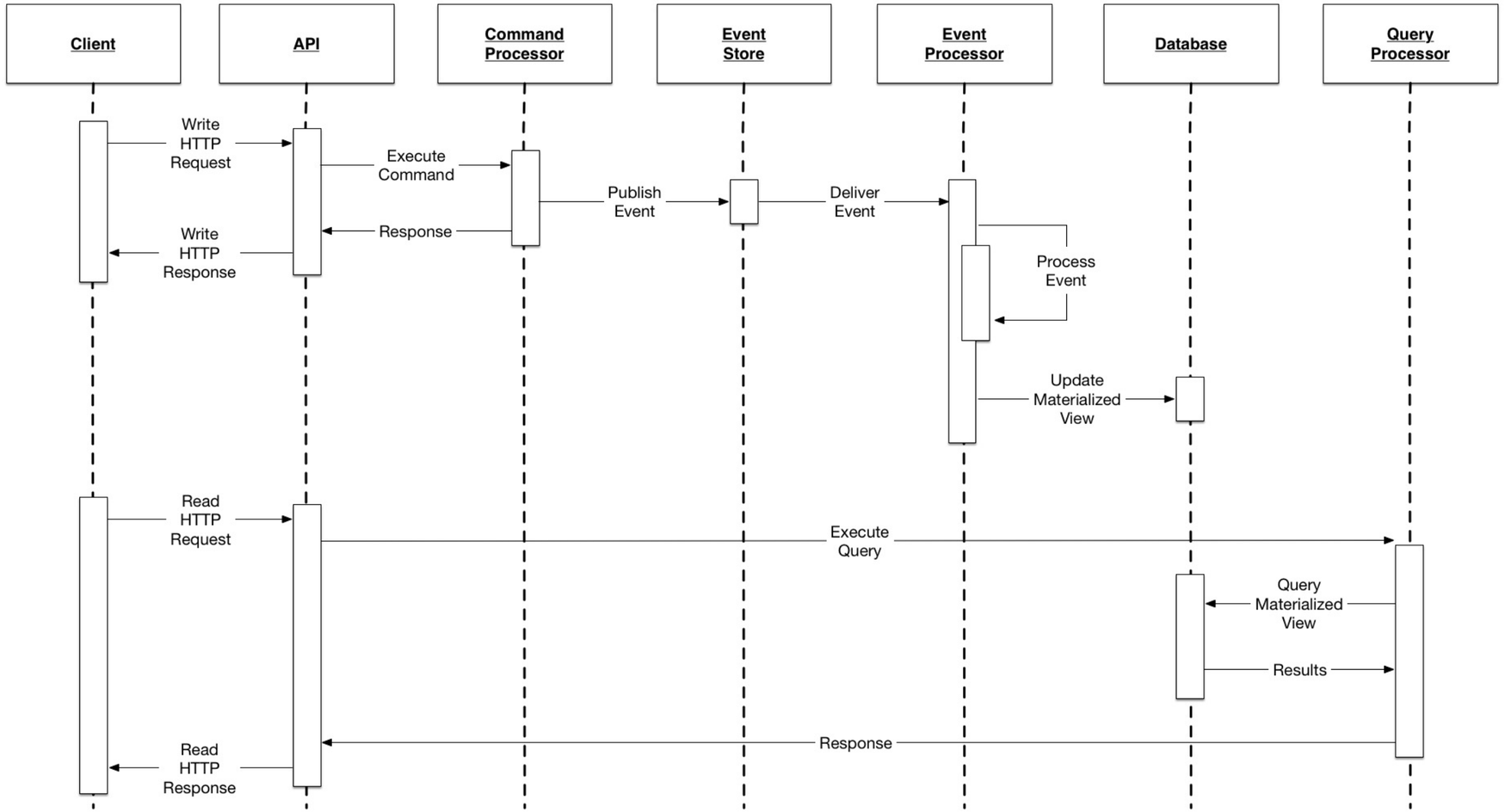
- Business processes that desire transactionality but that include multiple distributed nodes can be challenging to implement.
- Queries that were previously implemented via SQL joins across multiple contexts now require multiple service calls and programmatic joins.

# Solution Structure




# Event Sourcing/CQRS Variant

# Solution Dynamics




Event Sourcing/CQRS Variant

# Contract Management

# Context

*Decomposed architectures with decentralized governance still must maintain interface compatibility in order to communicate effectively.*

# Problem

*As service teams move autonomously and evolve interfaces independently, incompatibilities can be introduced, often leading to recentralization of governance via complex versioning strategies.*

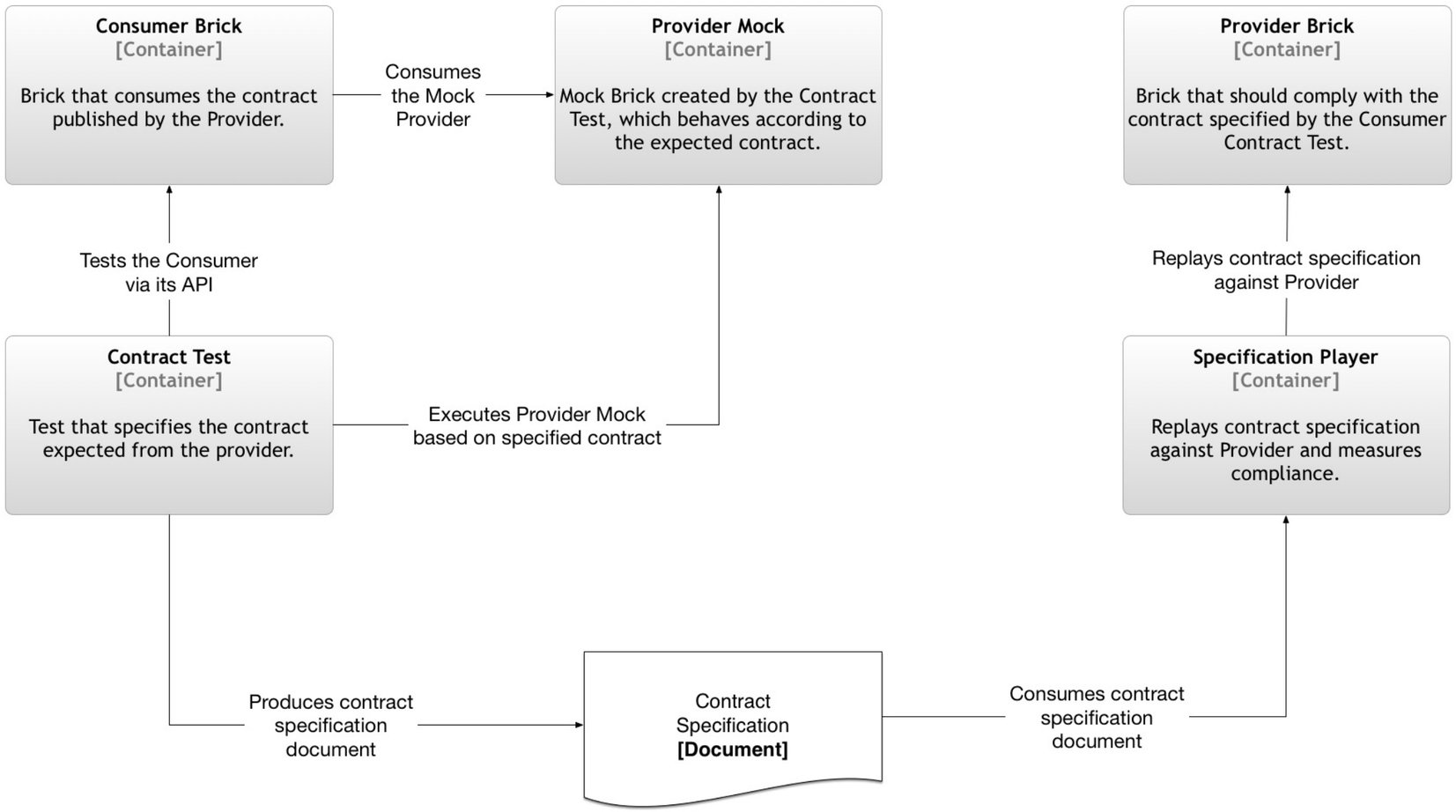
# Forces

- We want to support the autonomous evolution of service interfaces.
- Services must prove that they meet their existing contracts before they can deploy a new version of their interface.
- Not all upstream services are interested in a given service's new interface features and would prefer to keep the existing version.

# Forces

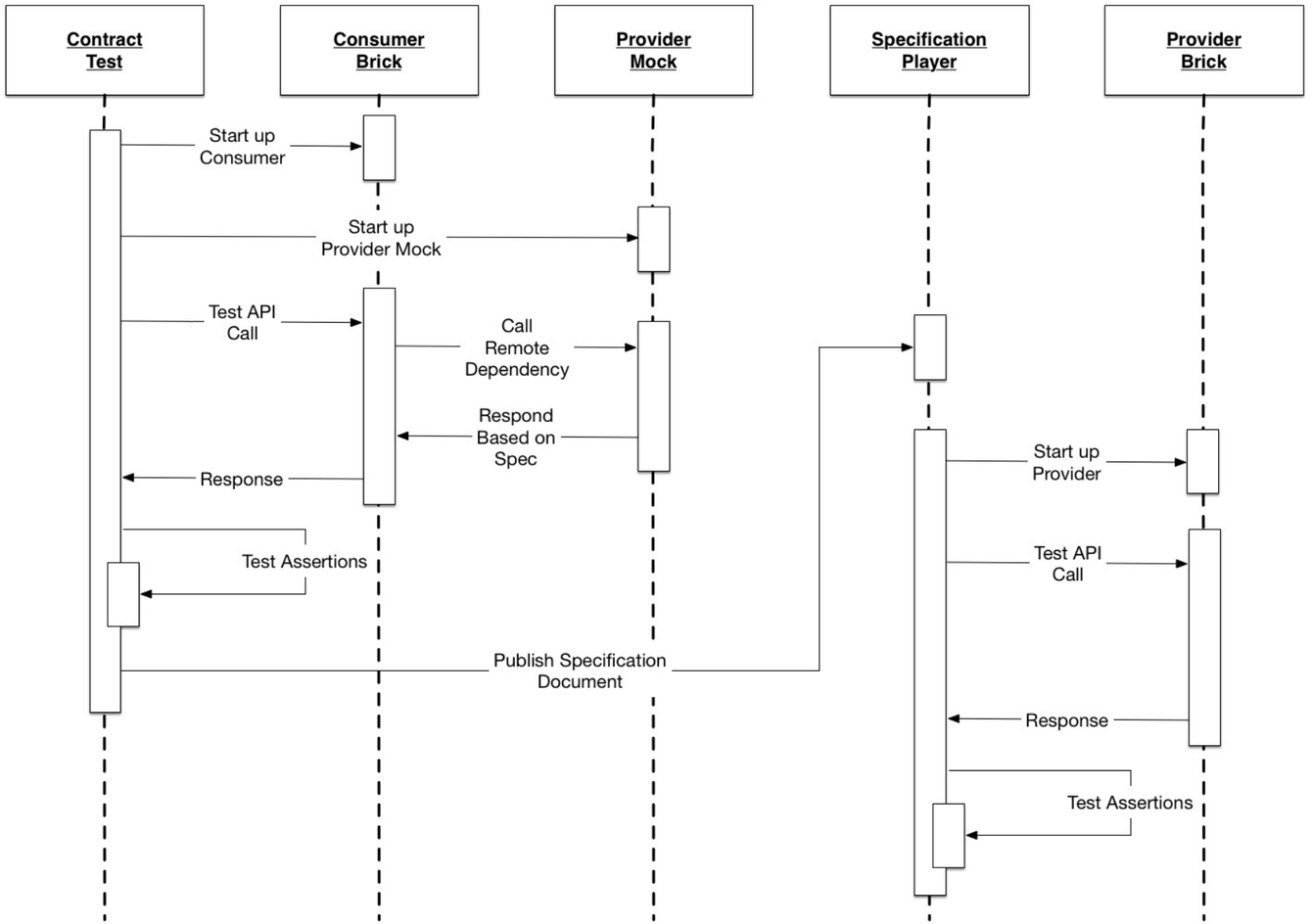
- Maintaining multiple API versions within a single service is complex.
- Deprecating an existing API version is often political.
- Deploying "all the things" in order to perform integration testing across service boundaries is expensive.

Solution Structure




Consumer-Driven Contract Variant

# Solution Dynamics




Consumer-Driven Contract Variant

# Integration Telemetry

# Context

*Realizing the DevOps Way of Feedback requires that we have visibility into the runtime behavior emerging from our brick composition.*

# Problem

*Distributed systems require additional types of visibility, and common approaches to visibility fall short.*

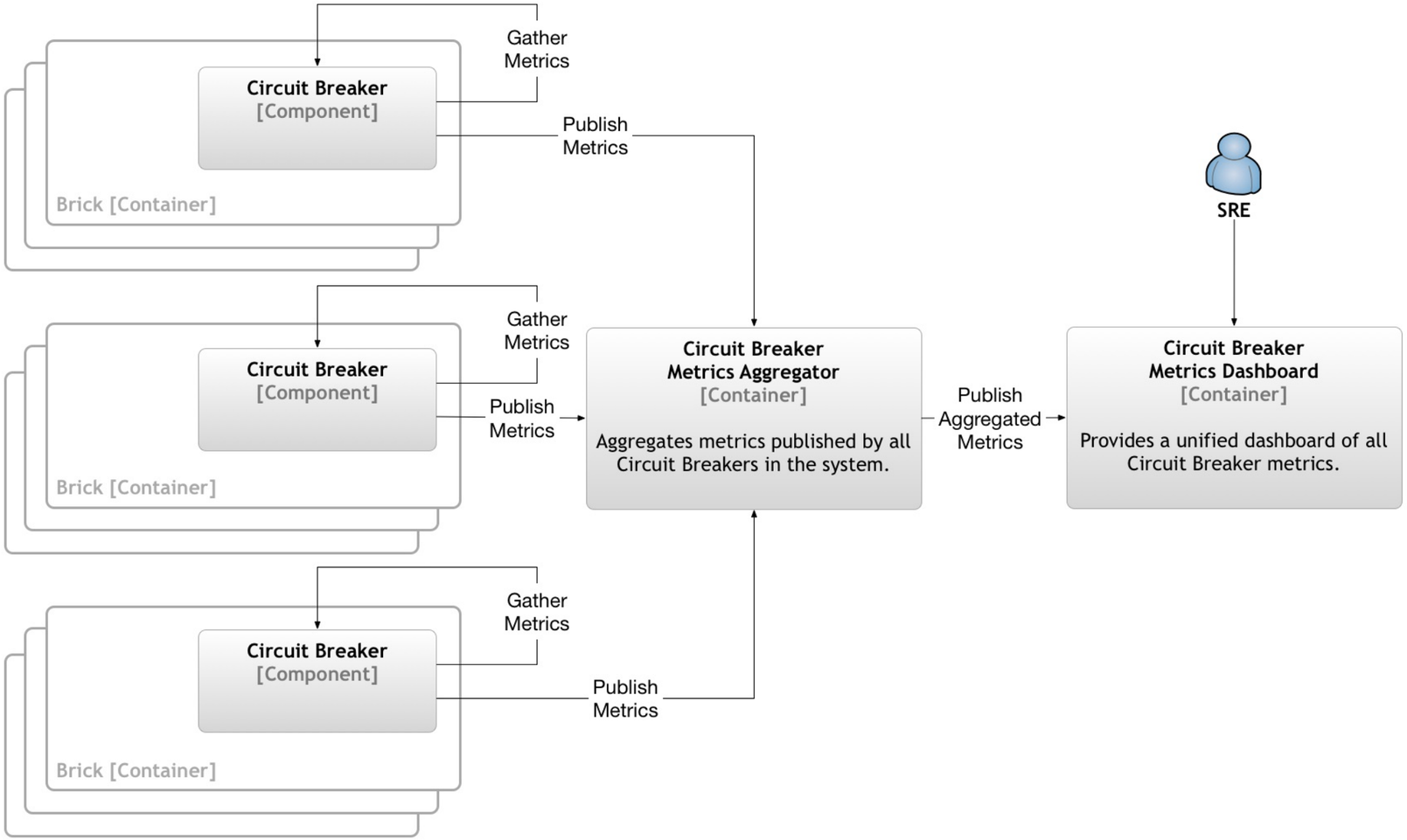
# Forces

- Distributed systems have emergent behavior.
- The edges in the graph are as (or more) important than the nodes.
- The health of two connected nodes does not tell you the health of the edge.

# Forces

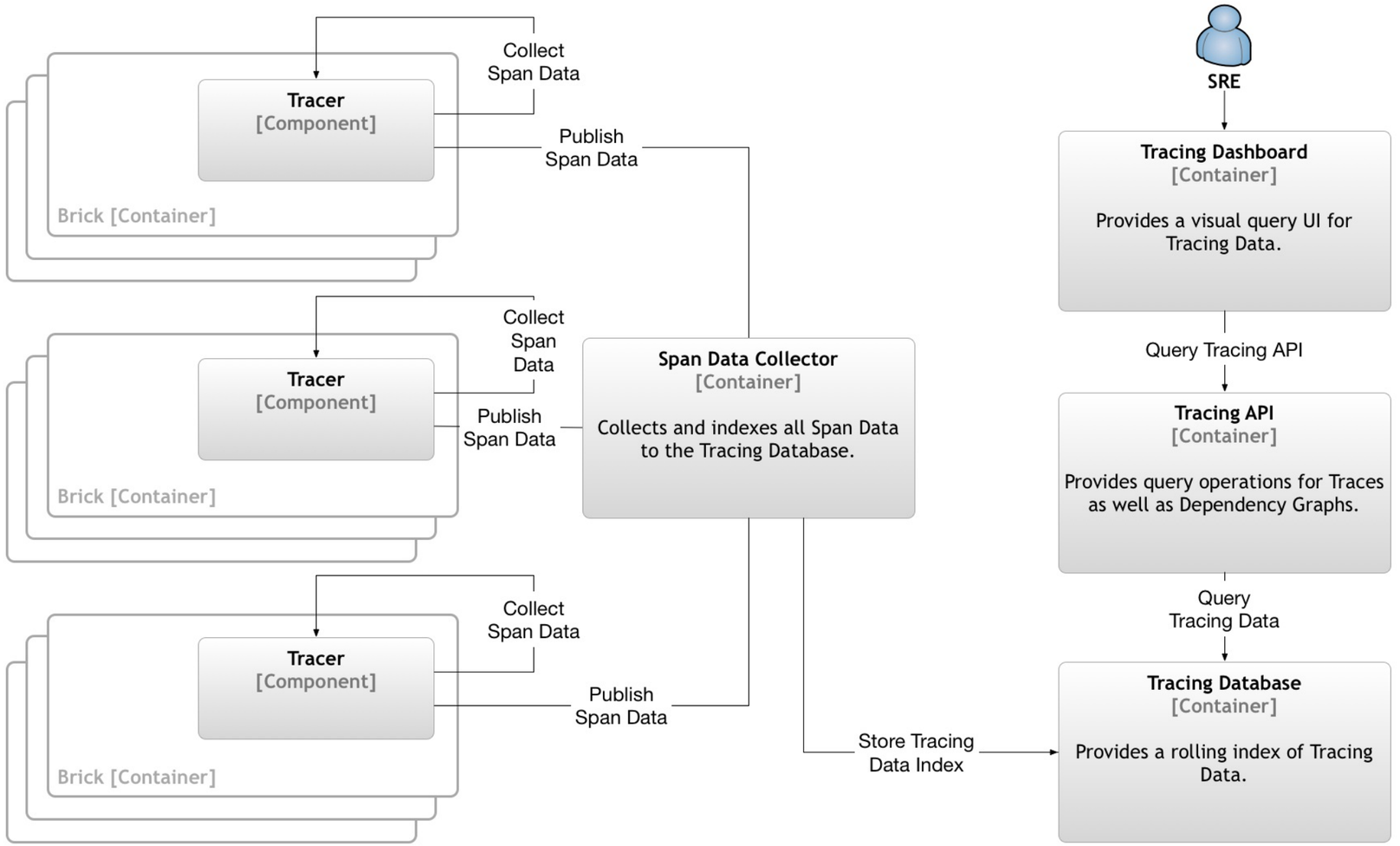
- Decentralized governance makes it difficult to know the complete dependency graph for request handling.
- It can be difficult to isolate and correlate the components of an end-to-end request flow.

Solution Structure



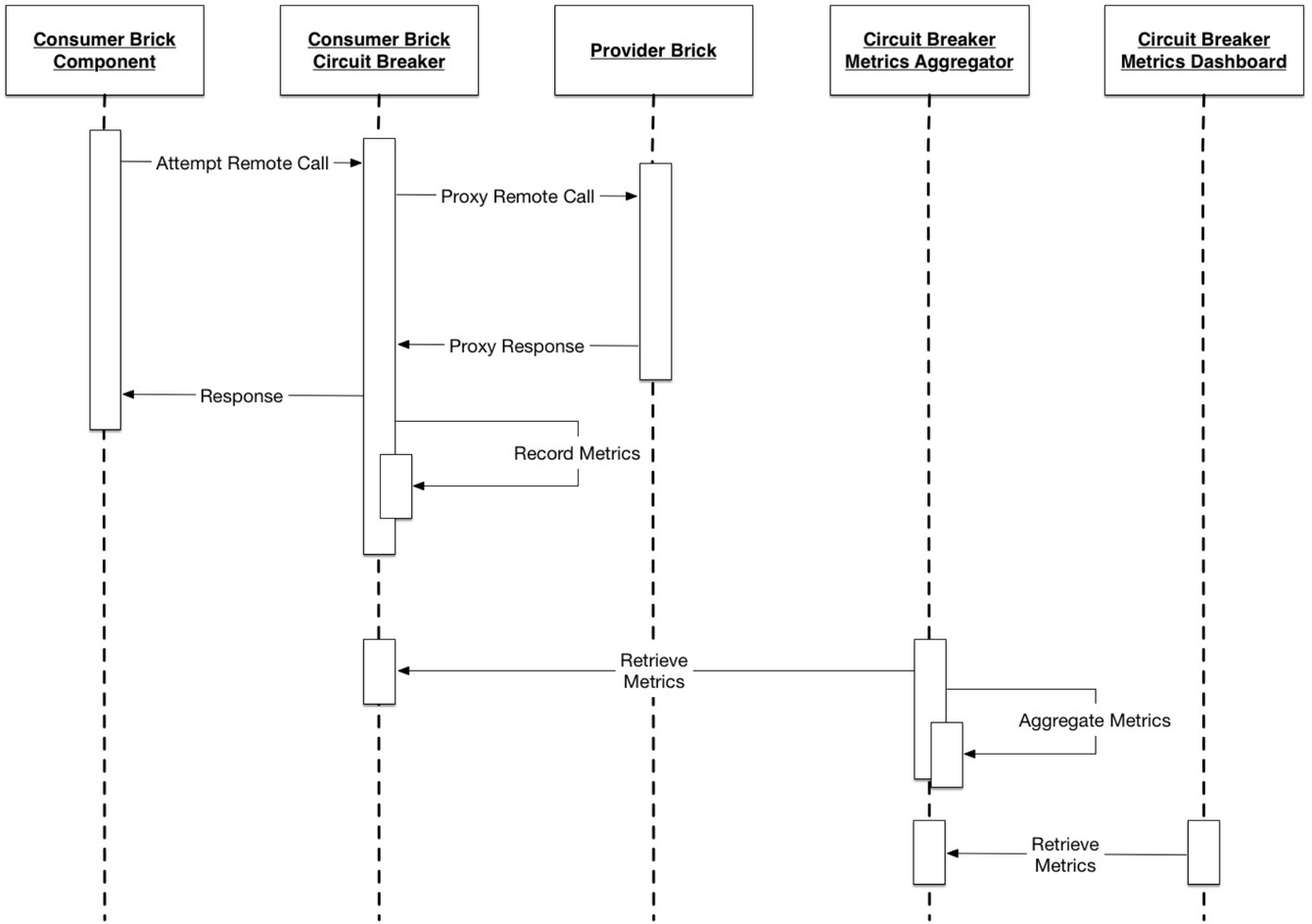

Circuit Breaker Dashboard Variant

# Solution Structure



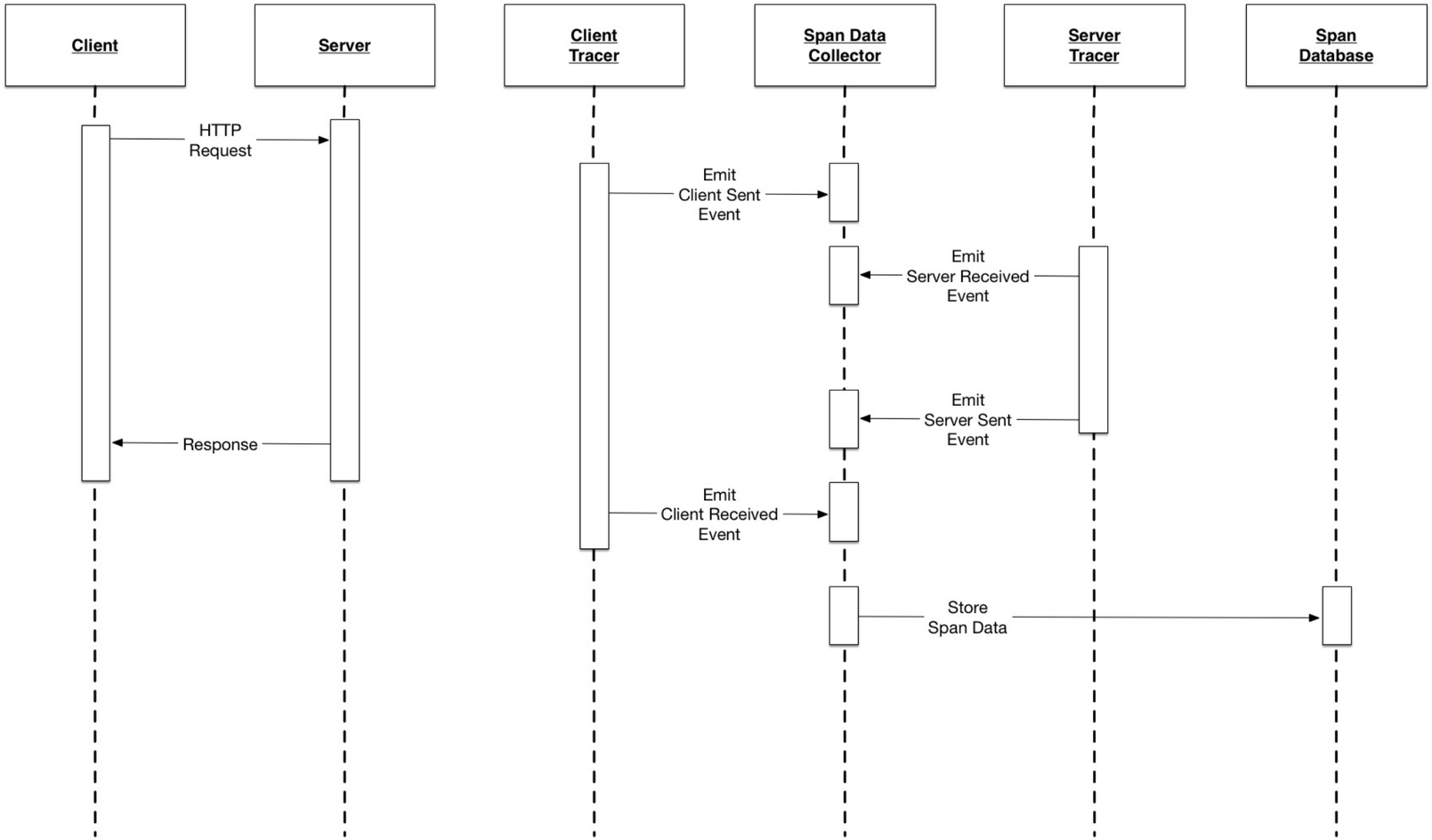

Distributed Tracing Variant

# Solution Dynamics




# Circuit Breaker Dashboard Variant

Solution Dynamics




Distributed Tracing Variant

# Mortar Pattern Assignment

In this kata, we will focus on the Mortar Patterns, but Brick Patterns are also fair game. We will now zoom out to the entire Where's Fluffymon? solution. You will assume that you are the architect in charge of the entire solution, and you will provide a complete system architecture. Your solution should consider the cloud native characteristics that will help all teams to build and operate the system.

# GO!

We will start peer review at 16:45!

# Peer Review

- Each group will have 5 minutes to present.
- You'll be reviewed on your solution and your answers to questions.
- Review will be: Thumbs Up/Meh/Down!
- We'll carry on these activities until we run out of time.

Thank You!

# Cloud Native Architecture Patterns and Katas

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