

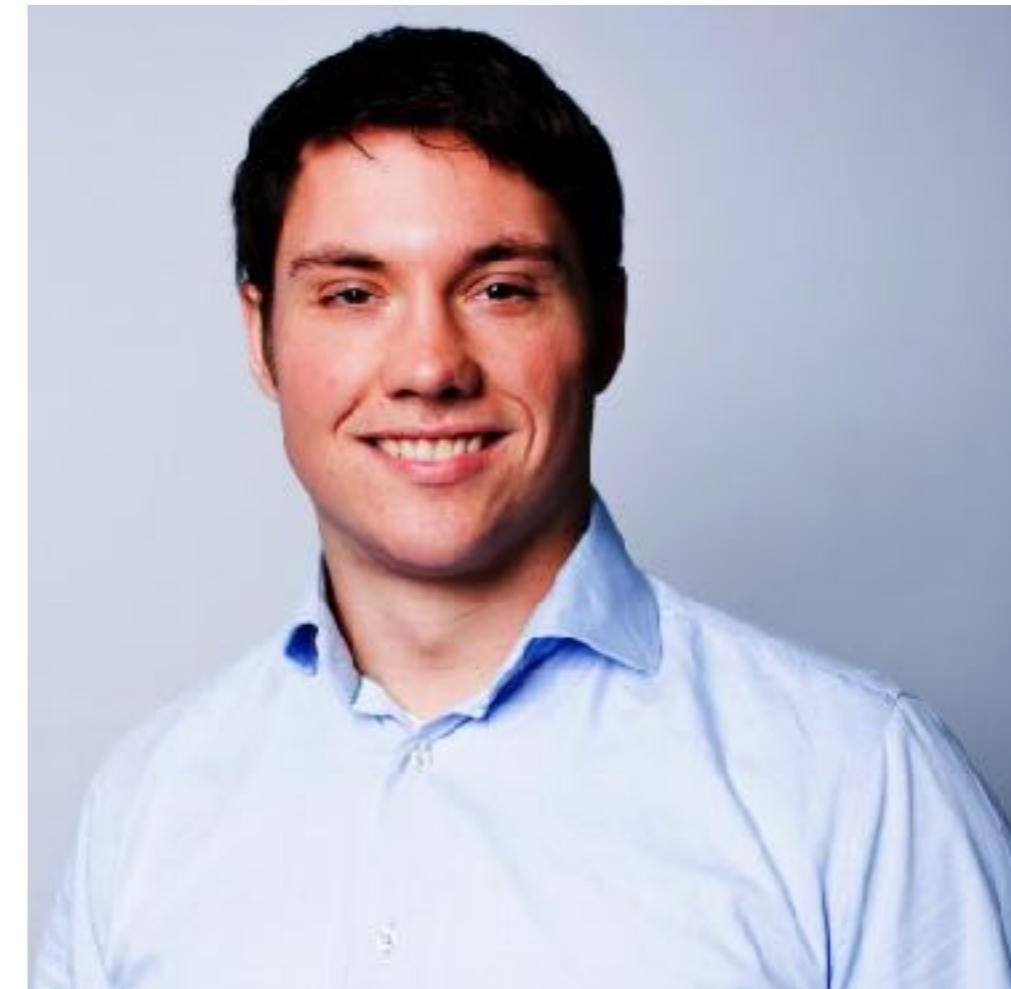
ARCHITECTING FOR OPERATIONS

BORING IS AWESOME!

INTRODUCTION

STEFFAN NORBERHUIS

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- ▶ steffan@norberhuis.nl
- ▶ Feel free to contact me!



INTRODUCTION

AUDIENCE

- ▶ Are you working in the industry?
- ▶ Are you operating infrastructure?
- ▶ What do you expect from this lecture?

A waiter in a blue shirt is holding a white plate with a vibrant green salad topped with pomegranate seeds and a dollop of white cream. The background is blurred, showing a restaurant interior with warm lighting.

SERVING THE CUSTOMER



IMPACT



MINDSET

A photograph of a team of rowers in a long, narrow boat on a lake. The rowers are silhouetted against the bright water, which reflects a warm, golden light from the setting sun. The boat is moving through the water, creating a wake. The rowers are wearing athletic gear, including caps and life jackets. The word "COLLABORATION" is overlaid in large, white, sans-serif capital letters across the bottom of the image.

COLLABORATION

INTRODUCTION

OVERVIEW

- ▶ Disruption
- ▶ Engineering a Sociotechnical System
- ▶ Building for Failure
- ▶ Failure is inevitable

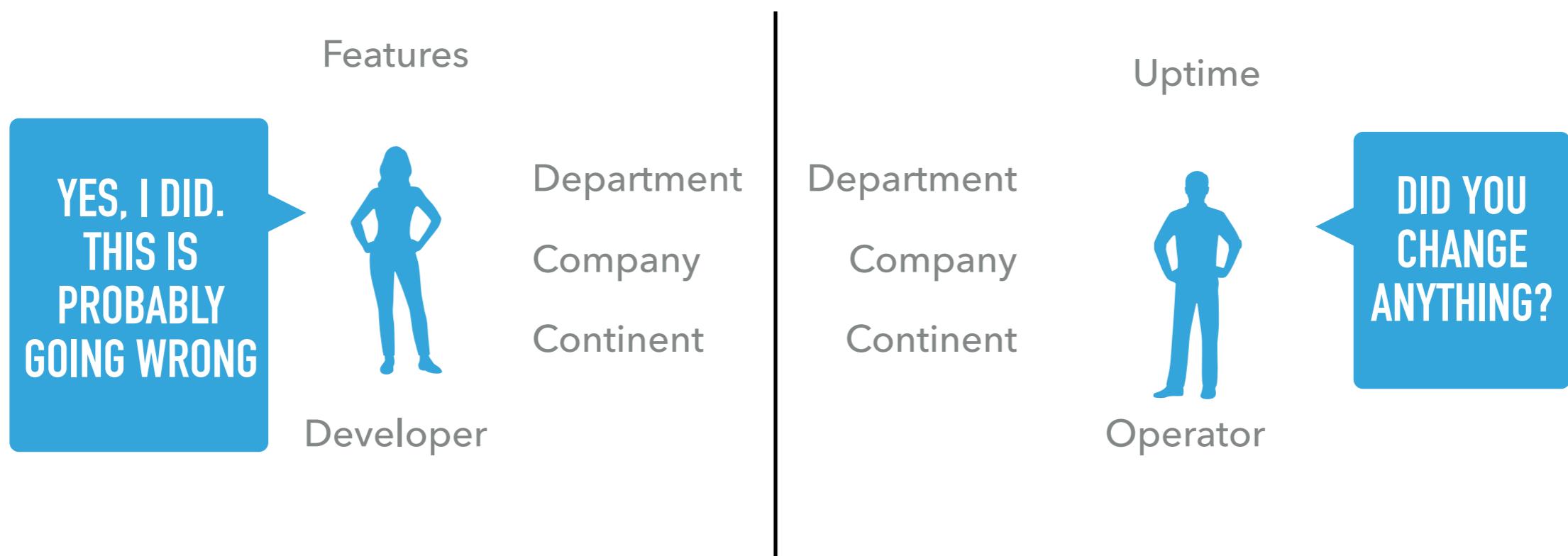


**ARCHITECTING FOR
OPERATIONS**

DISRUPTION

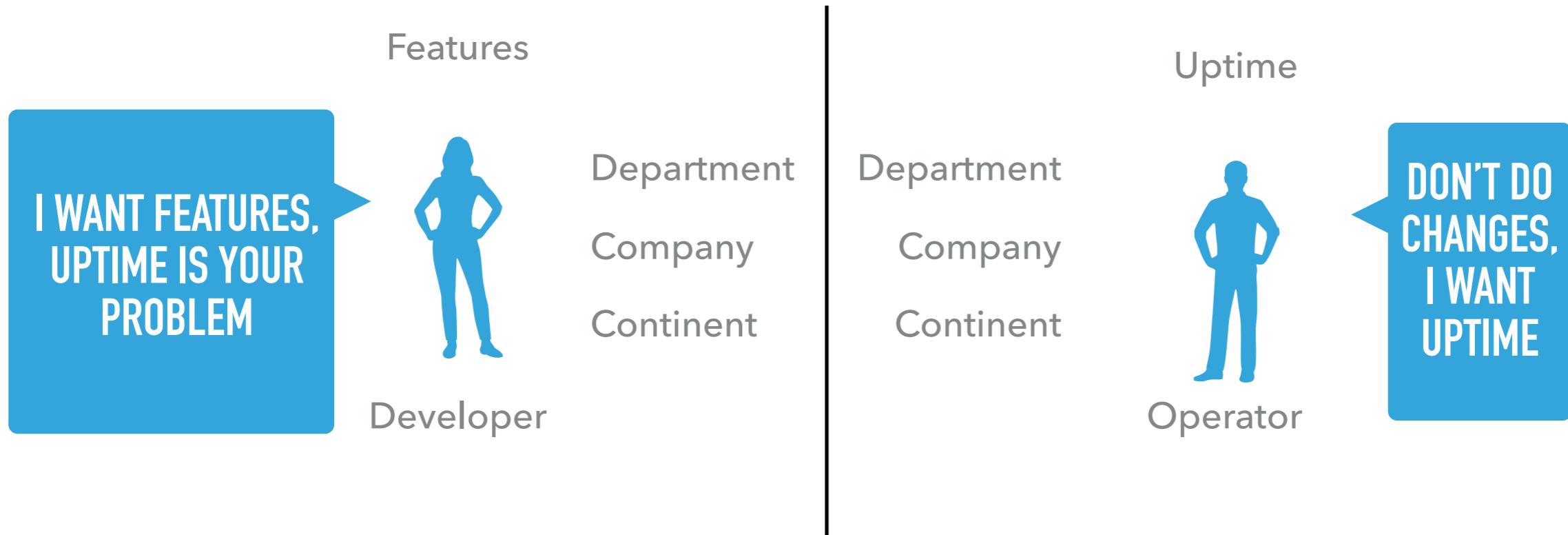
DISRUPTION

DEVOPS



DISRUPTION

DEVOPS



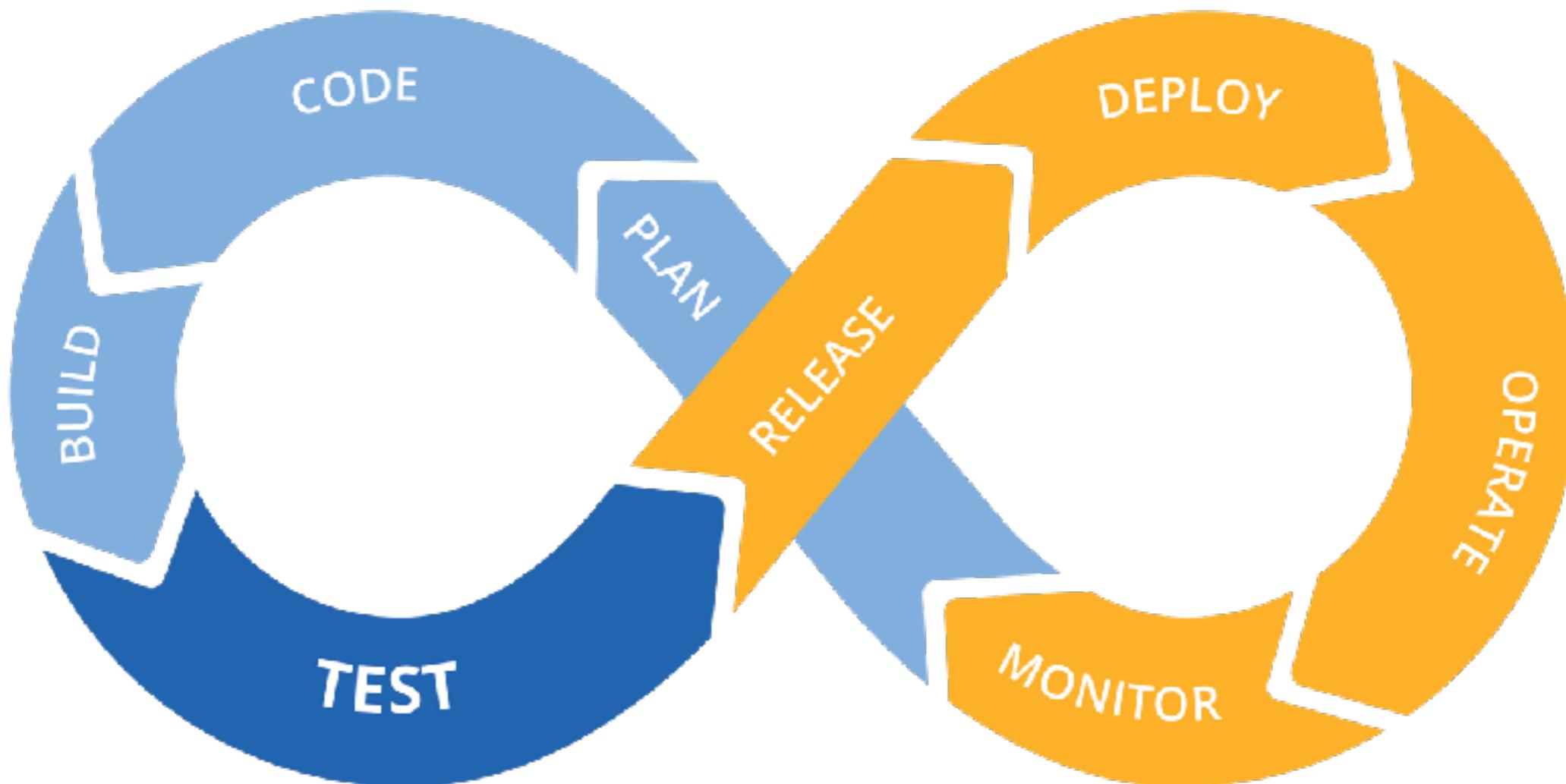
A photograph of a dark wooden fence in a field of tall, golden-brown grass. The fence runs horizontally across the frame. In the background, there are more trees and a bright sky.

ALIGN GOALS



YOU BUILD IT, YOU RUN IT

DEVOPS OWNERSHIP



The background of the image is a wide, open landscape filled with soft, white cumulus clouds. The clouds are more densely packed in the foreground and middle ground, creating a sense of depth. Above the clouds, the sky is a clear, vibrant blue, transitioning to a lighter, hazy orange near the horizon. The overall scene is bright and airy, evoking a sense of freedom and openness.

CLOUD

DISRUPTION

CLOUD



PAY WHAT YOU USE



[1. Choose AMI](#)[2. Choose Instance Type](#)[3. Configure Instance](#)[4. Add Storage](#)[5. Tag Instance](#)[6. Configure Security Group](#)[7. Review](#)

Step 3: Configure Instance Details

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot Instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of instances (i)

Purchasing option (i) Request Spot Instances

Network (i) C Create new VPC

Subnet (i) C Create new subnet
4091 IP Addresses available

Auto-assign Public IP (i)

IAM role (i) C Create new IAM role

Shutdown behavior (i)

Enable termination protection (i) Protect against accidental termination

Monitoring (i) Enable CloudWatch detailed monitoring
Additional charges apply.

Tenancy (i)

Additional charges apply for dedicated tenancy.

Network interfaces

Device	Network Interface	Subnet	Primary IP	Secondary	Additional IP	Actions
eth0	New network interface (i)	subnet-d579c5a2	<input type="text" value="A"/> <input type="button" value="Assign IP"/>	<input type="button" value="Add"/>	<input type="button" value="Add"/>	<input type="button" value="Actions"/>

[Cancel](#)[Previous](#)[Review and Launch](#)[Next: Add Storage](#)

DISRUPTION

CLOUD

- ▶ Operate technology without owning technology
- ▶ Infrastructure Agility with no planning
- ▶ Focus on your business

WORK SHIFTED

- ▶ Architect combines
 - ▶ Development
 - ▶ Operations
- ▶ Architecture shifts to Cloud Components



ARCHITECTING FOR OPERATIONS

ENGINEERING A SOCIOTECHNICAL SYSTEM

A photograph of a large, mature tree with a wide canopy of green leaves, standing on a grassy hill. The sky is a clear, vibrant blue. In the foreground, the word "EVOLUTION" is written in large, bold, white capital letters.

EVOLUTION

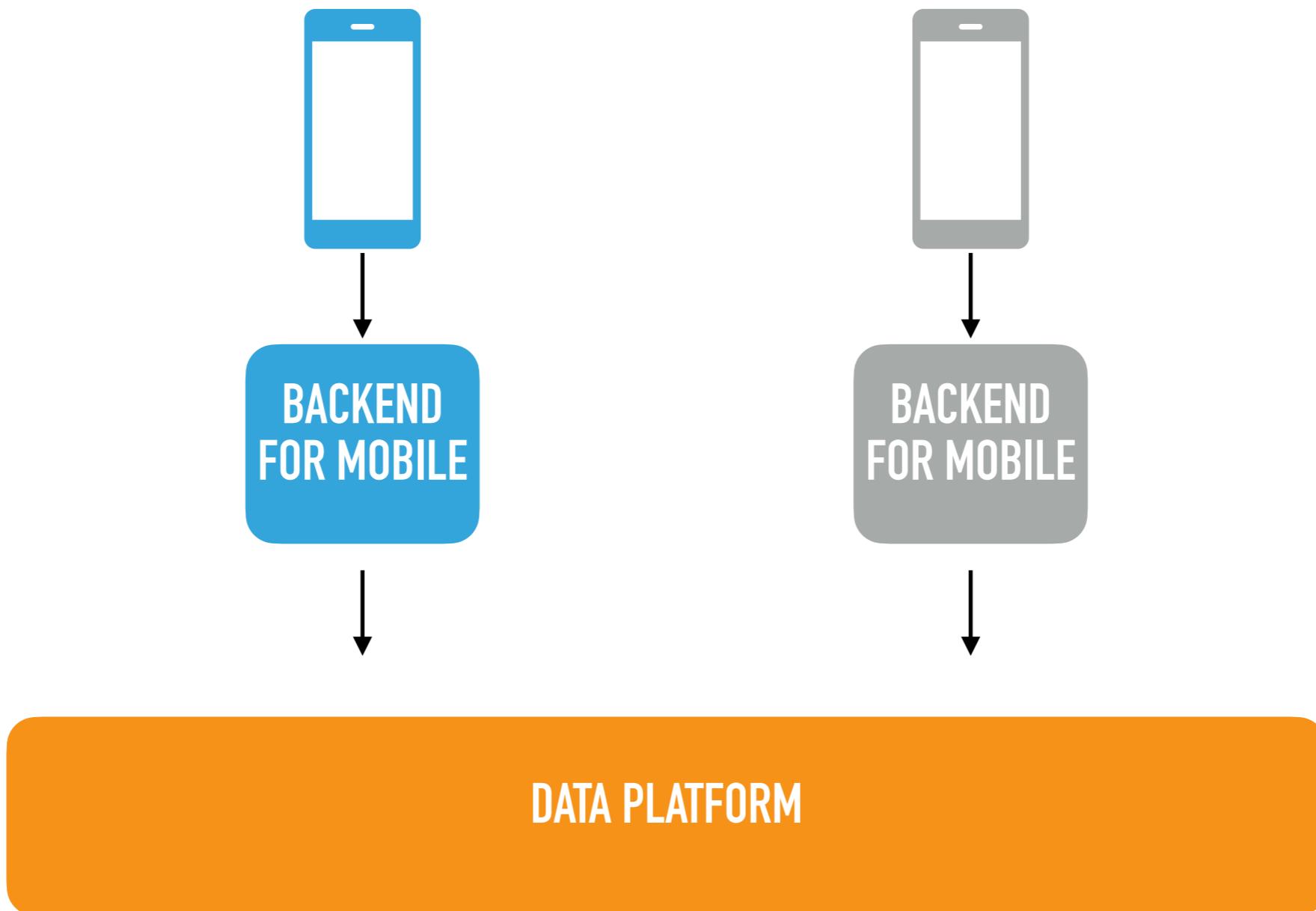
A blurry, out-of-focus photograph of a football game at night. In the foreground, the back of a player in a white jersey with the number 6 is visible. Behind him, another player in a black jersey with "TITANS" and the number 21 is walking away. To the right, a player in a white jersey with the number 15 is also walking away. The background is dark with some stadium lights visible.

**6 ARCHITECTURE STARTS WITH
ORGANIZATION**

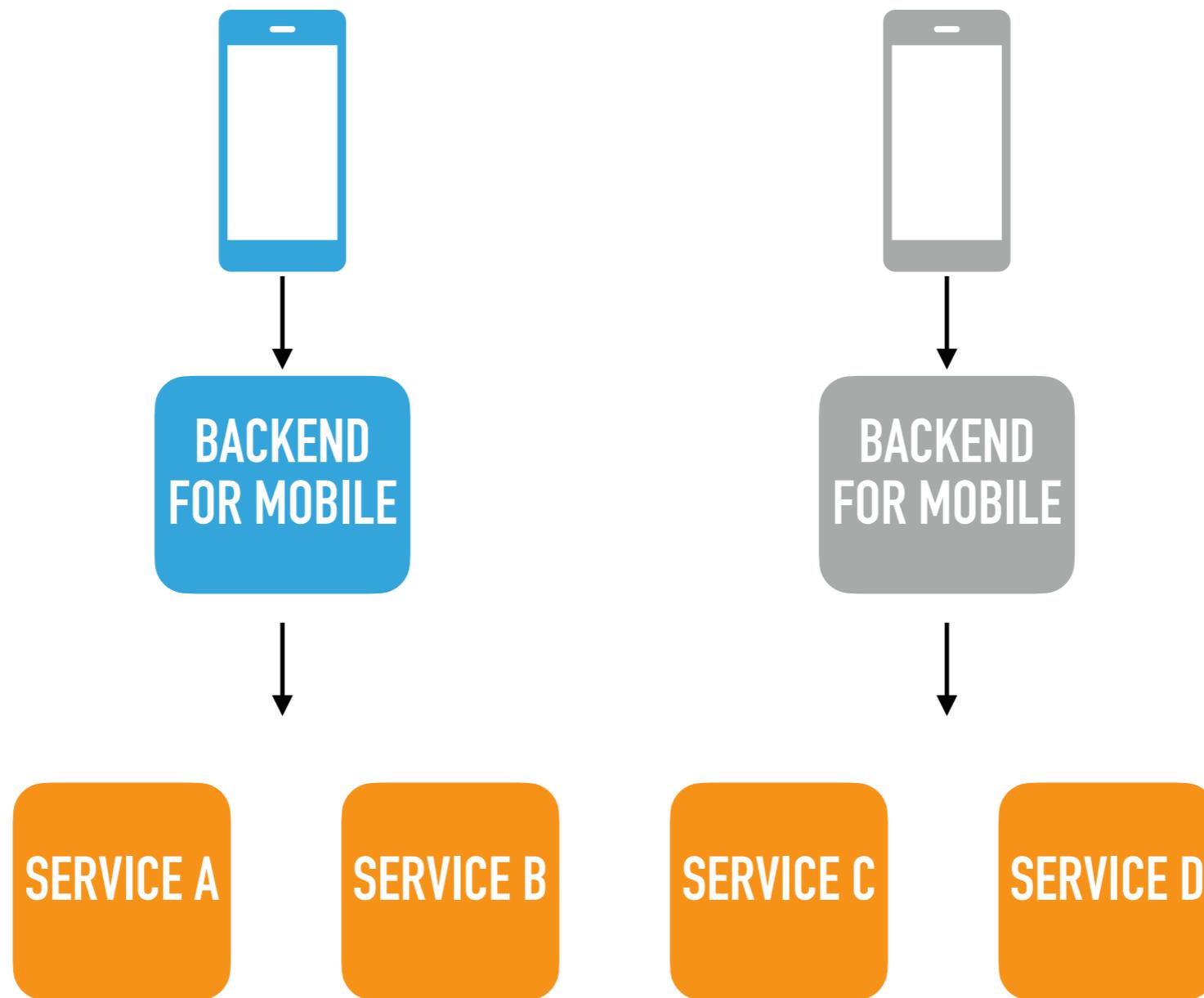
ANY ORGANIZATION THAT DESIGNS A SYSTEM
WILL PRODUCE A DESIGN WHOSE STRUCTURE
IS A COPY OF THE ORGANIZATION'S
COMMUNICATION STRUCTURE.

Melvin E. Conway

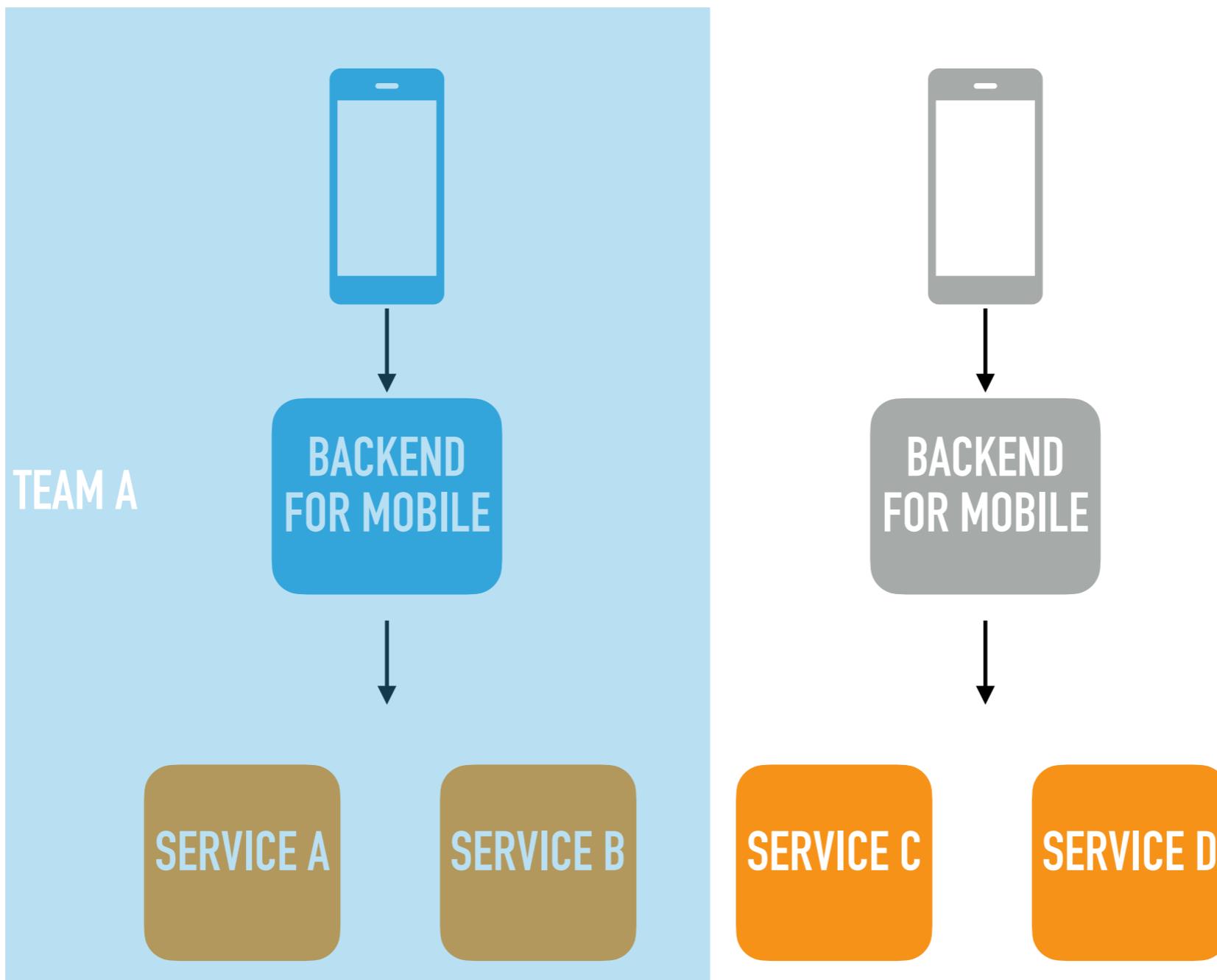
CONWAY'S LAW



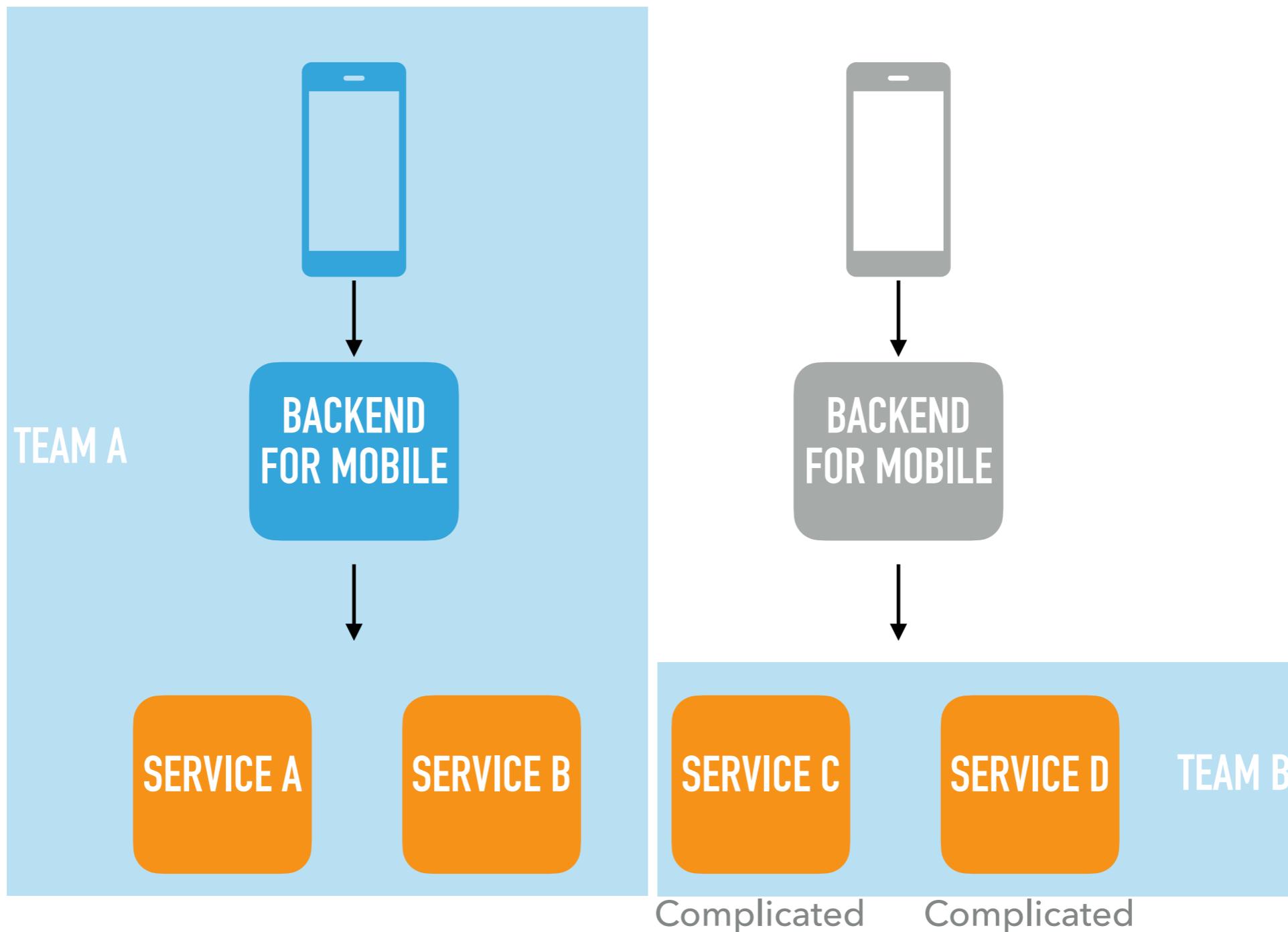
CONWAY'S LAW



CONWAY'S LAW



CONWAY'S LAW



A photograph of a bamboo forest taken from a low angle looking up. The numerous bamboo stalks are dark green and reach upwards, creating a dense canopy against a bright, overexposed sky. The perspective emphasizes the height and density of the forest.

COMPLEXITY



FRONTEND



BACKEND



INFRA

STREAM ALIGNED

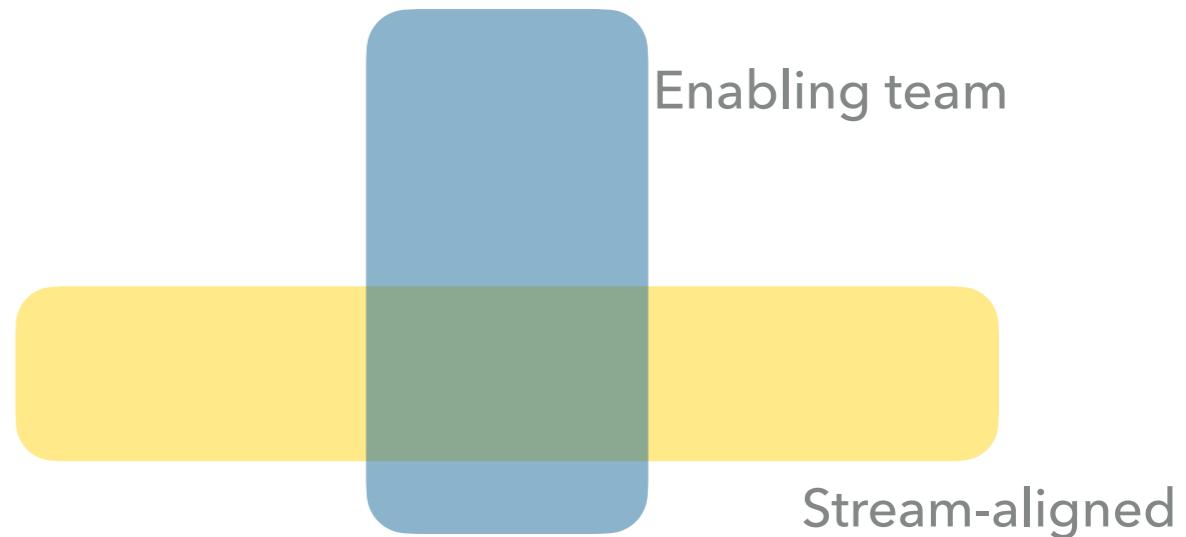
- ▶ Valuable stream of work
- ▶ Empowered to deliver value



Stream-aligned

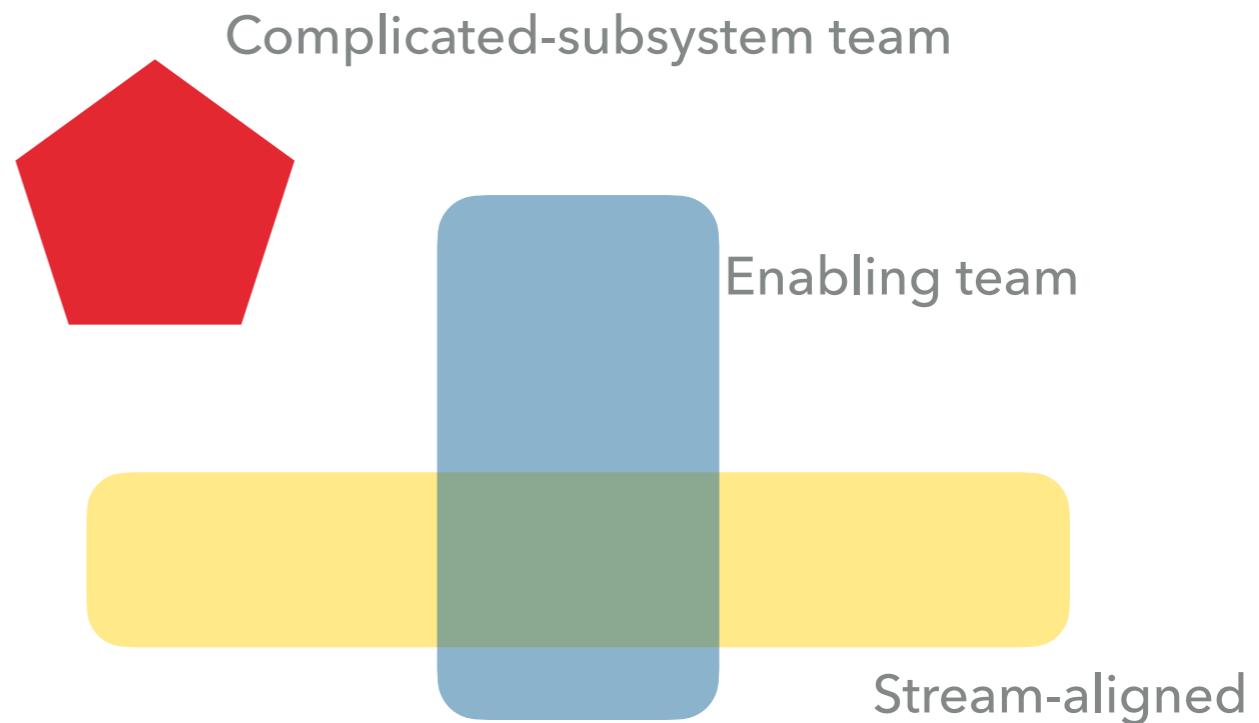
ENABLING TEAM

- ▶ Up skill stream-aligned team
- ▶ Servant Leadership
- ▶ Temporary



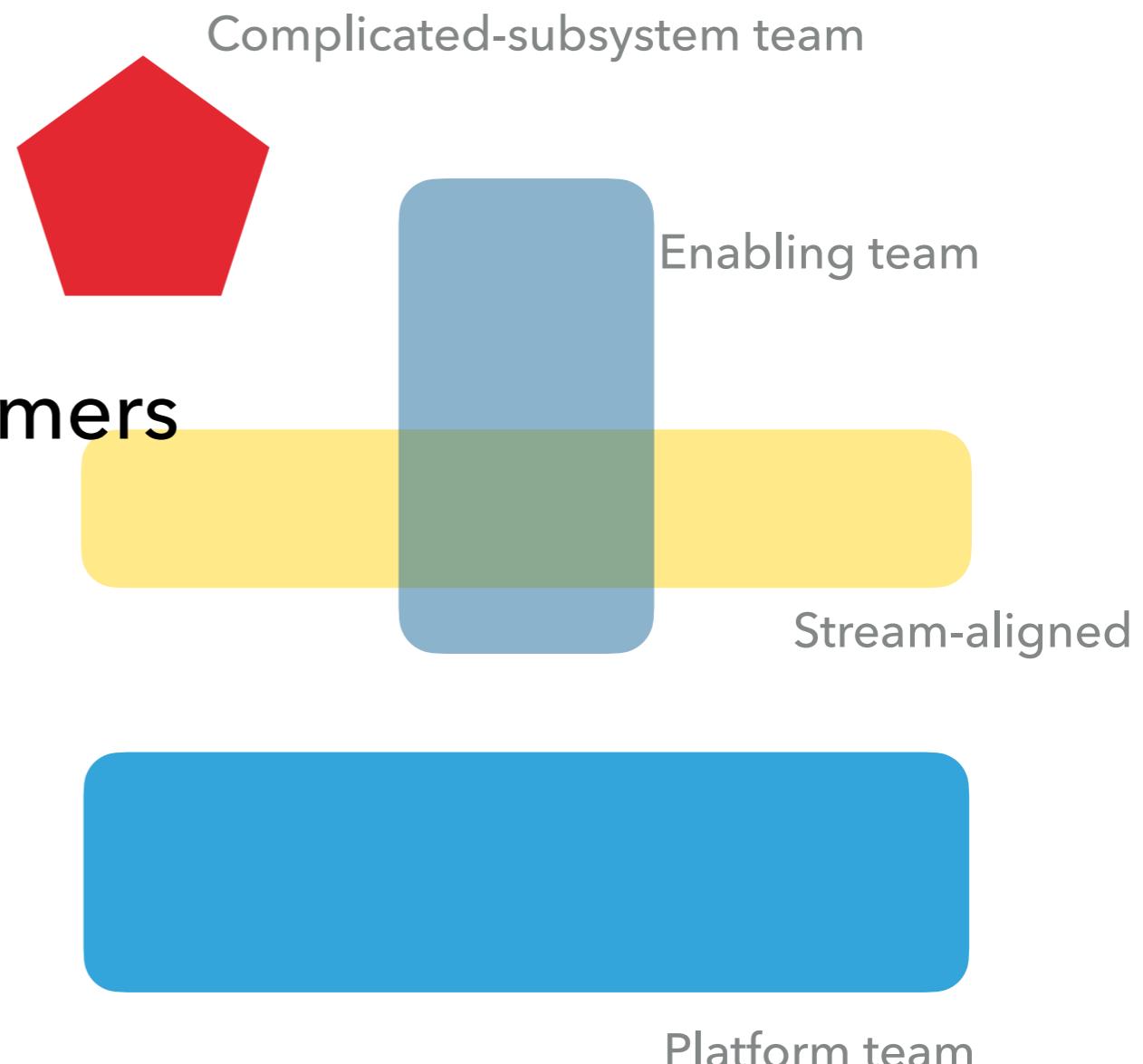
COMPLICATED SUBSYSTEM

- ▶ Captures complexity
- ▶ Provides it as a service

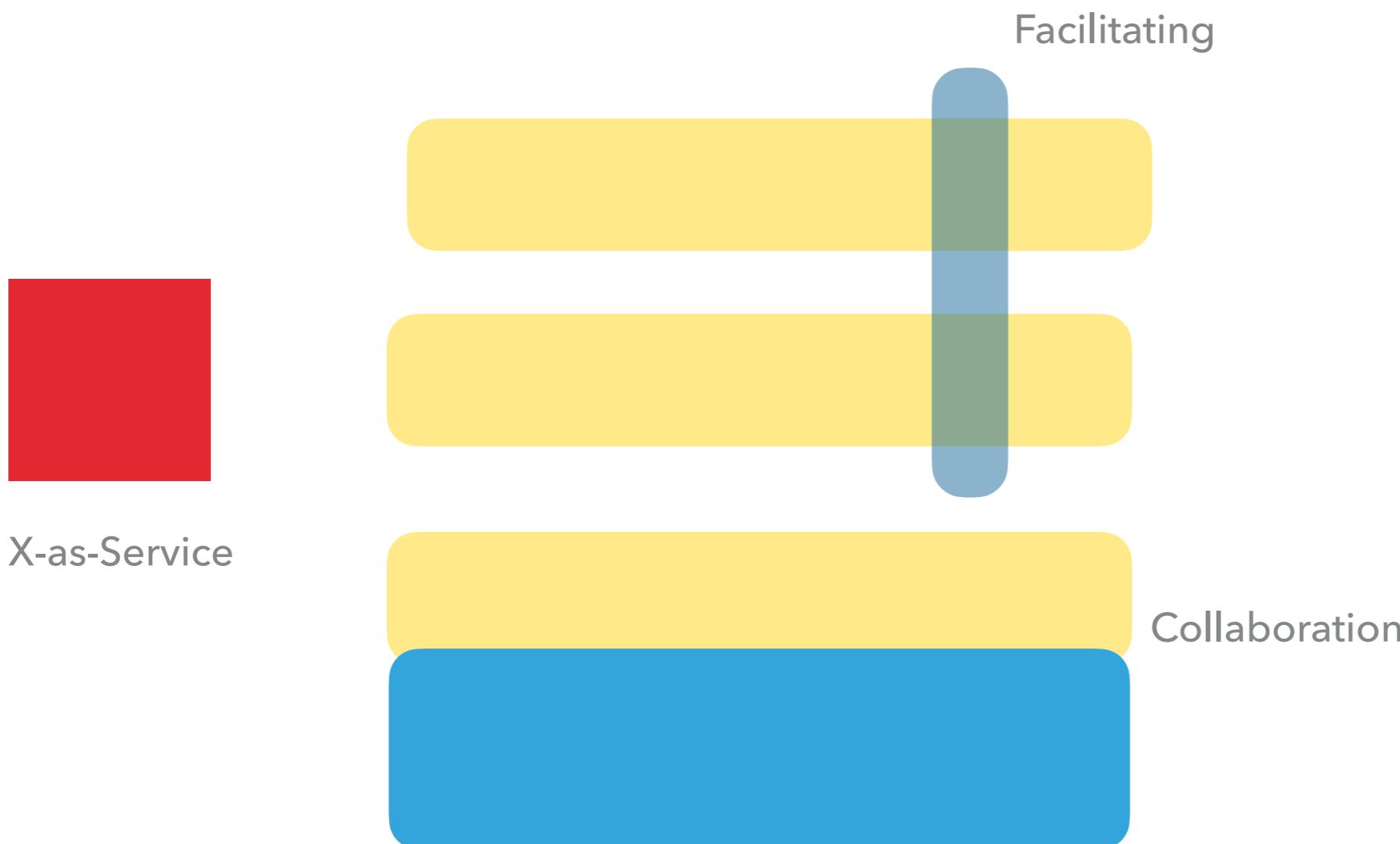


PLATFORM TEAM

- ▶ Thinnest Viable Platform
- ▶ Treat Stream-aligned as Customers



INTERACTION MODES





LONG LIVED TEAM



CHESTERTONS FENCE

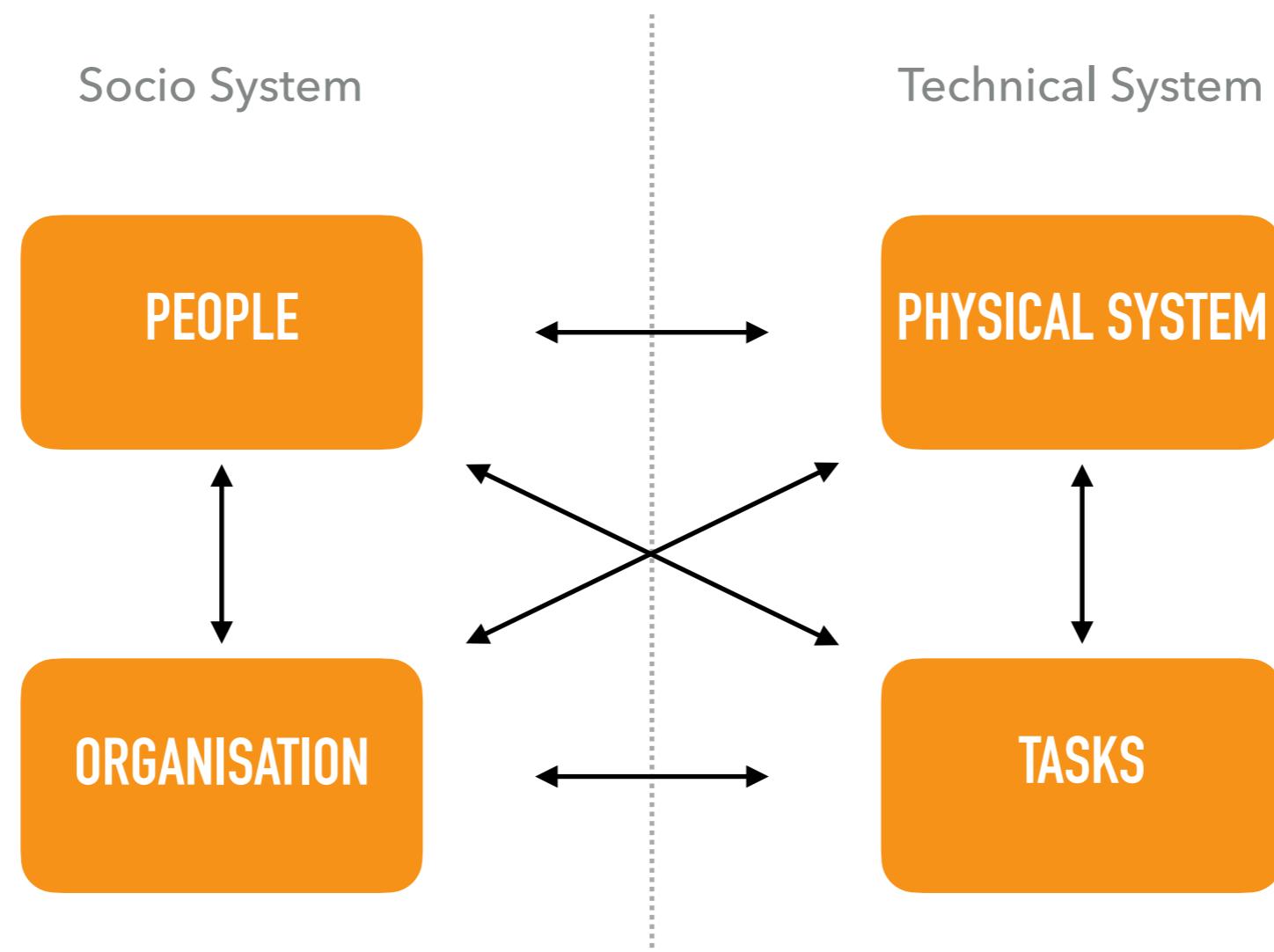
ARCHITECTURAL DECISION RECORDS

- ▶ Documents Architectural Decisions
- ▶ Documents Architectural Significant Requirements
- ▶ Collaborate through Pull Requests
- ▶ Show previous designs to show evolution in thinking

A photograph of a dead, gnarled tree in a desert environment. The tree's branches reach out against a clear blue sky. In the background, there are several large, rugged mountains under a hazy sky.

ABANDONED SOFTWARE

SOCIOTECHNICAL SYSTEM





**ARCHITECTING FOR
OPERATIONS**

**BUILDING FOR
FAILURE**

An aerial photograph of a large, modern cargo ship, likely a bulk carrier or chemical tanker, painted in a vibrant red color. The ship is shown from a high angle, moving from the bottom right towards the top left across a vast expanse of blue ocean. The horizon is visible in the distance under a clear sky. The ship's hull reflects the warm light of the setting sun, creating a bright path on the water.

DEPLOYMENT STRATEGY

A dramatic photograph of a volcanic eruption. A massive, dark, billowing plume of smoke and ash rises from a volcano, dominating the center of the frame. The smoke is thick and turbulent, with various shades of grey and black. In the foreground, the dark, rocky slopes of the volcano are visible, covered in sparse vegetation. The background is filled with more clouds and smoke, creating a sense of scale and intensity.

BIG BANG RELEASES

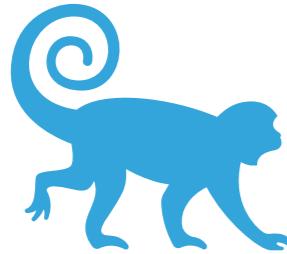
A dramatic photograph of a man in dark swim trunks leaping from a large, rugged, light-colored rock cliff into the ocean. He is captured mid-air, arms slightly outstretched, against a backdrop of a cloudy sky and the vast, dark blue sea. The cliff face shows clear horizontal sedimentary layers.

UNSTOPPABLE RELEASES

A close-up photograph of a very young, small kitten. The kitten has light-colored, possibly cream or beige, fur with some darker stripes on its back. It has large, expressive blue eyes and a slightly pink nose. It is looking directly at the camera with a curious expression. The background is dark and out of focus.

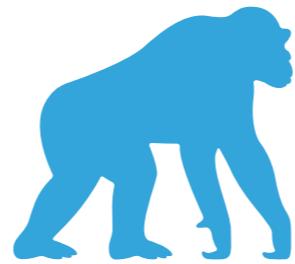
SMALL & ATOMIC

BUILDING FOR FAILURE



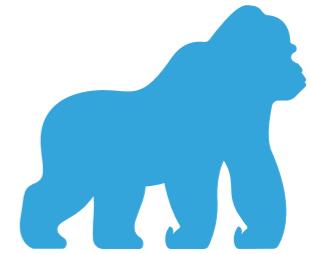
Continuous Integration

- ▶ Integrate daily to Main branch
- ▶ Run Tests to verify
- ▶ Automate



Continuous Delivery

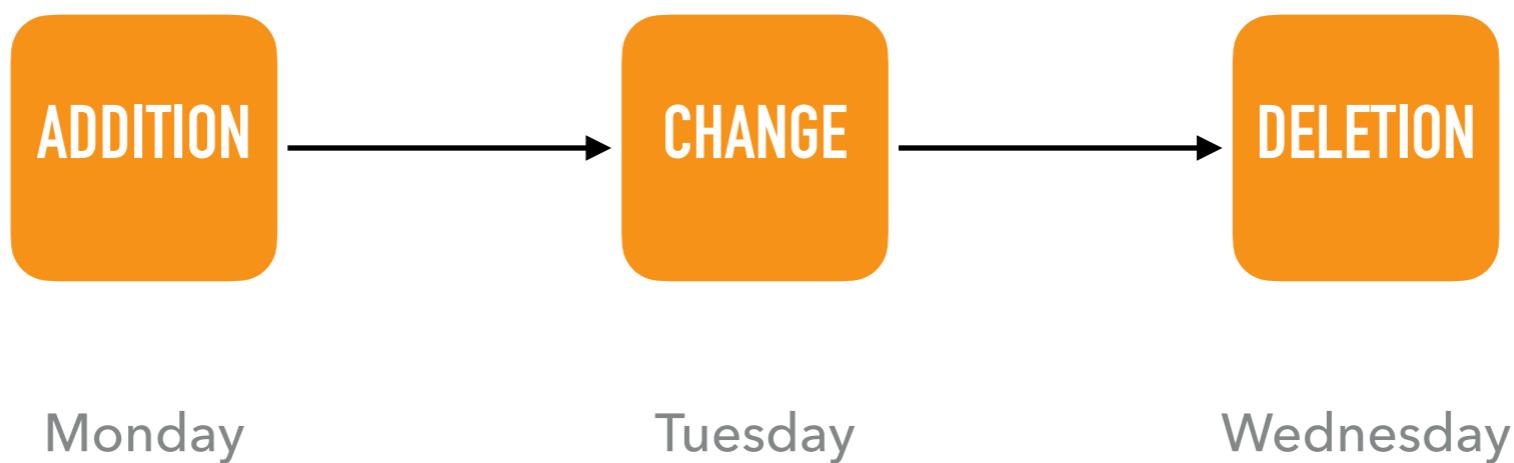
- ▶ Main branch always in Release State
- ▶ Run Tests to verify
- ▶ Automate



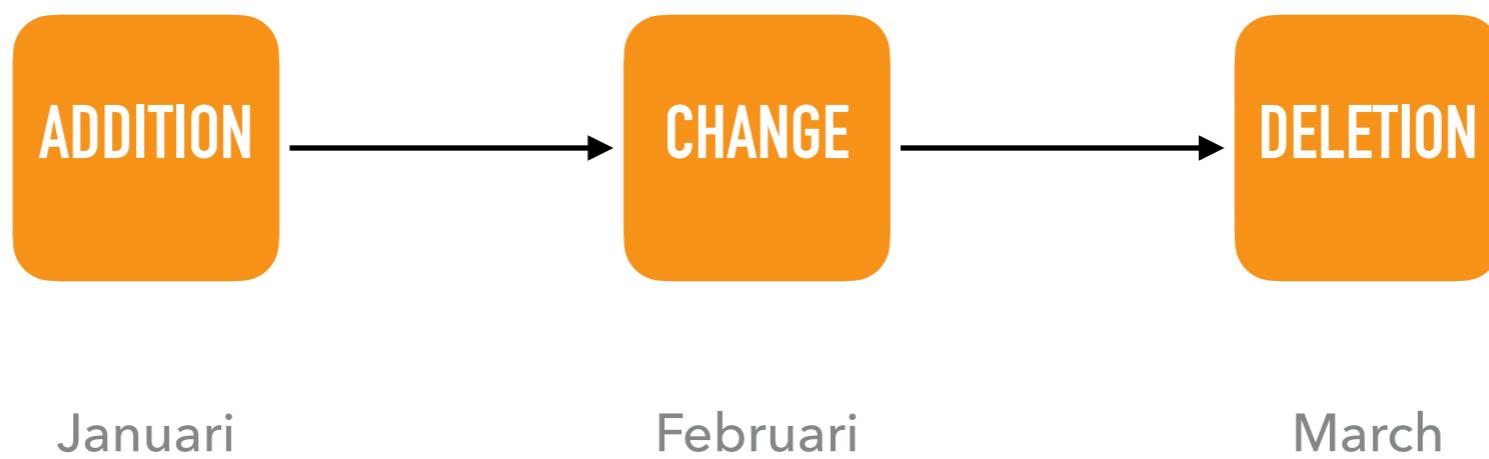
Continuous Deployment

- ▶ Every change on Main branch is deployed
- ▶ Run Tests to verify
- ▶ Automate

BACKWARDS COMPATIBLE



BACKWARDS COMPATIBLE





ALWAYS PUSH TO PRODUCTION

A close-up, slightly blurred photograph of a person's hands as they adjust various knobs and faders on a professional sound mixing console. The hands are positioned across the center of the frame, with fingers pressing buttons and turning knobs. The background is out of focus, showing more of the console and some bright stage lights.

FEATURE TOGGLES

SIMPLE FEATURE TOGGLES

```
function calculate(){  
    if( featureToggle("use-new-algorithm") ){  
        return newCalculation();  
    }else{  
        return oldCalculation();  
    }  
}
```



HOPE IS NOT A STRATEGY

DEALING WITH RISK USING LANGUAGE

- ▶ Can we deploy this?
 - ▶ Yes / No
 - ▶ No Risk
- ▶ How sure are we that we can deploy this?
 - ▶ 4 potential issues discussed
 - ▶ 2 bugs found

A young girl with a pink bow in her hair is sitting in a chair, looking down at her arm. A medical professional's hands are visible, holding a small bandage or piece of tape near her elbow. The girl is wearing a white top with a colorful strap across her shoulder and a rainbow-colored crocheted item. The background shows a wooden door and a white wall.

IF IT HURTS,
DO IT MORE OFTEN

GRACEFUL DEGRADATION



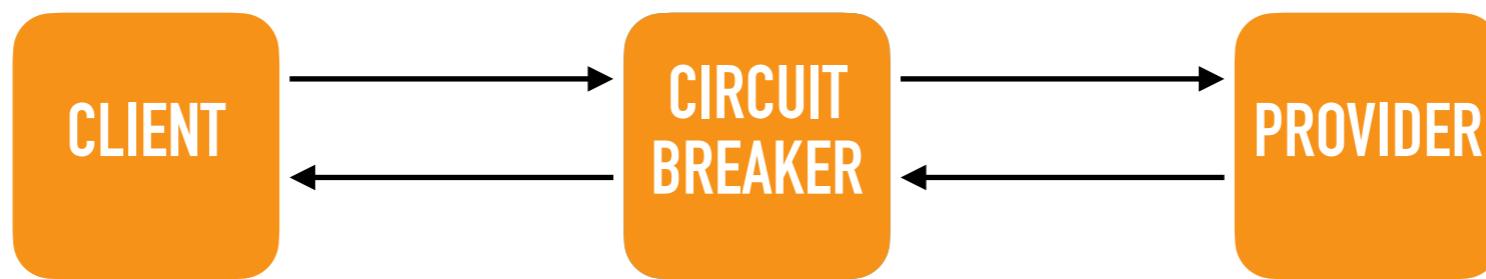
GRACEFUL DEGRADATION

- ▶ Return less precise data
 - ▶ Incomplete data
 - ▶ Cached data
 - ▶ Preset data
 - ▶ No data

CIRCUIT BREAKER

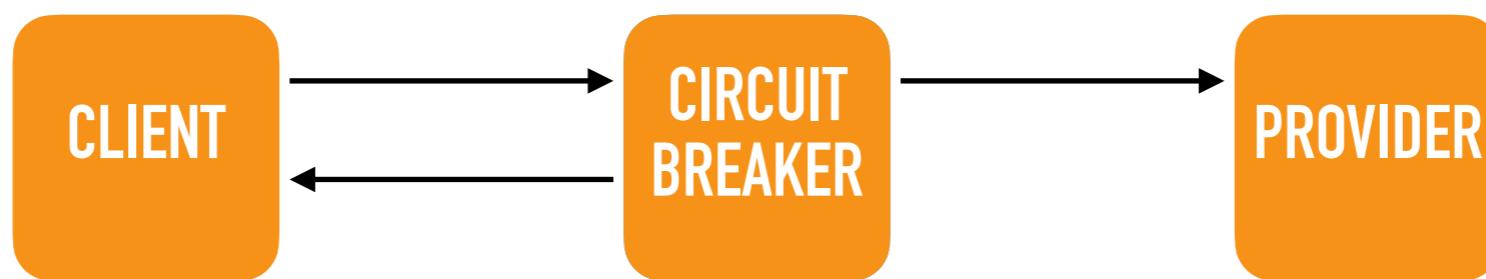


CIRCUIT BREAKER



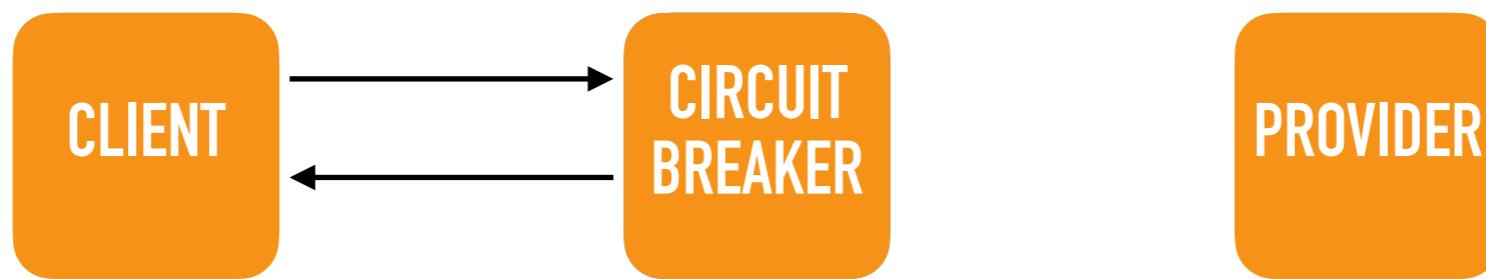
NORMAL

CIRCUIT BREAKER



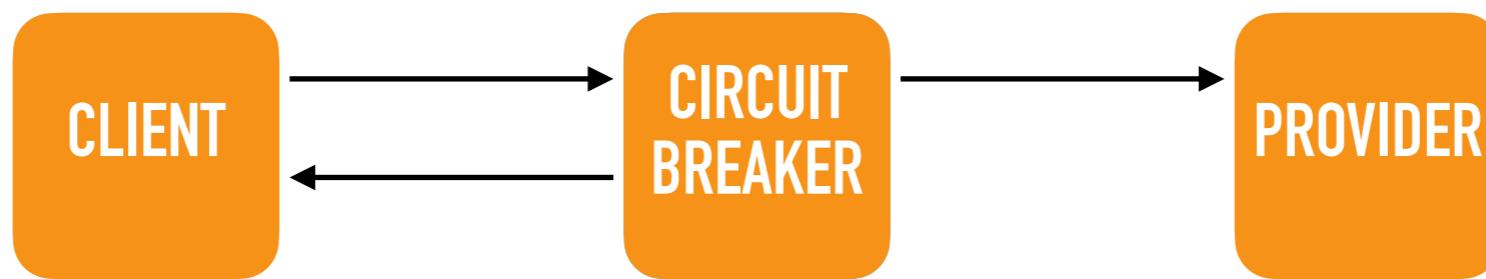
TIMEOUT

CIRCUIT BREAKER



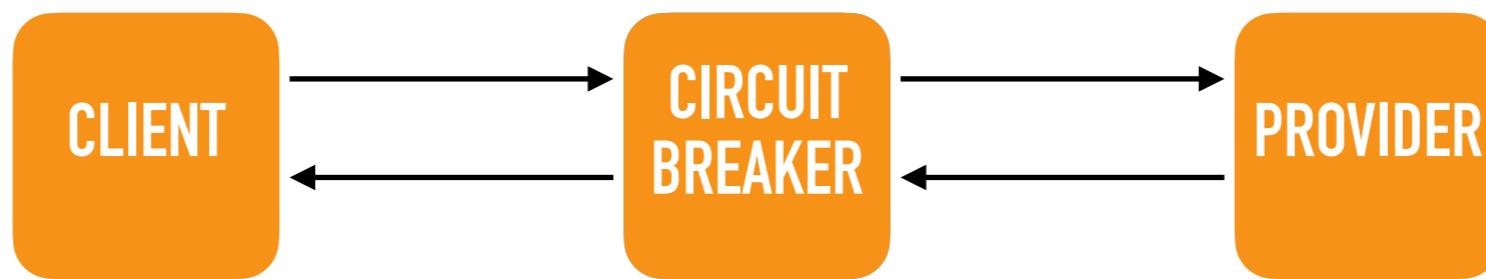
CIRCUIT OPEN

CIRCUIT BREAKER



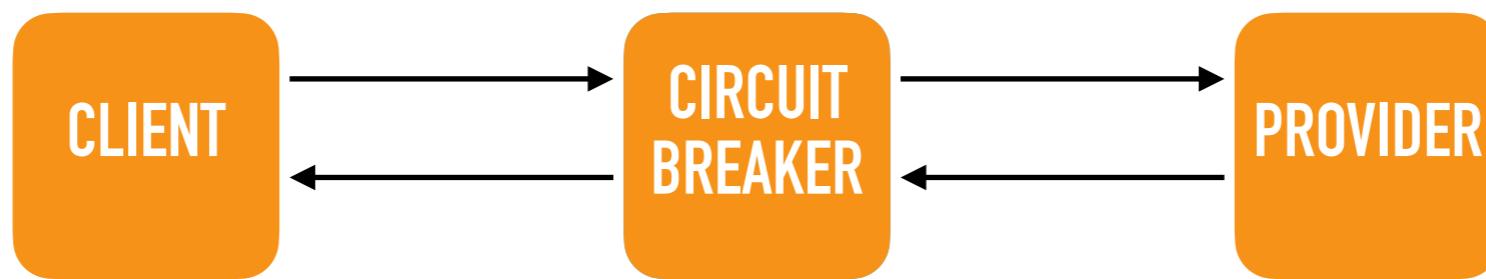
TRIAL

CIRCUIT BREAKER



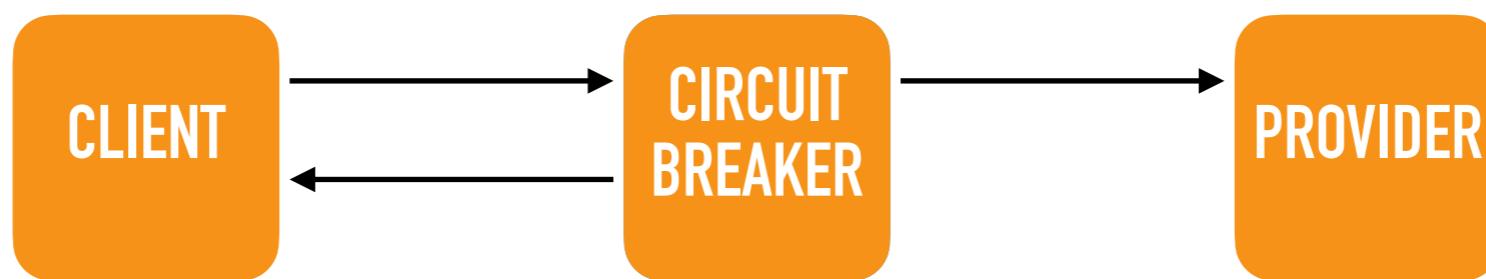
RECOVERY

CIRCUIT BREAKER



NORMAL

CIRCUIT BREAKER

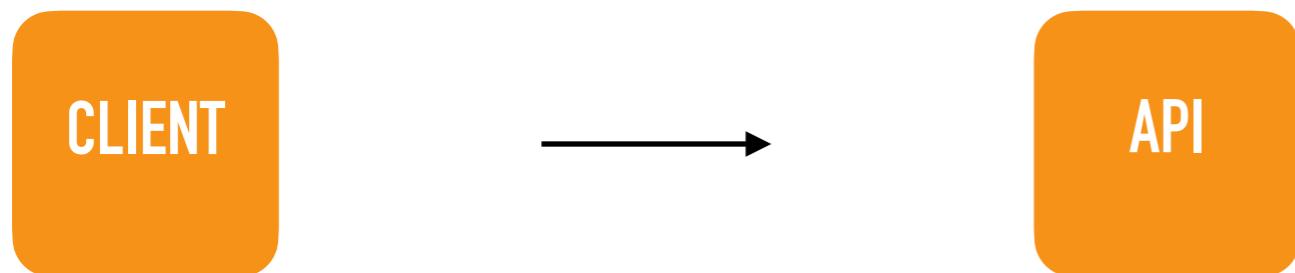


TIMEOUT

A blue U.S. Mail mailbox is mounted on a wooden post in a park-like setting. The mailbox is open, showing its interior. The word "U.S. MAIL" is embossed on the front panel. The background features trees and a building, suggesting a residential or park area.

ASYNCHRONOUS

ASYNCHRONOUS



Source: Asynchronous patterns for Cloud Functions by Preston Holmes <https://cloud.google.com/community/tutorials/cloud-functions-async>

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ASYNCHRONOUS

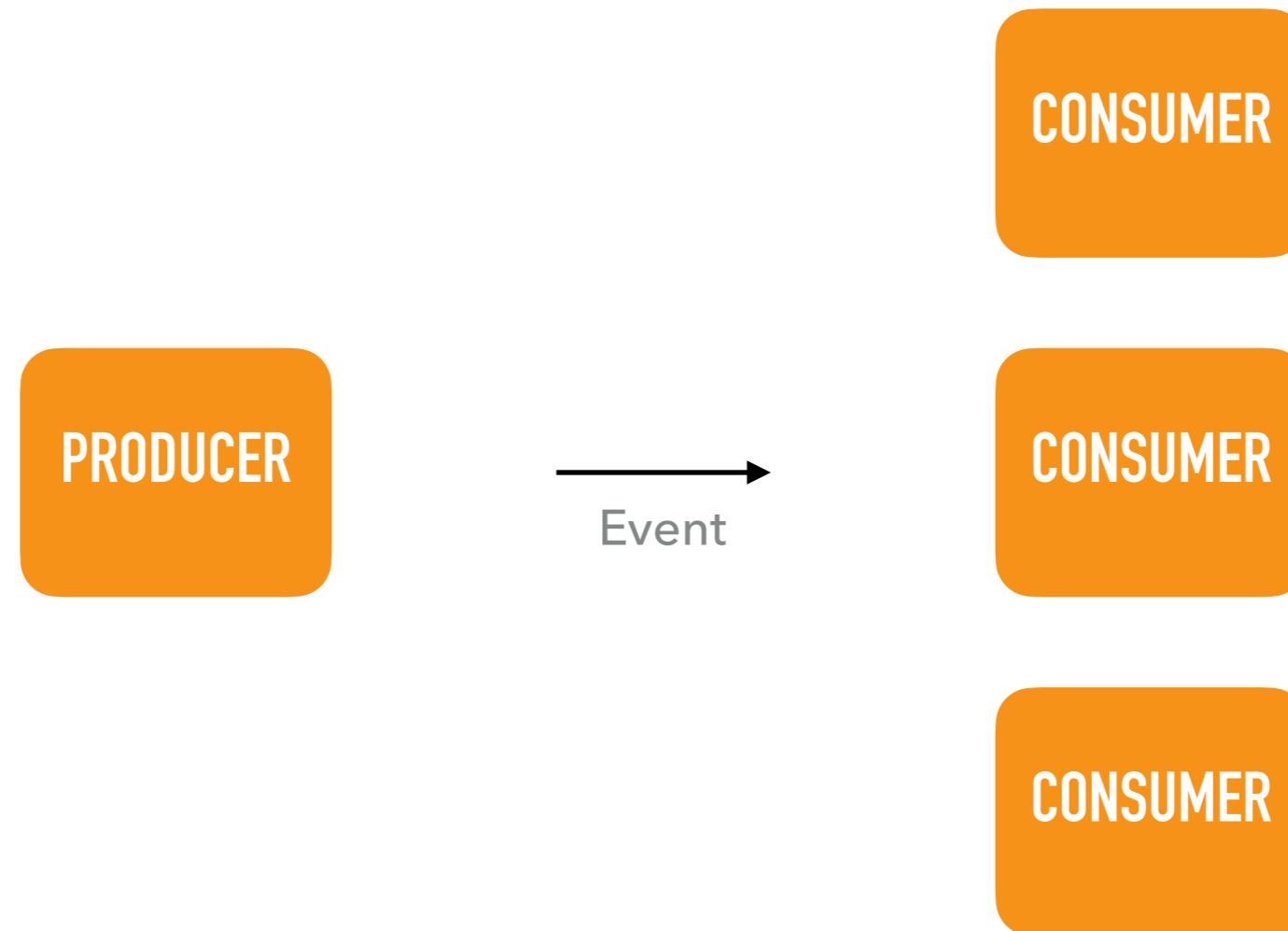


Source: Asynchronous patterns for Cloud Functions by Preston Holmes <https://cloud.google.com/community/tutorials/cloud-functions-async>

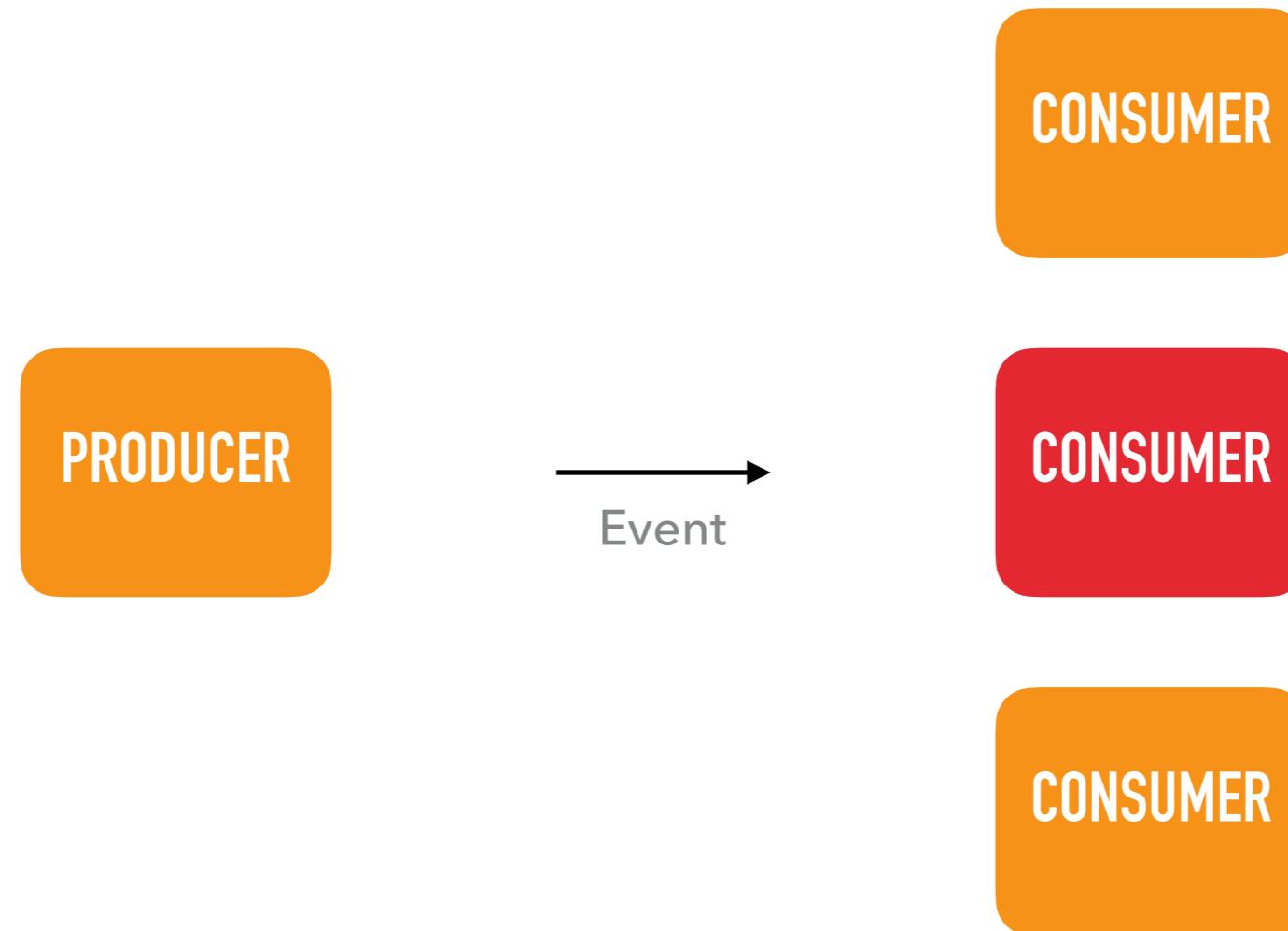
EVENT DRIVEN



EVENT DRIVEN



EVENT DRIVEN





QUALITY VS INNOVATION

SITE RELIABILITY ENGINEERING

- ▶ How much quality have we agreed upon? (SLA)
- ▶ How much quality do we provide? (SLI)
- ▶ How much quality do we want? (SLO)



QUANTIFY QUALITY

ERROR BUDGET





TOIL

TOIL

- ▶ Designate Engineer
- ▶ Focus on incidents
- ▶ Shields the team
- ▶ Engineers solutions
- ▶ Close collaboration with Product Owner



OBSERVABILITY

FAKE POSITIVES



USER NOTIFICATIONS





**ARCHITECTING FOR
OPERATIONS**

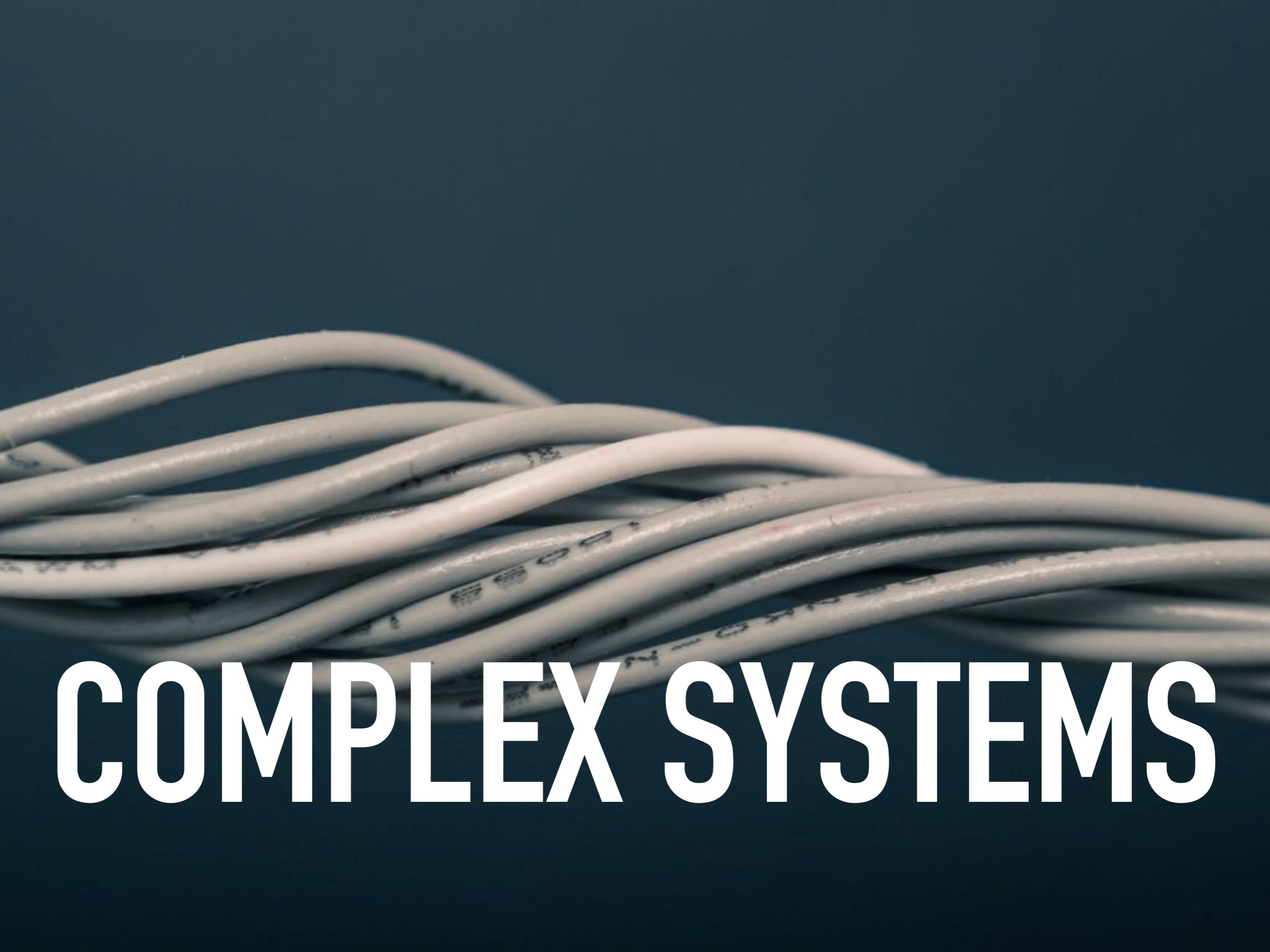
**FAILURE IS
INEVITABLE**



RUNTIME

DATA

DATA



COMPLEX SYSTEMS

A black and white photograph showing a close-up view of laboratory glassware. In the foreground, there is a clear glass Erlenmeyer flask containing a liquid. A clear plastic dropper or pipette is inserted into the liquid. Behind it, there is a larger, wider glass flask also containing liquid. To the right, several test tubes are standing upright in a holder. The lighting is dramatic, creating strong highlights and shadows on the glass surfaces.

SCIENTIFIC APPROACH

SCIENTIFIC APPROACH

- ▶ Describe objectively
- ▶ Formulate a hypothesis
- ▶ Derive an experiment
- ▶ Observe outcomes



LOOK FOR CHANGE

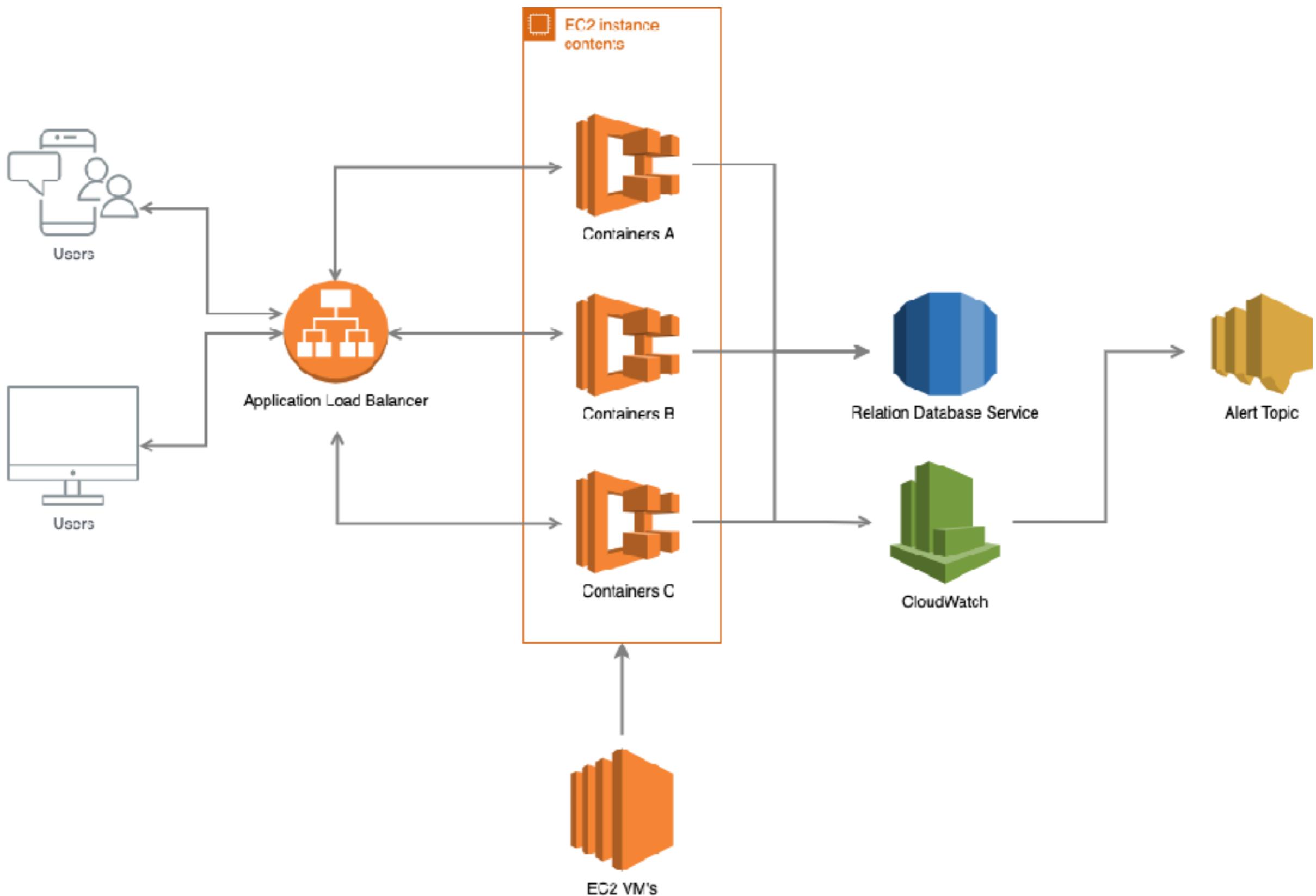


POST MORTEM

A close-up photograph of a person's hand holding a pair of sunglasses. The sunglasses have dark, reflective lenses that show a clear reflection of a dense green forest with many trees. The frames of the sunglasses are dark brown or black. The background is a solid, muted green.

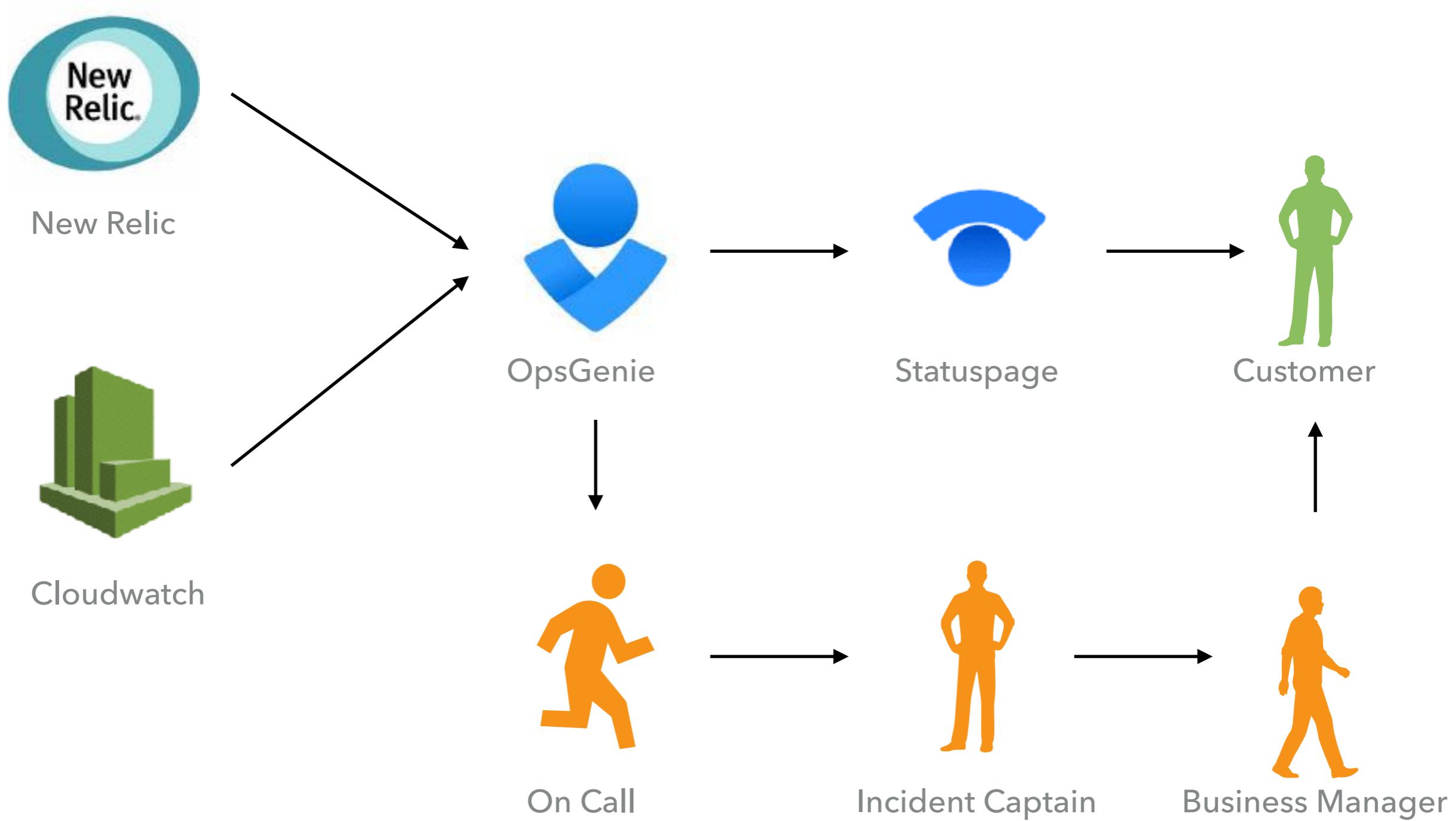
TRANSPARENCY

FAILURE IS INEVITABLE



FAILURE IS INEVITABLE

COMMUNICATION



POST MORTEM TEMPLATE

- ▶ Timeline: What happened?

- ▶ Impact

- ▶ Resolutions

- ▶ Root Cause

- ▶ Follow up

- ▶ Public Communication

- ▶ Improvements

- ▶ Organisational

- ▶ Technical



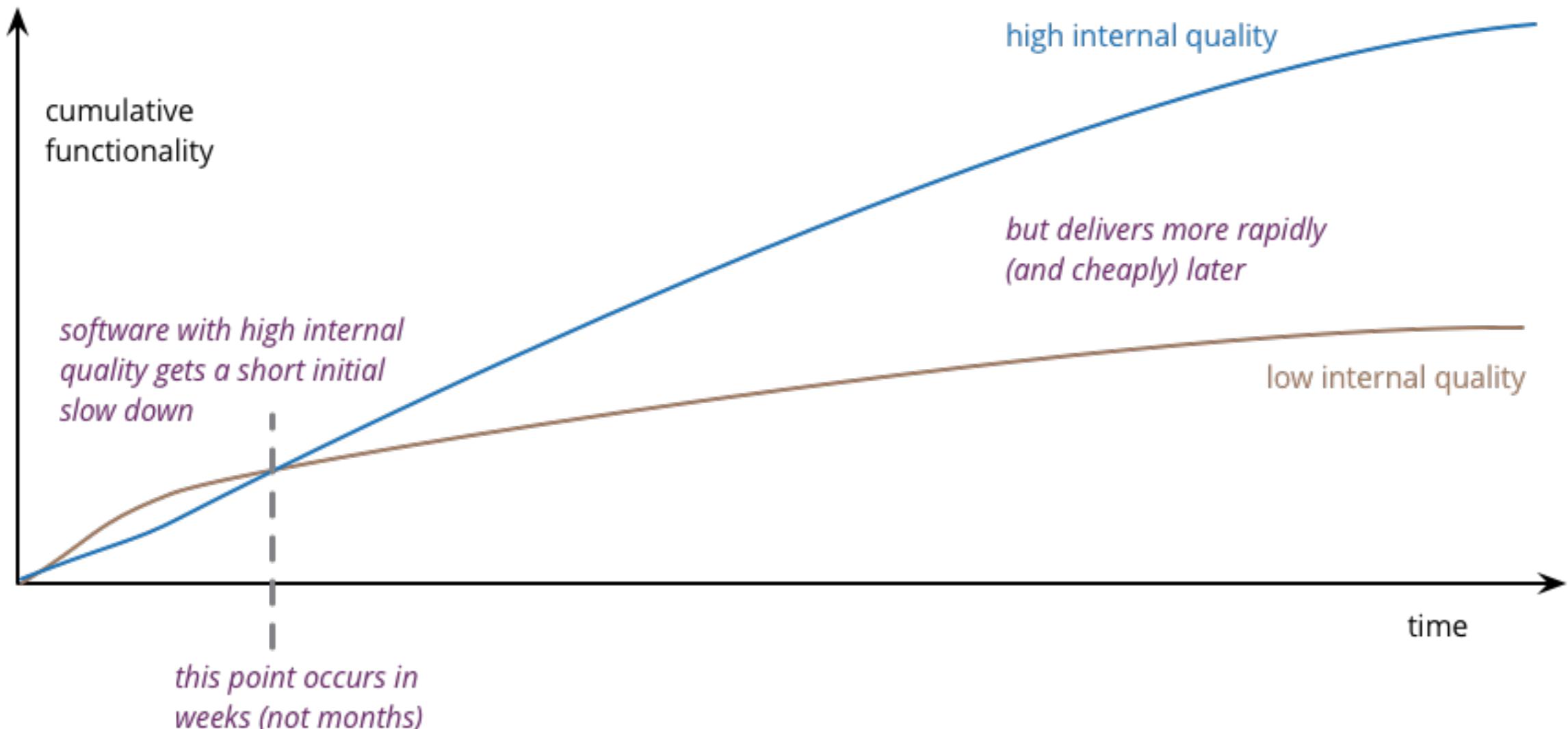
UNIQUE FAILURES



NO WORKAROUND

BUILDING FOR FAILURE

QUALITY



Source: Is High Quality Software Worth the Cost? By Martin Fowler <https://www.martinfowler.com/articles/is-quality-worth-cost.html>



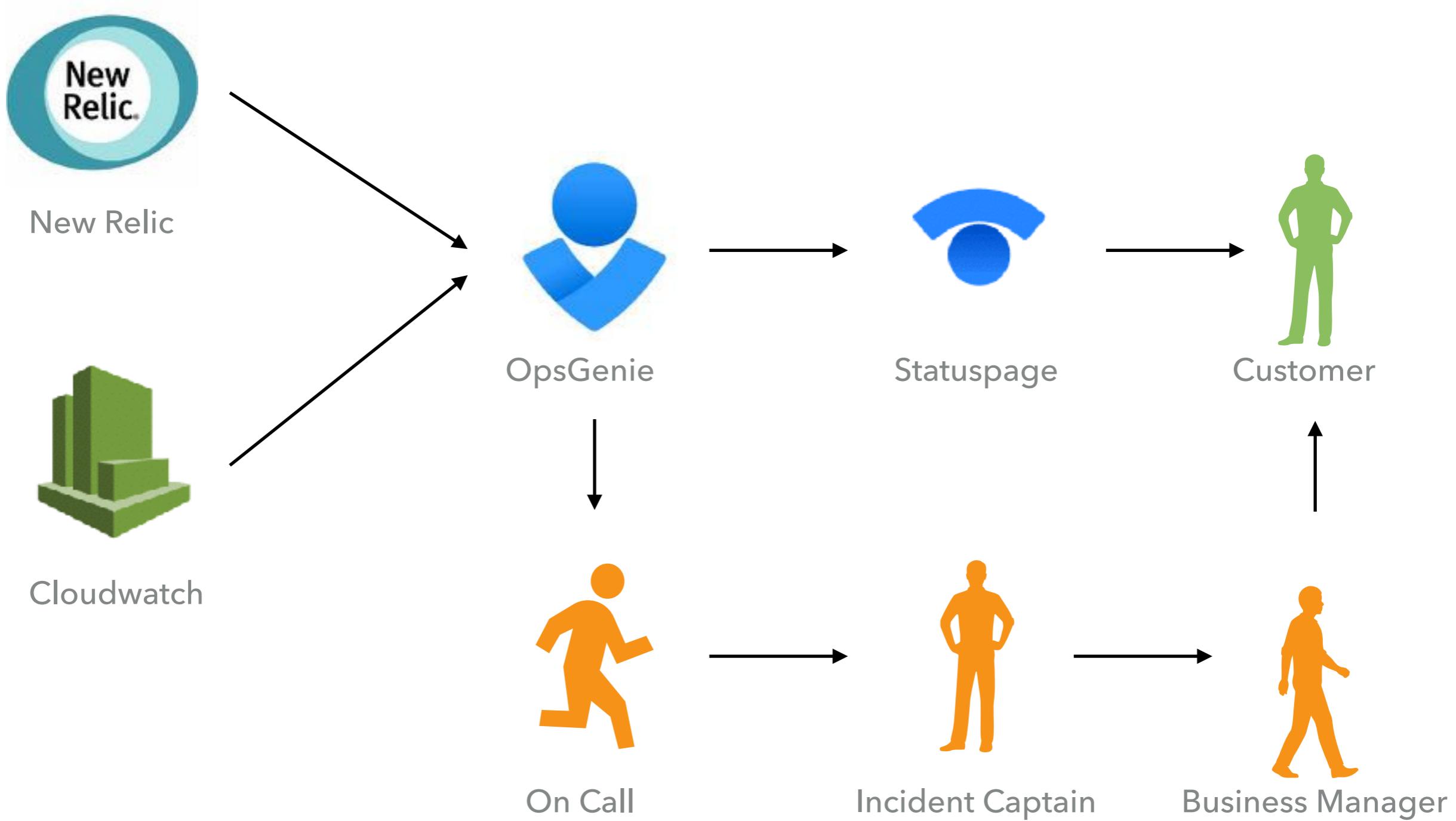
BROKEN WINDOW THEORY

A close-up, low-angle shot of a person's legs and torso as they perform a pull-up on a dark-colored horizontal bar. The person is wearing dark shorts, white socks, and blue athletic shoes with red accents. Their hands are gripping the bar, and their body is suspended in mid-air. The background is a textured, dark surface.

TRAIN YOUR OPERATIONS

FAILURE IS INEVITABLE

COMMUNICATION





STAGING

CONCLUSION

ATTRIBUTION

- ▶ Sources are on bottom of the slides
- ▶ All pictures are from unsplash.com and their creators

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ANY QUESTIONS?



CONCLUSION

FURTHER READING

AWS Well-Architected Framework
November 2018



Source: AWS Well-Architected Framework Whitepaper <https://aws.amazon.com/architecture/well-architected/>



ARCHITECTING FOR OPERATIONS

INFRASTRUCTURE AS CODE

BENEFITS

- ▶ Automation
- ▶ Version control
- ▶ Code Review
- ▶ Testing
- ▶ Documentation
- ▶ Reuse

Source: 5 Lessons Learned From Writing Over 300,000 Lines of Infrastructure Code by Yevgeniy Brickman

<https://www.youtube.com/watch?v=RTEgE2lcyk4> <https://www.youtube.com/watch?v=RTEgE2lcyk4>

INFRASTRUCTURE AS CODE



AWS CloudFormation



HashiCorp Terraform



Azure Resource Manager

JSON / YAML



Troposphere



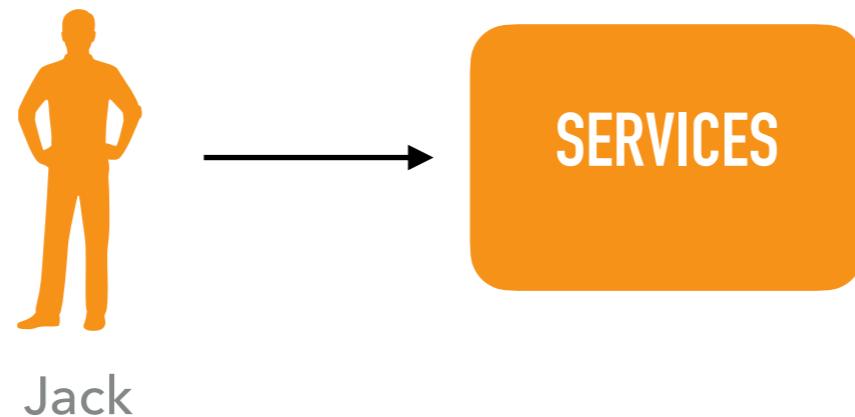
AWS Cloud Development Kit

Declarative

DOM

Componentized

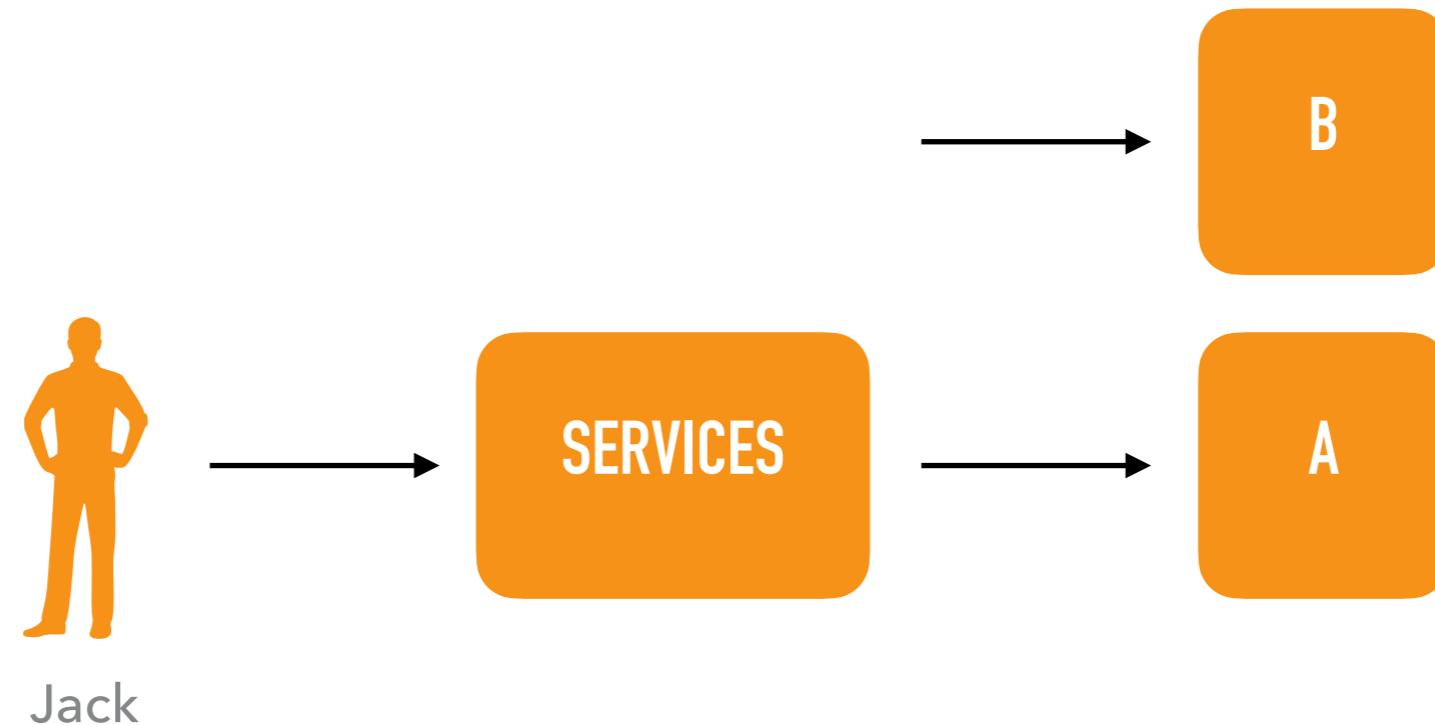
SLOW FEEDBACK LOOP



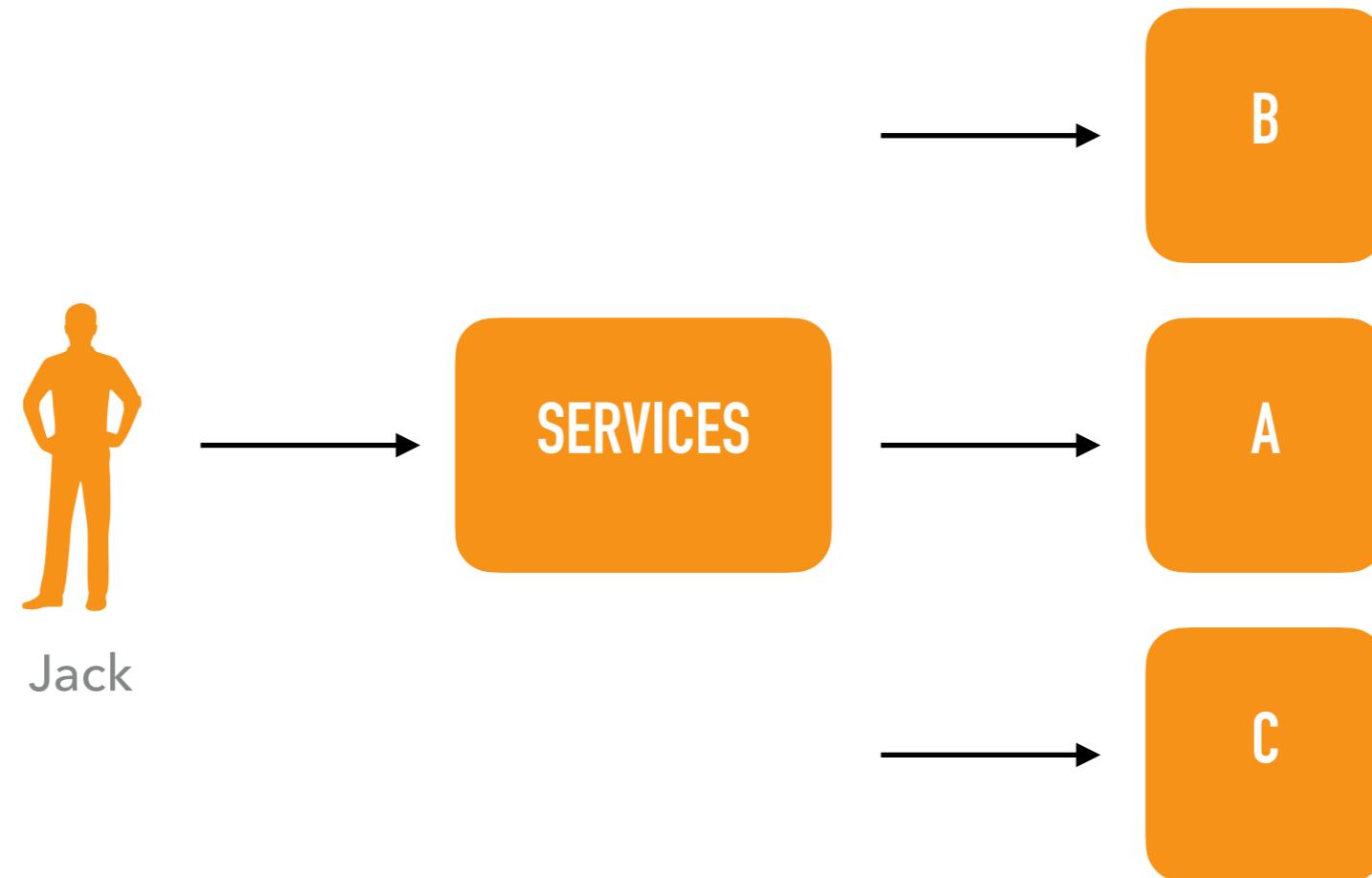
SLOW FEEDBACK LOOP



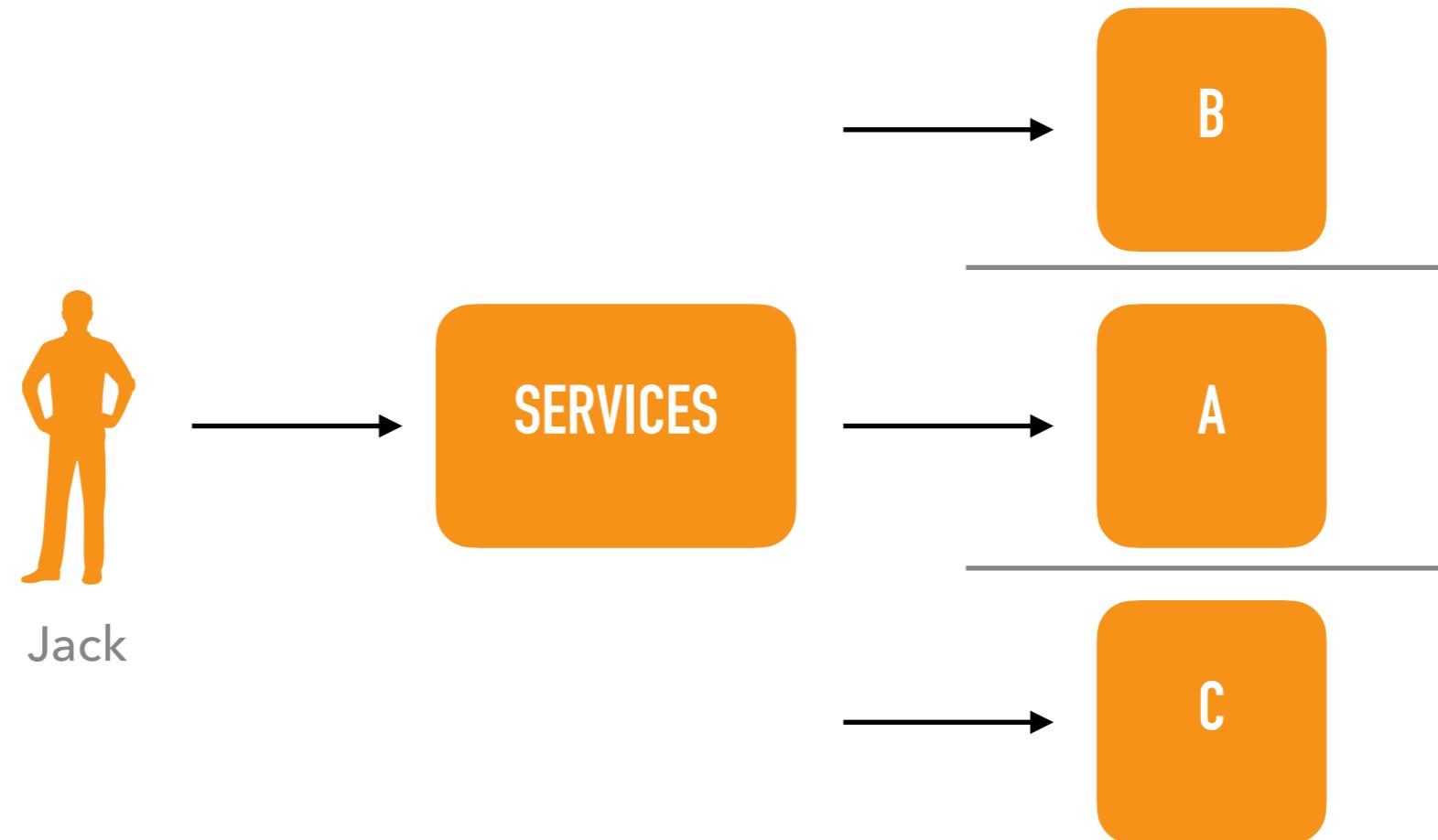
SLOW FEEDBACK LOOP



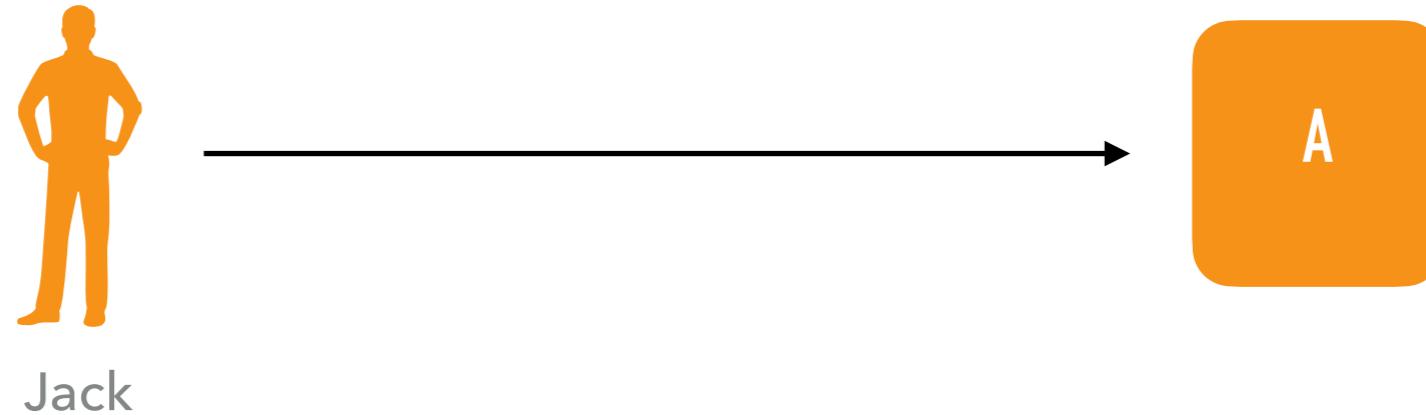
SLOW FEEDBACK LOOP



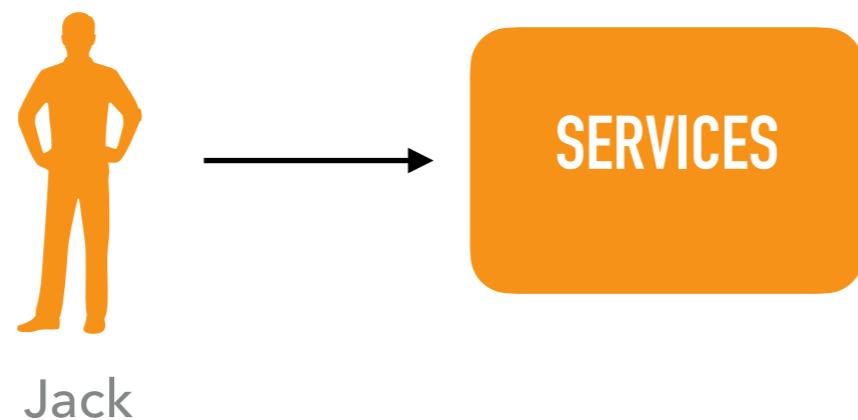
SLOW FEEDBACK LOOP



SLOW FEEDBACK LOOP



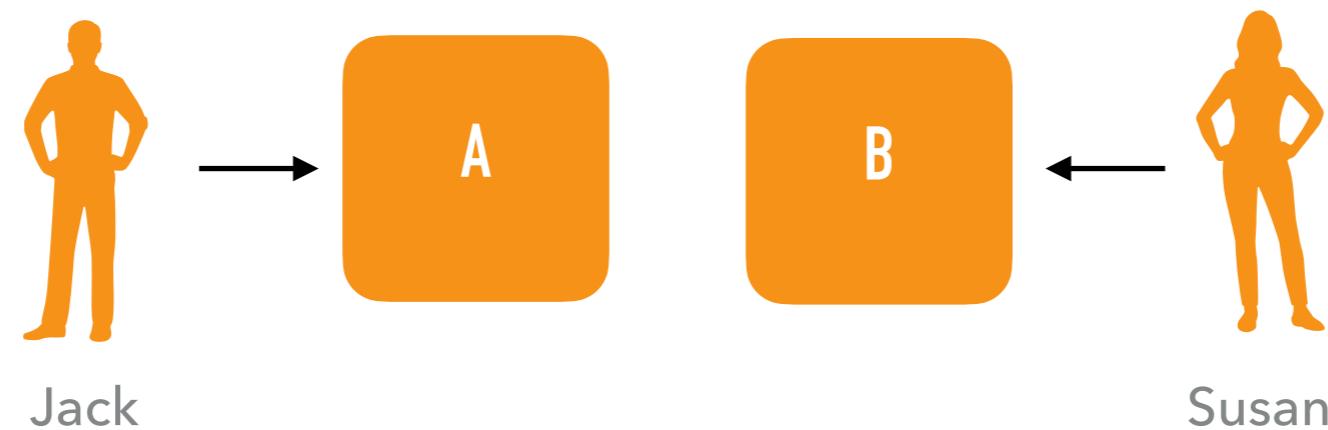
COLLISIONS DURING DEVELOPMENT



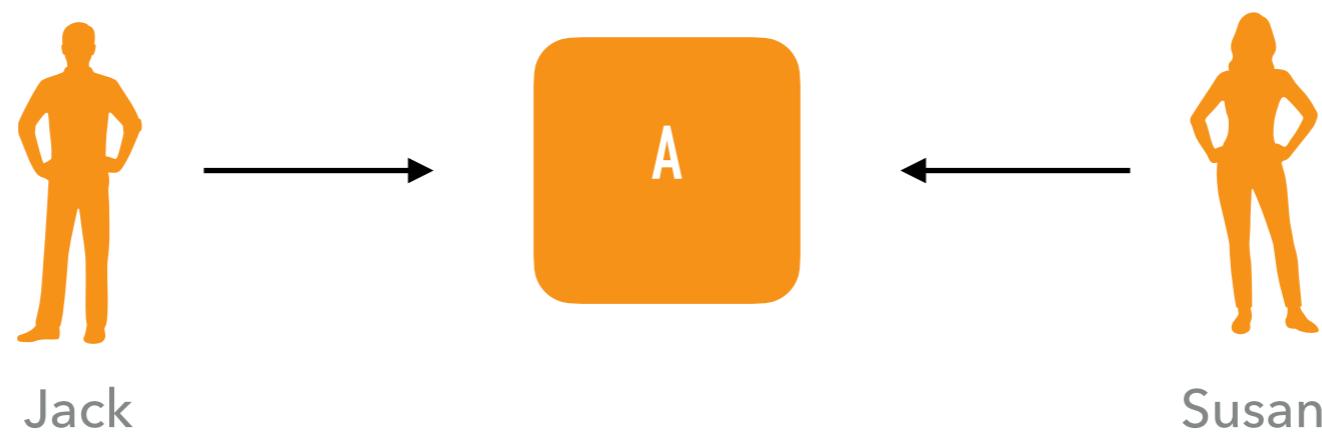
COLLISIONS DURING DEVELOPMENT



COLLISIONS DURING DEVELOPMENT



COLLISIONS DURING DEVELOPMENT

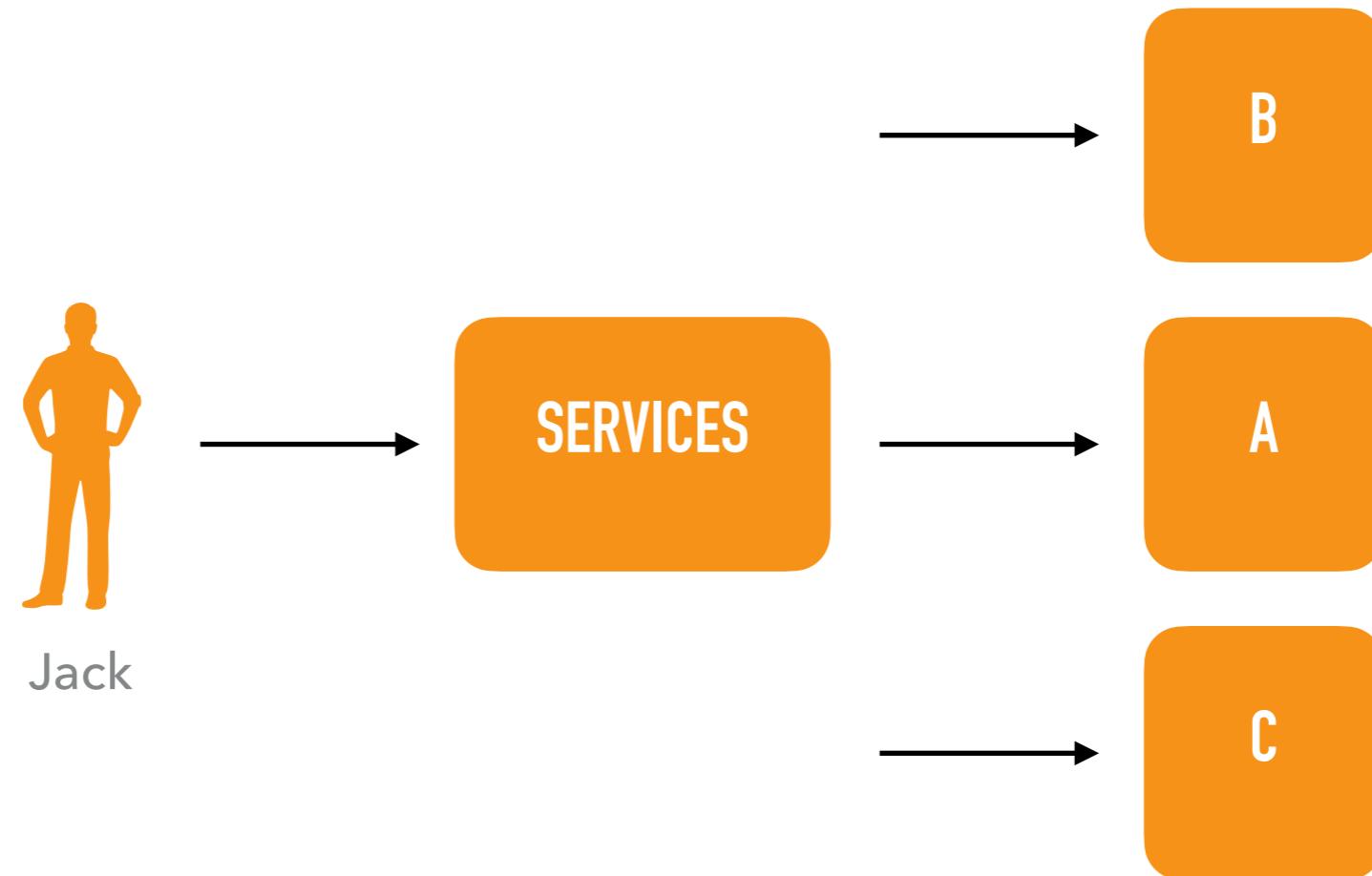


COLLISIONS DURING DEVELOPMENT

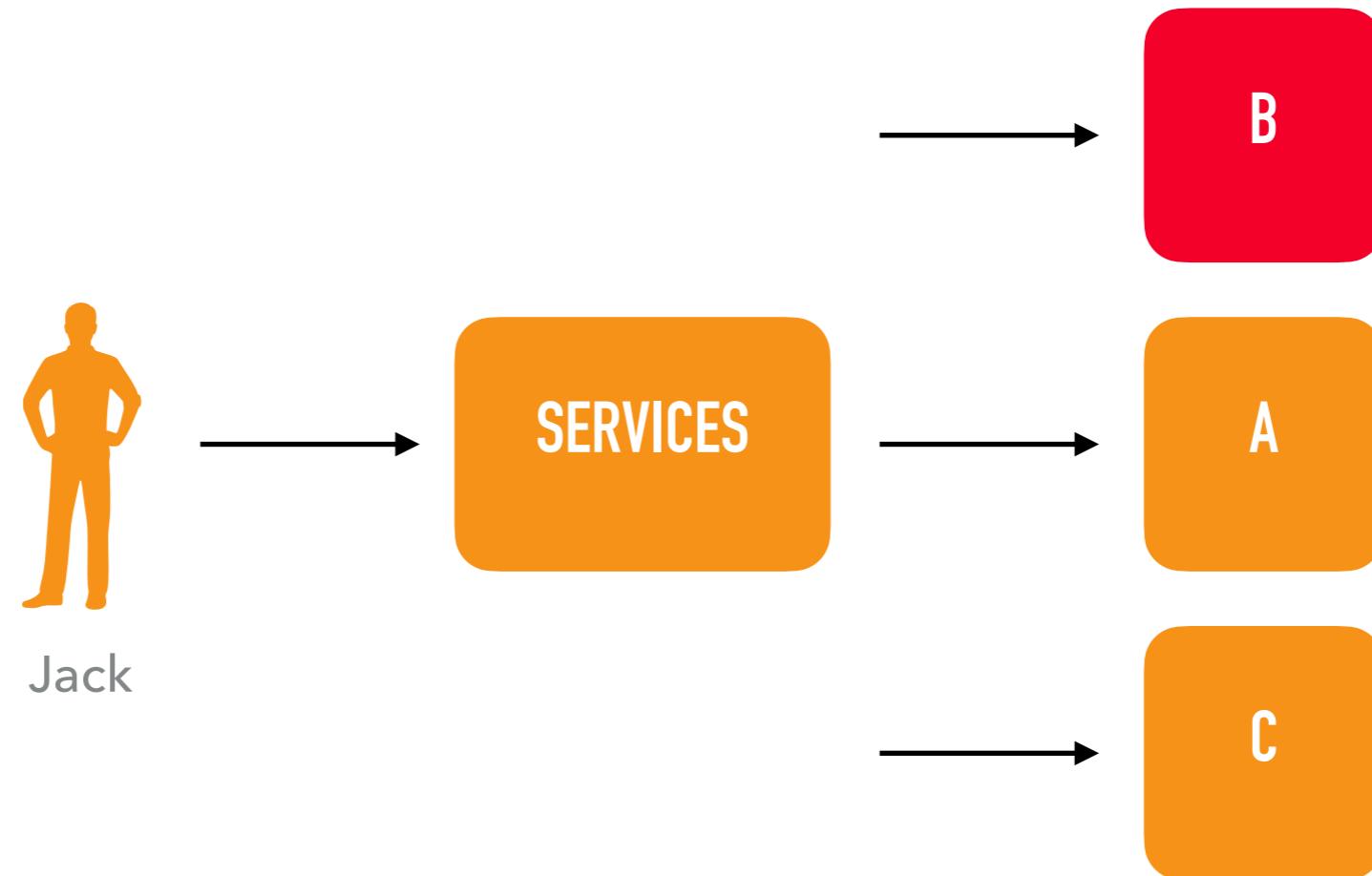


INFRASTRUCTURE AS CODE

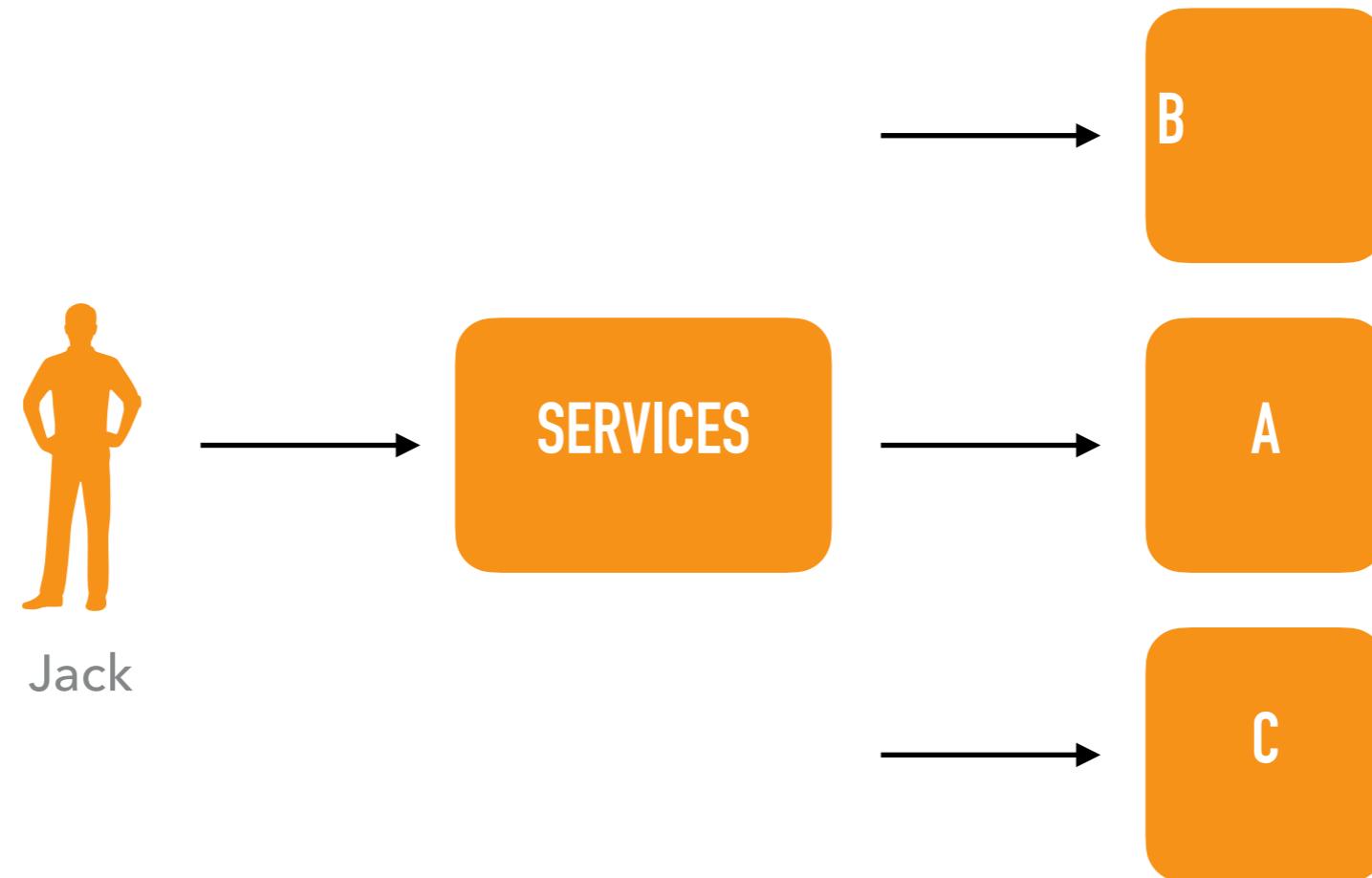
PROBLEMS



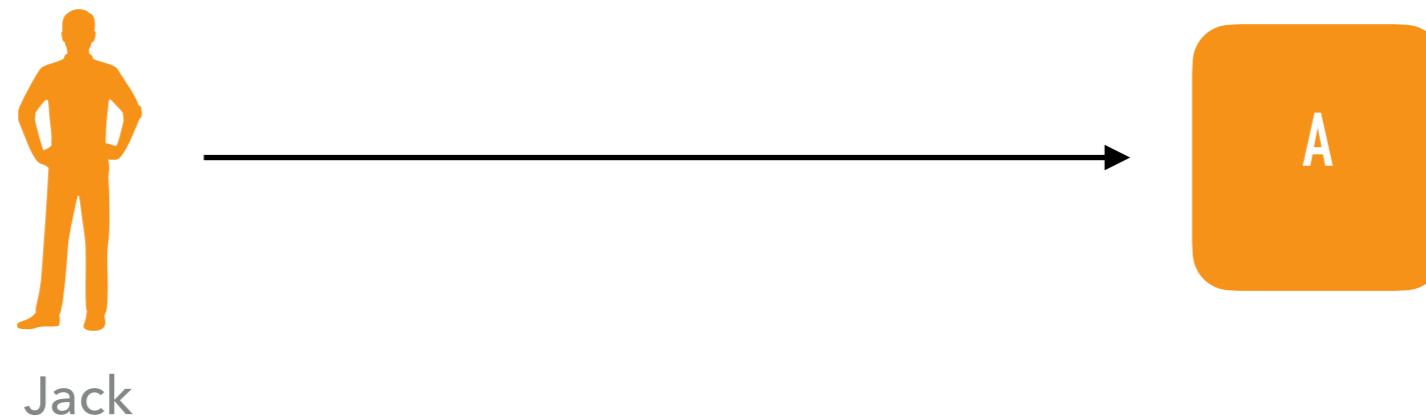
PROBLEMS: BUGS



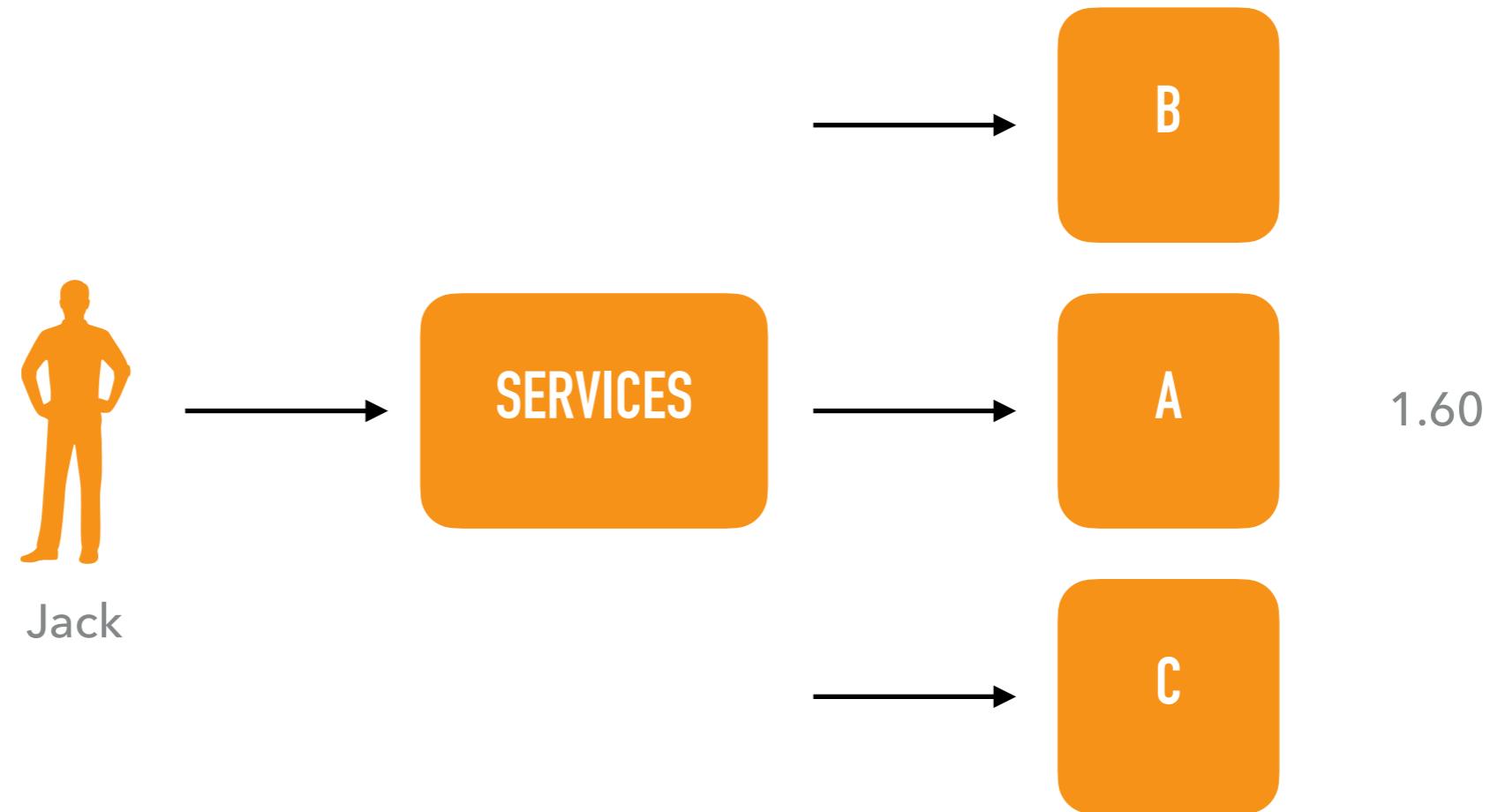
PROBLEMS: DRIFT



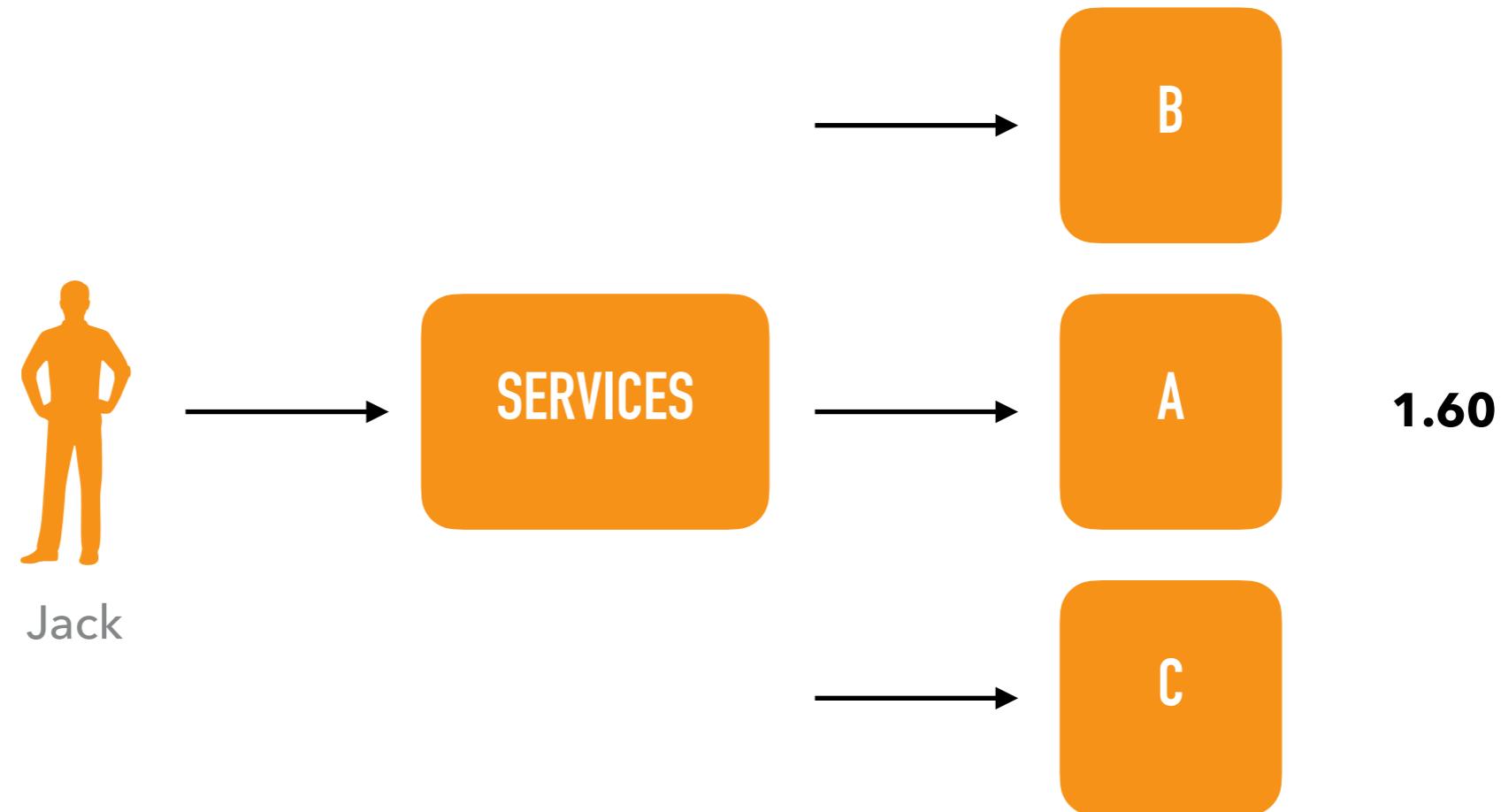
PROBLEMS



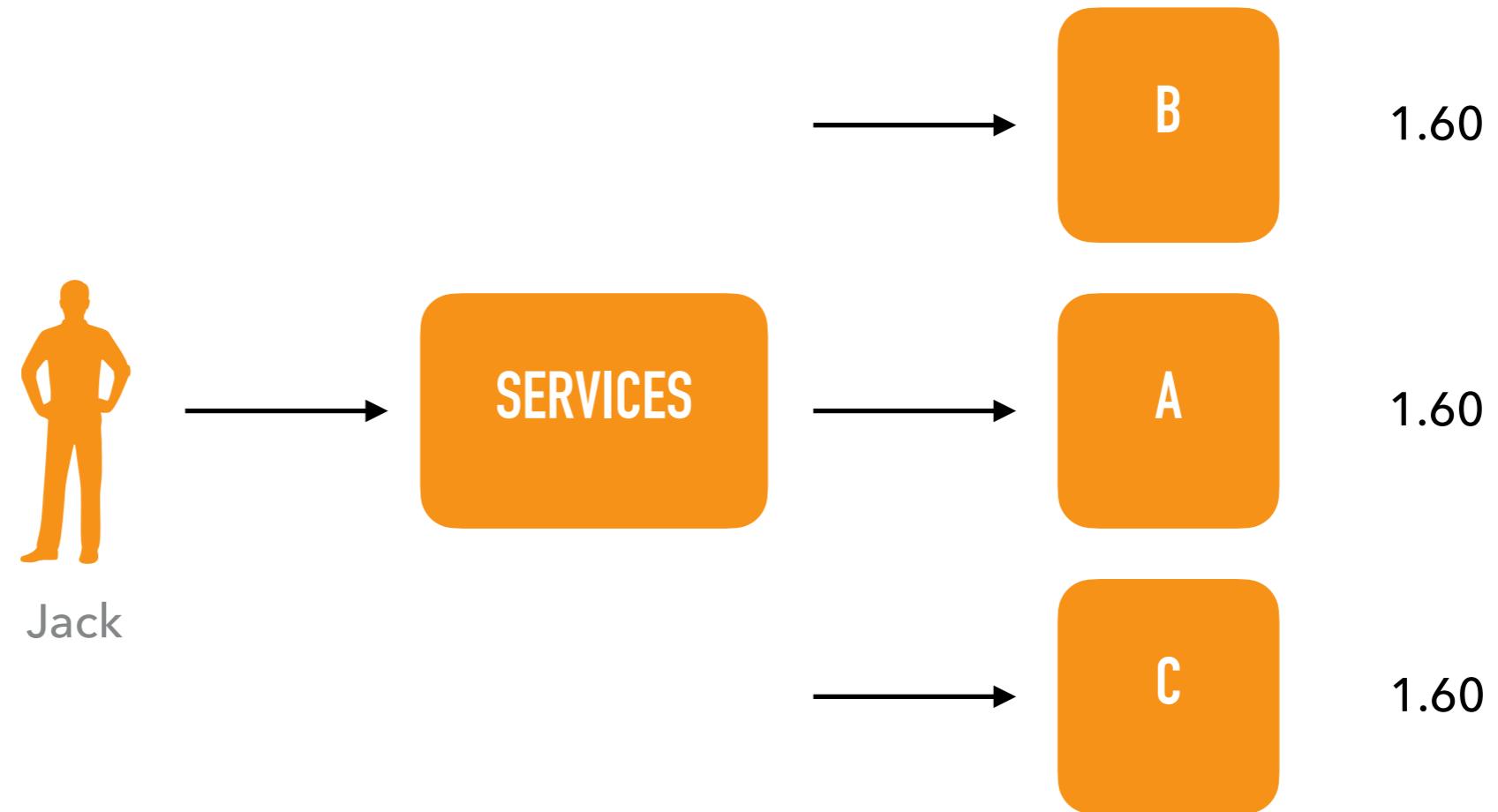
TAGGING/BRANCH DEADLOCKS



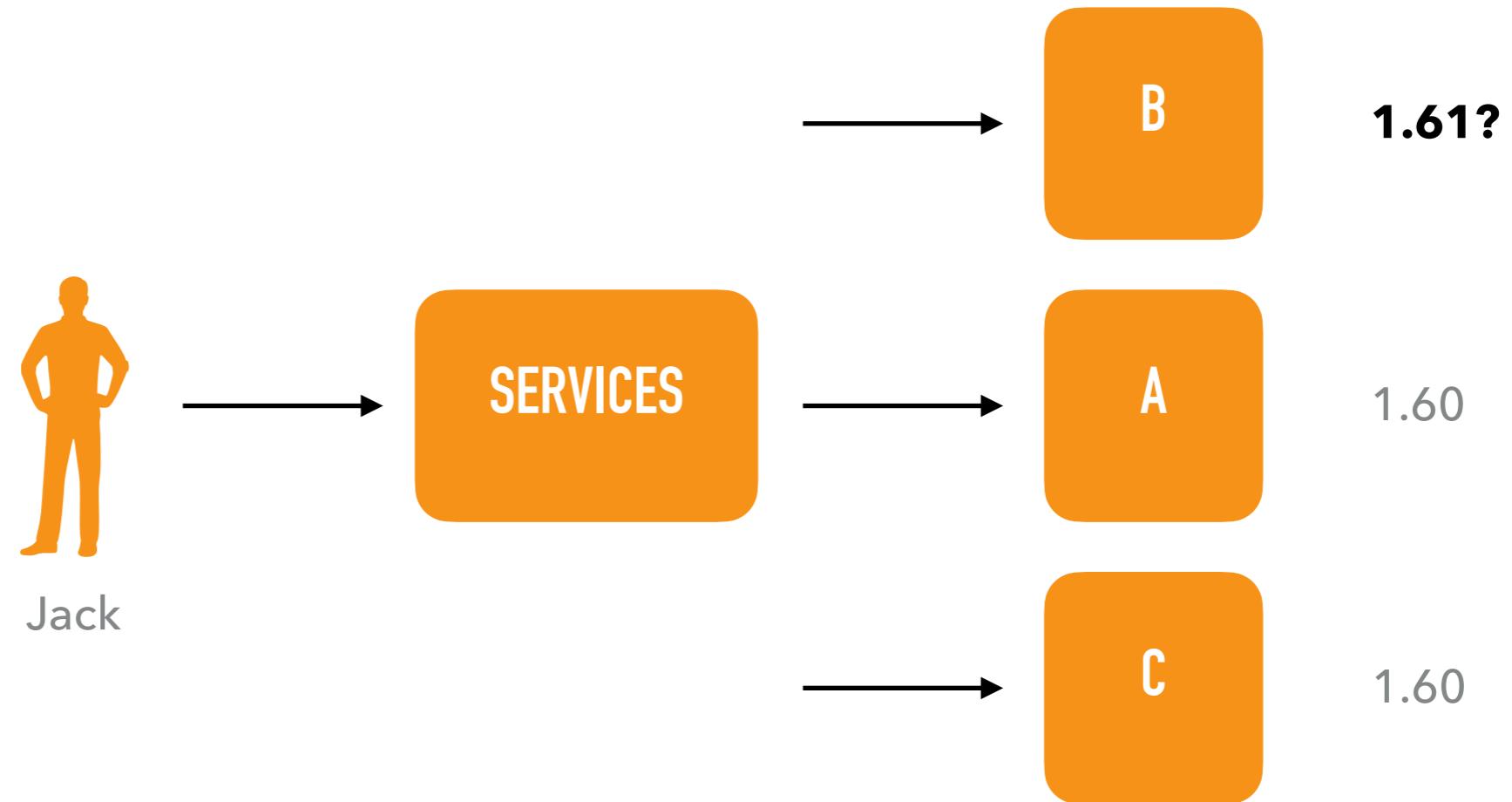
TAGGING DEADLOCKS



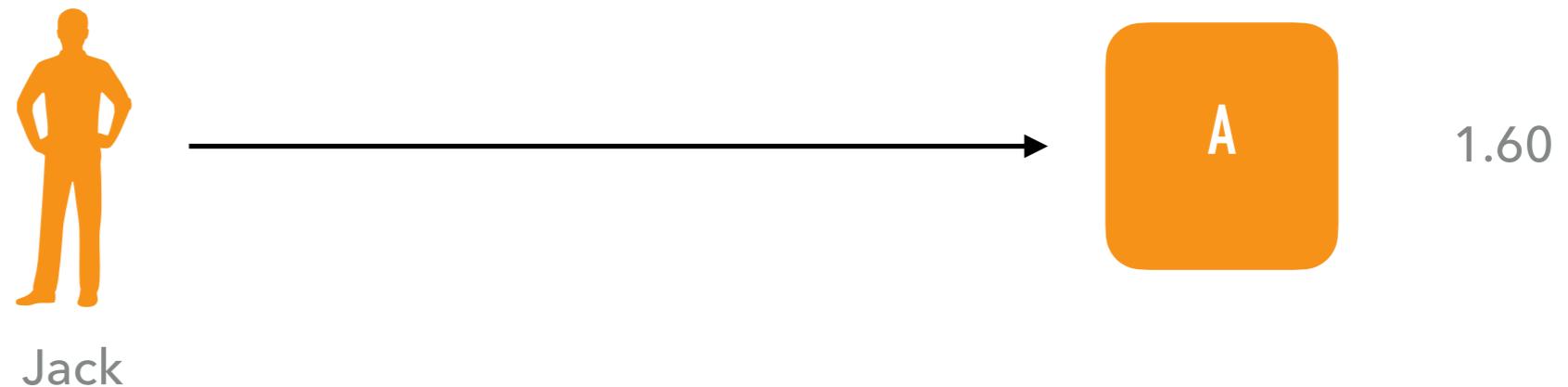
TAGGING DEADLOCKS



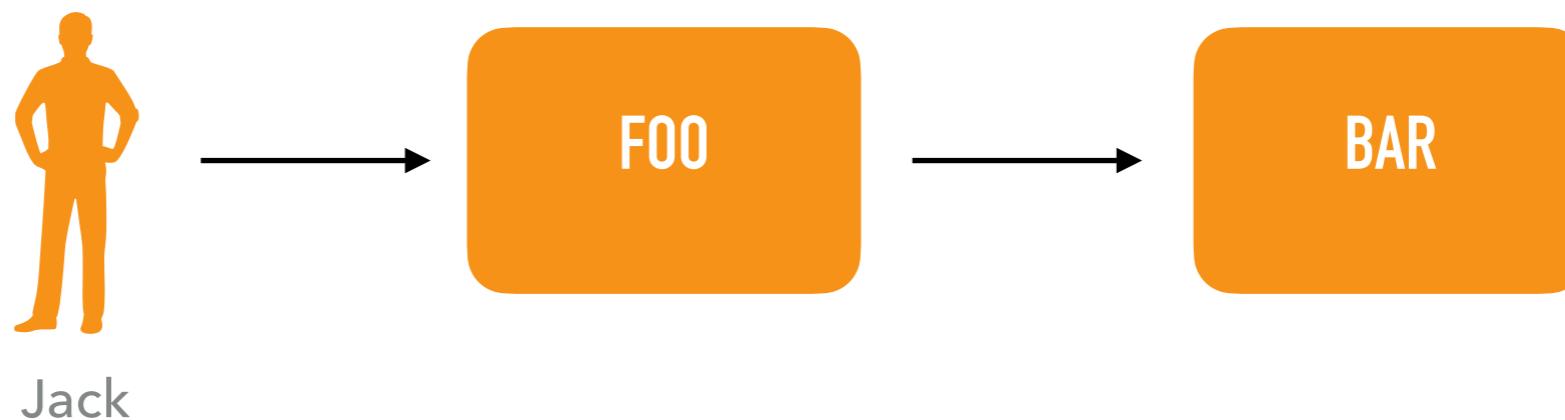
TAGGING DEADLOCKS



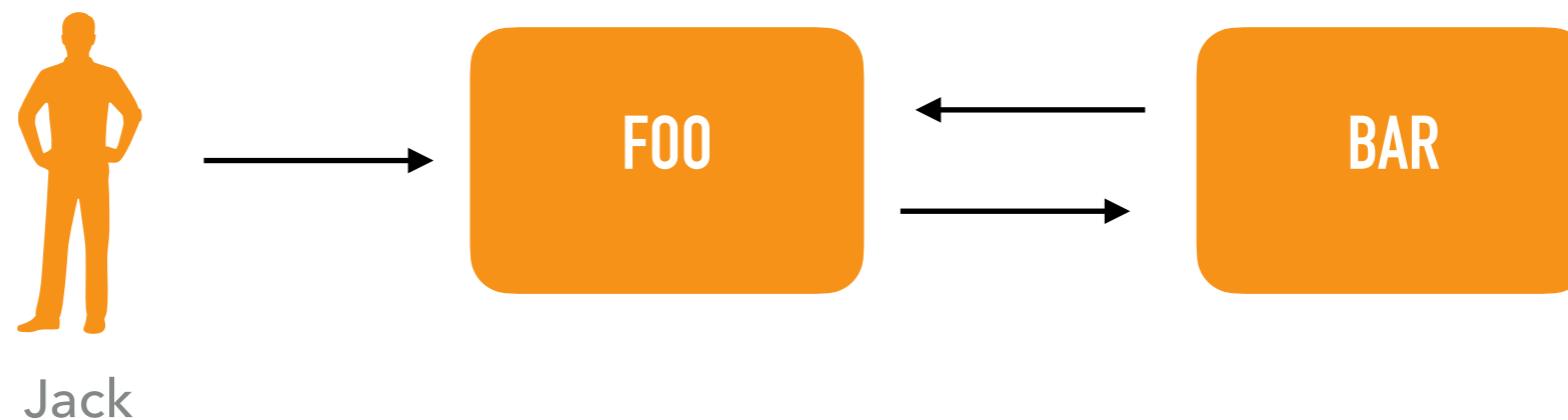
TAGGING DEADLOCKS



CYCLOMATIC DEPENDENCY



CYCLOMATIC DEPENDENCY



CHALLENGES

- ▶ Feedback speed
- ▶ Parallel development
- ▶ Complexity
- ▶ Different lifecycles
- ▶ Different teams

GUIDELINES

- ▶ Less frequent changes, higher risk, in lower layers
- ▶ Small blocks
- ▶ No cyclomatic dependencies
- ▶ Decouple independent services
- ▶ Only deploy pipelines manually

NEW APPROACH

ARCHITECTURE

DOMAIN

CONFIG

DATA

APPLICATION

SECRETS

INFRA

VPC

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GLOBAL

ALERTING

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BOOTSTRAP

ACCOUNTS

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NAMING STANDARDISATION

- ▶ Environment
- ▶ Application
- ▶ Component
- ▶ Examples:
 - ▶ /prod/billing/foo
 - ▶ /dev-susan/billing/foo
 - ▶ staging-billing-foo

CODE TRACEABILITY

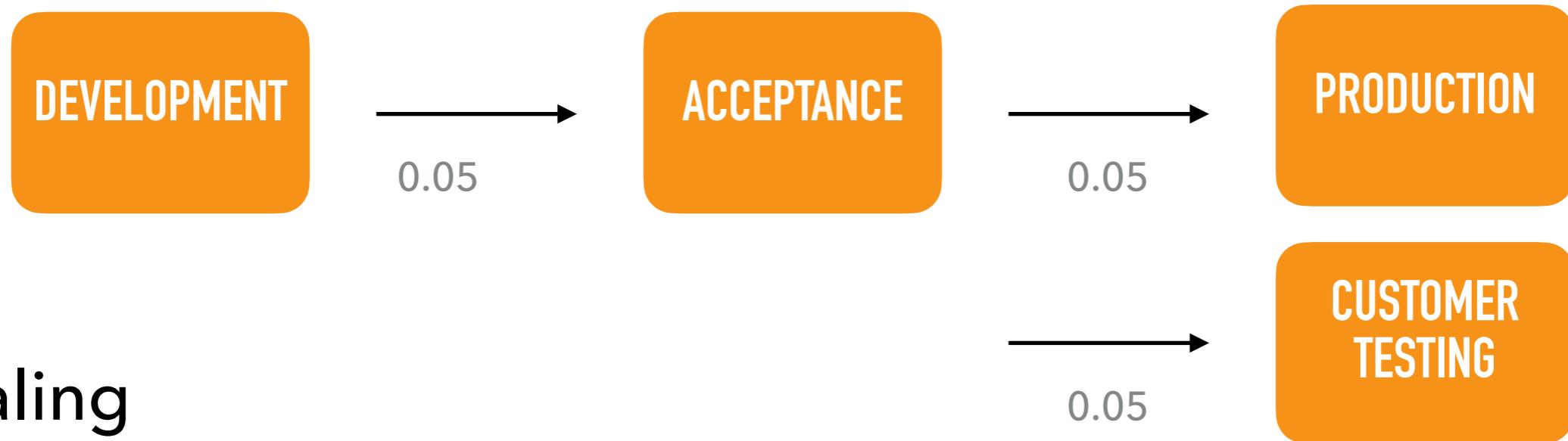
- ▶ Tag:
 - ▶ github.com/org/teamA/billing-infrastructure/stackA
- ▶ Naming:
 - ▶ Billing-application-foo -> GitHub.com/org/billing/infrastructure/src/application/foo

IDENTICAL ENVIRONMENTS



- ▶ Scaling

IDENTICAL ENVIRONMENTS



- ▶ Scaling
- ▶ Multiple environments

IDENTICAL ENVIRONMENTS



- ▶ Scaling
- ▶ Multiple environments
- ▶ Acceptance tests everything

OPEN SOURCE

- ▶ Terraform: <https://github.com/terraform-community-modules>
- ▶ AWS CDK: <https://cdkpatterns.com/>
- ▶ AWS CloudFormation: [https://aws.amazon.com/quicksstart/?](https://aws.amazon.com/quicksstart/)
- ▶ Gruntwork*: <https://www.gruntwork.io/>



PATH OF ENLIGHTENMENT

DEVOPS METRICS

LEAD TIME

DEPLOYS

CHANGE
FAILURE RATE

MEAN TIME TO
RECOVERY

DEVOPS METRICS

LEAD TIME

DEPLOYS

CHANGE
FAILURE RATE

MEAN TIME TO
RECOVERY

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DEPLOYS

CHANGE
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TEST DRIVEN DEVELOPMENT