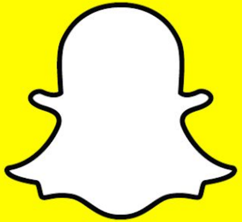


Securing Apps in the Open-By-Default Cloud

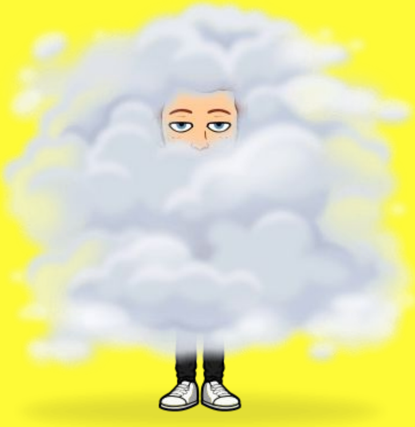
Winston Howes and Michael Wozniak

Who are we?

Michael Wozniak
Infrastructure Security

Winston Howes
Application Security

Welcome to the Cloud



Welcome to the Cloud

EC2

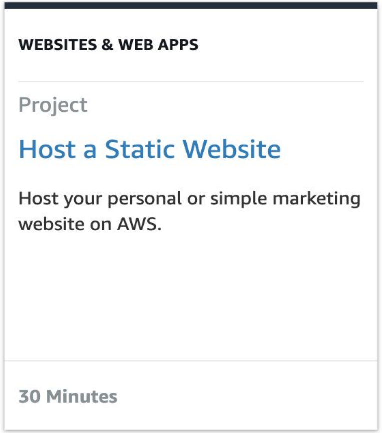
EKS

App Engine

GKE

GCE

Open By Default



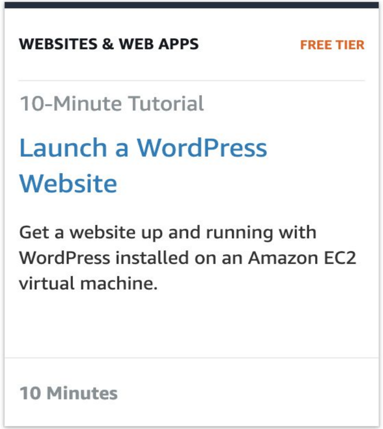
WEBSITES & WEB APPS

Project

Host a Static Website

Host your personal or simple marketing website on AWS.

30 Minutes



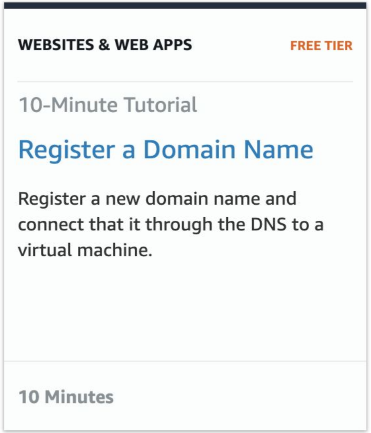
WEBSITES & WEB APPS FREE TIER

10-Minute Tutorial

Launch a WordPress Website

Get a website up and running with WordPress installed on an Amazon EC2 virtual machine.

10 Minutes



WEBSITES & WEB APPS FREE TIER

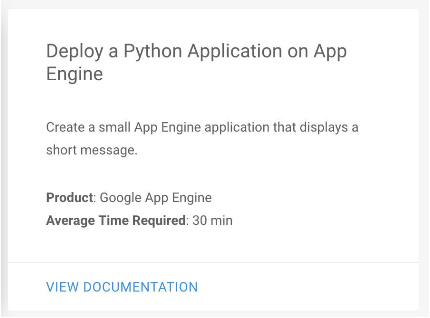
10-Minute Tutorial

Register a Domain Name

Register a new domain name and connect that it through the DNS to a virtual machine.

10 Minutes

“After deploying the application, you need to expose it to the Internet so that users can access it.”
- GKE Quickstart



Deploy a Python Application on App Engine

Create a small App Engine application that displays a short message.

Product: Google App Engine
Average Time Required: 30 min

VIEW DOCUMENTATION

Constraints

- Networking
  - Not possible to have one large internal only network
  - Limited enforcement options provided by AWS/GCP
  - Services like App Engine must be exposed directly to the Internet
- Central Management
  - Lack of central CI/CD Pipeline
  - Wide variety of technologies

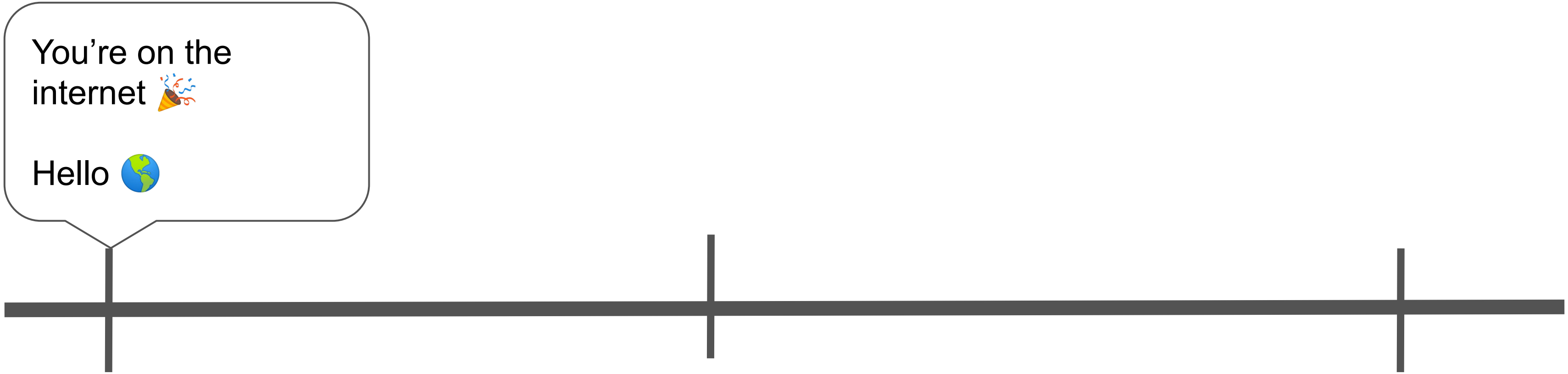
Development Lifecycle

- It’s unclear when security should review an app.

Development Lifecycle

- It’s unclear when security should review an app.

New app created

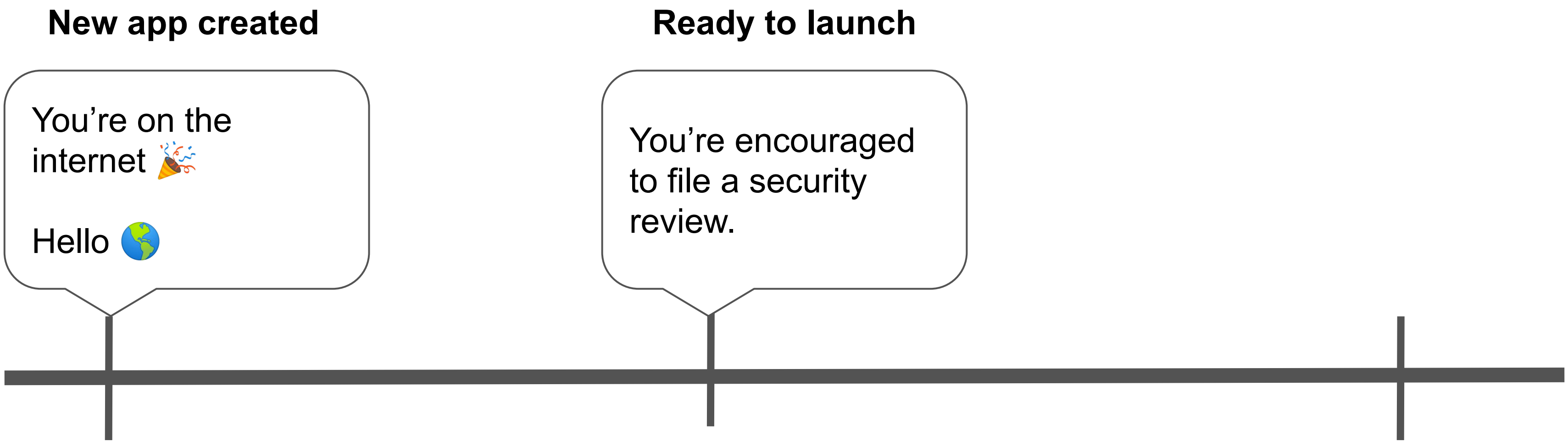


You’re on the internet 🎉

Hello 🌎

Development Lifecycle

- It’s unclear when security should review an app.



New app created

You’re on the internet 🎉

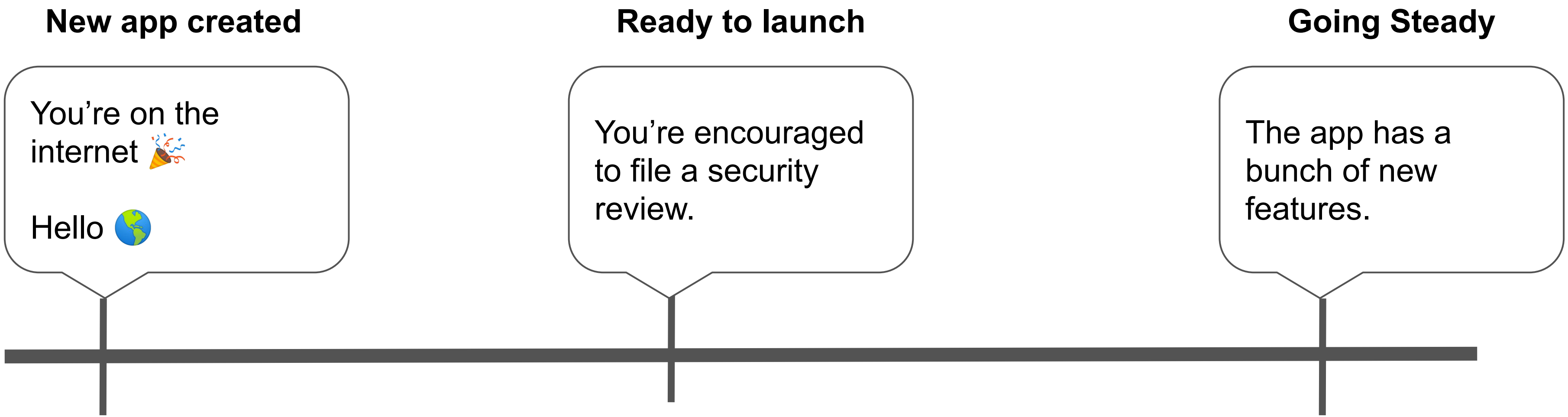
Hello 🌎

Ready to launch

You’re encouraged to file a security review.

Development Lifecycle

- It’s unclear when security should review an app.



New app created

You’re on the internet 🎉

Hello 🌎

Ready to launch

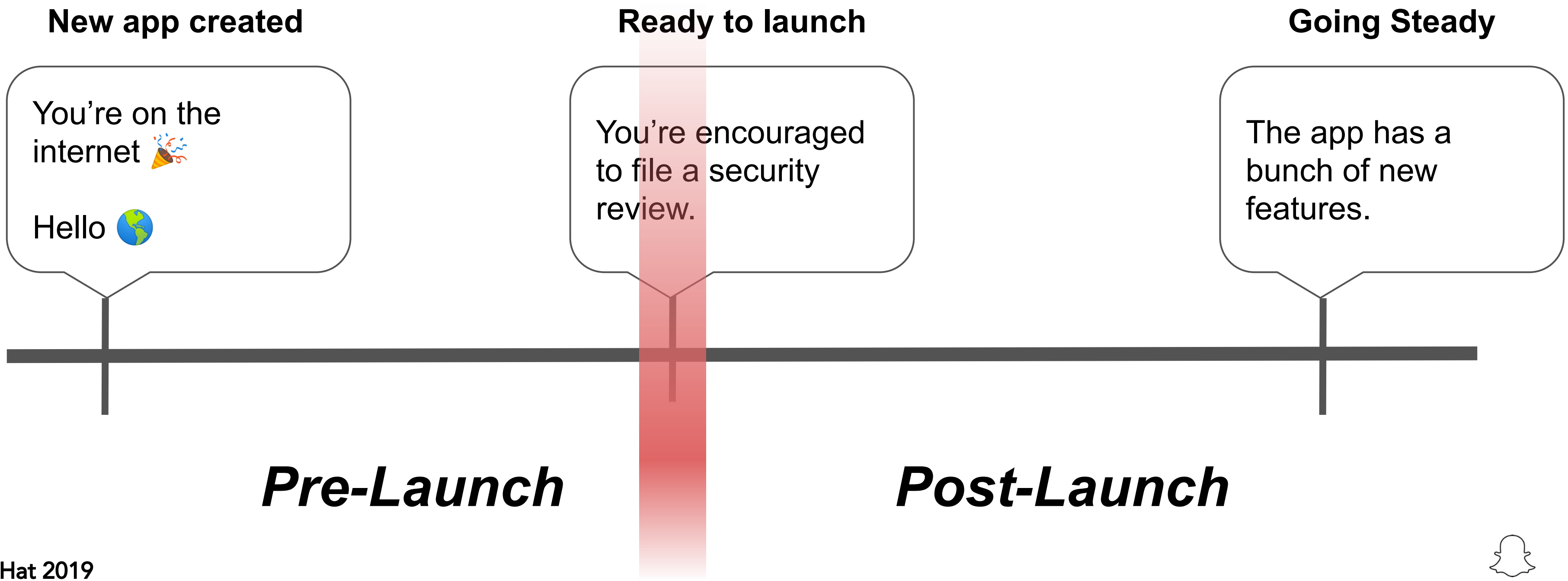
You’re encouraged to file a security review.

Going Steady

The app has a bunch of new features.

Development Lifecycle

- It’s unclear when security should review an app.



New app created

You’re on the internet 🎉

Hello 🌎

Ready to launch

You’re encouraged to file a security review.

Going Steady

The app has a bunch of new features.

Pre-Launch

Post-Launch

Considered Gating Approaches

1. Enabling Billing Post-Review
2. Implement AuthN & AuthZ controls on individual services
3. Firewalls
4. Google's Identity Aware Proxy

Considered Gating Approaches

1. ~~Enabling Billing Post-Review~~
2. Implement AuthN & AuthZ controls on individual services
3. Firewalls
4. Google's Identity Aware Proxy

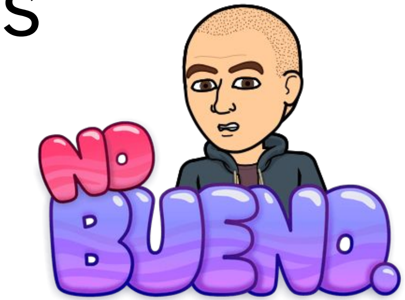
Restricts Feature Development

Considered Gating Approaches

1. ~~Enabling Billing Post-Review~~
2. ~~Implement AuthN & AuthZ controls on individual services~~
3. Firewalls
4. Google's Identity Aware Proxy

Limited Scalability

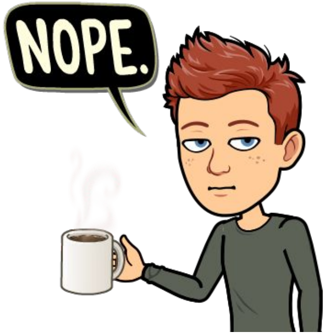
Considered Gating Approaches



1. ~~Enabling Billing Post-Review~~
2. ~~Implement AuthN & AuthZ controls on individual services~~
3. ~~Firewalls~~
4. Google's Identity Aware Proxy

Limited Granularity

Considered Gating Approaches



1. ~~Enabling Billing Post-Review~~
2. ~~Implement AuthN & AuthZ controls on individual services~~
3. ~~Firewalls~~
4. ~~Google's Identity Aware Proxy~~

Not Automatable

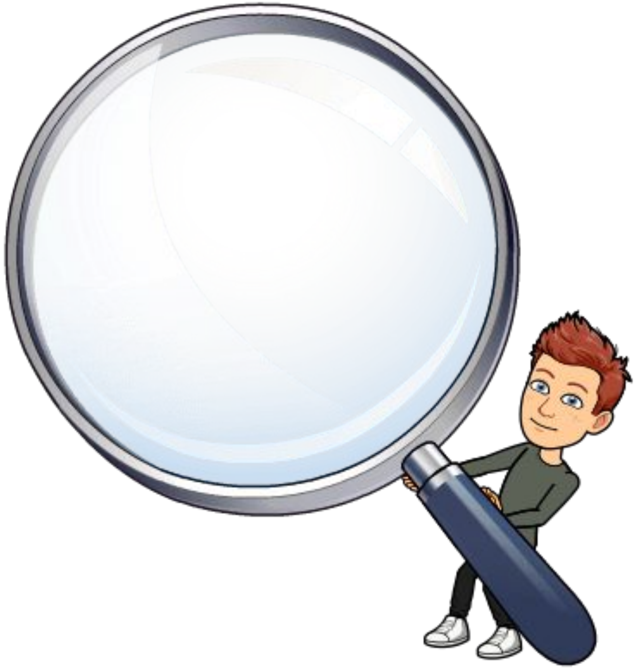
Goals

- **Flexibility:** Minimum opinions about development environments and cloud feature use*
- **Scalability:** No need for developer instrumentation
- **Granularity:** By default all services are gated with granular authN and authZ
- **Automatability:** Reduce operational costs

*if developers want high QPS or to receive user traffic, there will be necessary changes

Laying the Groundwork: Primitives

1. Network Control
2. Service Inventory

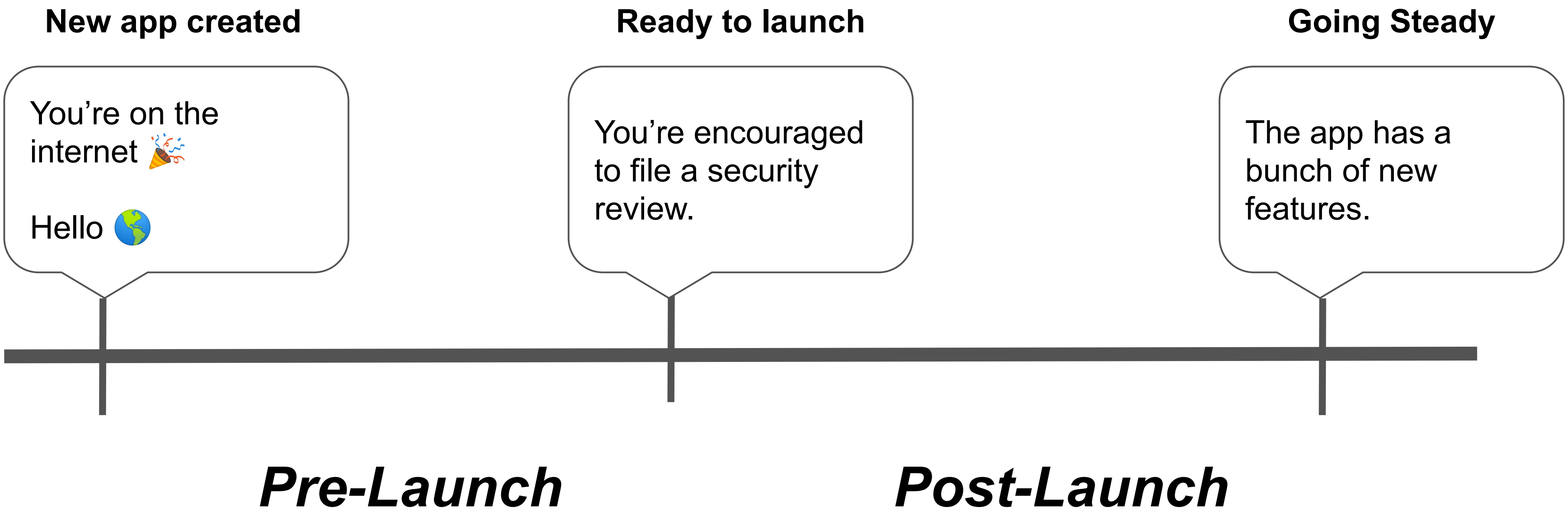


Laying the Groundwork: Primitives

Solution: Central service that enables billing and gives the security team network management access and inventories services

Development Lifecycle

- It’s unclear when security should review an app.



New app created

You’re on the internet 🎉

Hello 🌎

Ready to launch

You’re encouraged to file a security review.

Going Steady

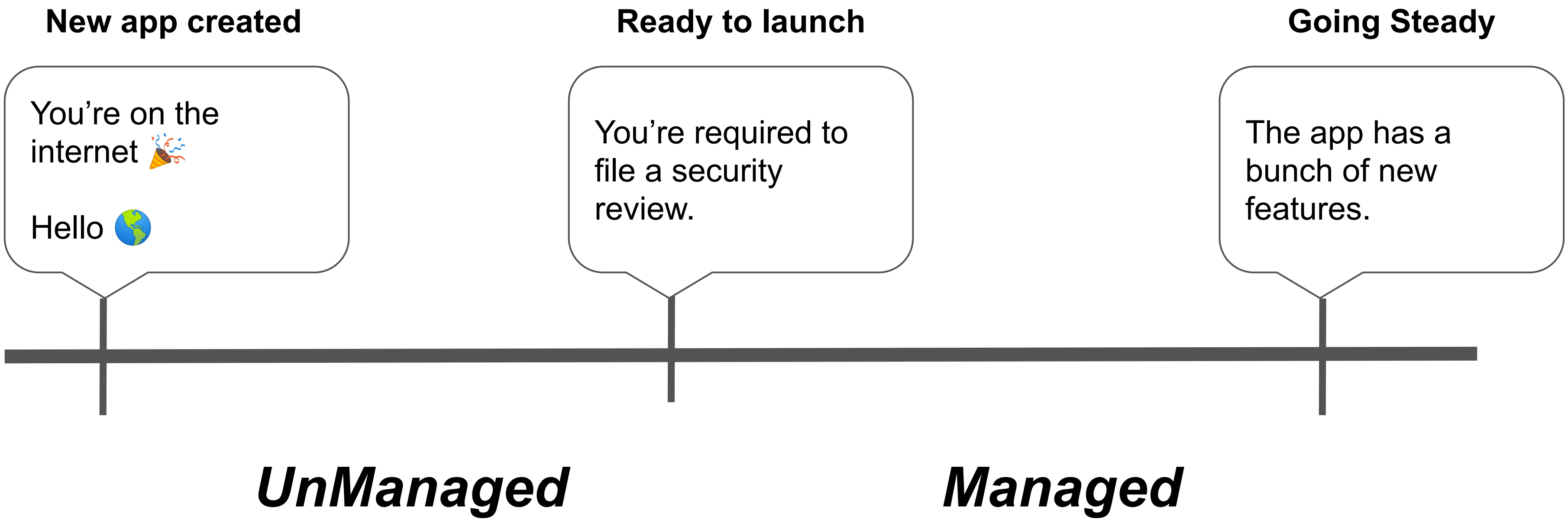
The app has a bunch of new features.

Pre-Launch

Post-Launch

Development Lifecycle

- It’s unclear when security should review an app.



New app created

You’re on the internet 🎉

Hello 🌎

Ready to launch

You’re required to file a security review.

Going Steady

The app has a bunch of new features.

UnManaged

Managed

UnManaged Services

1. New Services in Development
2. Internal Tools

Treated identically by Security

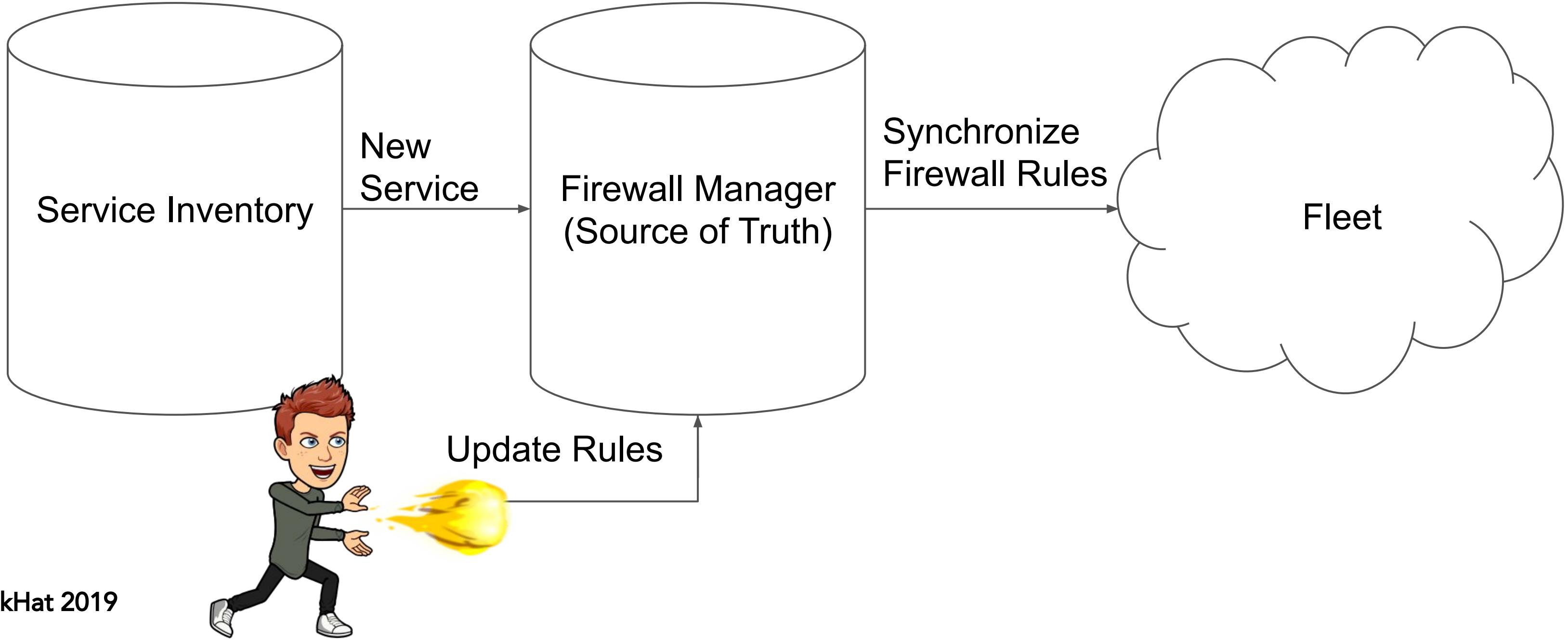
UnManaged Services: Primitives

1. Firewall Manager
2. Stateless AuthN/Z Proxy

Firewall Manager

1. Import every service from our central inventory
2. Set base level firewall rules on every service
   a. App Engine: Only allow requests from our stateless proxy
   b. Other: Only allow requests from our SSH proxy
3. Revert non-Security approved modifications to the firewall rules

Firewall Manager Architecture


Service Inventory
New Service
Firewall Manager (Source of Truth)
Synchronize Firewall Rules
Fleet
Update Rules

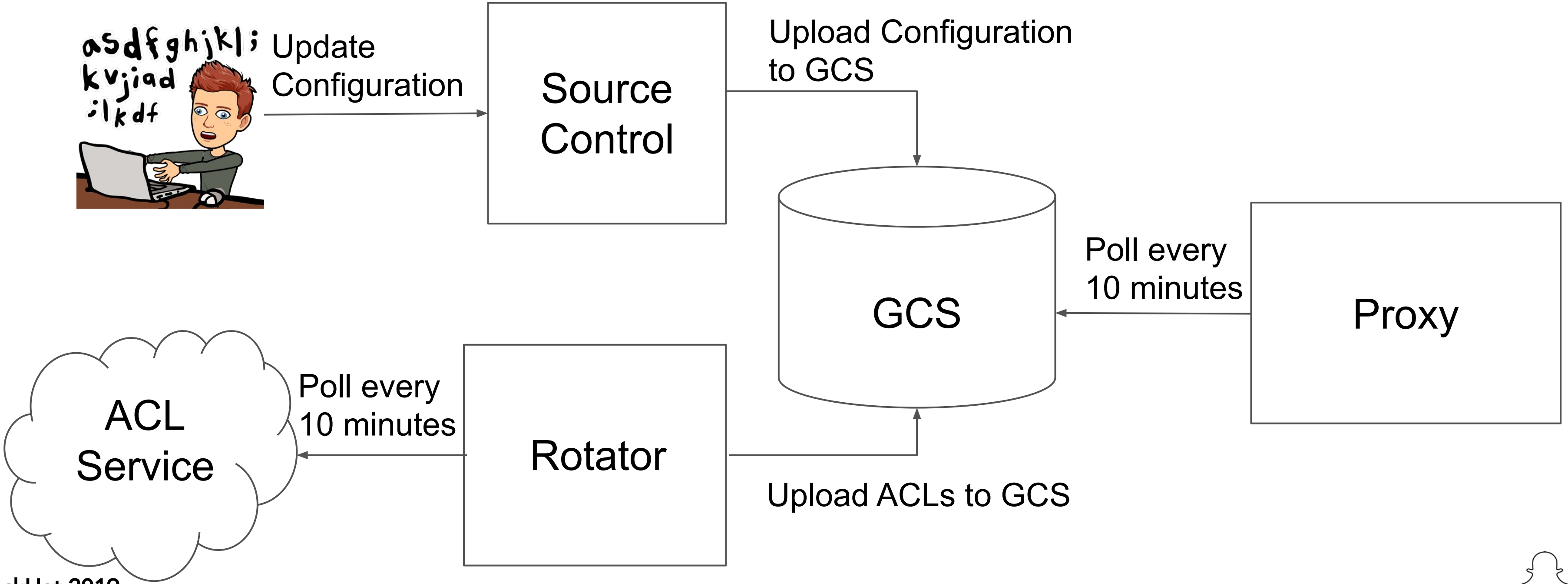
Stateless AuthN/Z Proxy

- Support multiple forms of AuthN
  - Service-to-service
  - User-to-service
- Easy integration
  - App Engine: zero setup
  - Other: config change to stateless proxy
- Easily offboard users
  - Periodic syncs with ACL source of truth
- Reliable

Stateless AuthN/Z Proxy Architecture

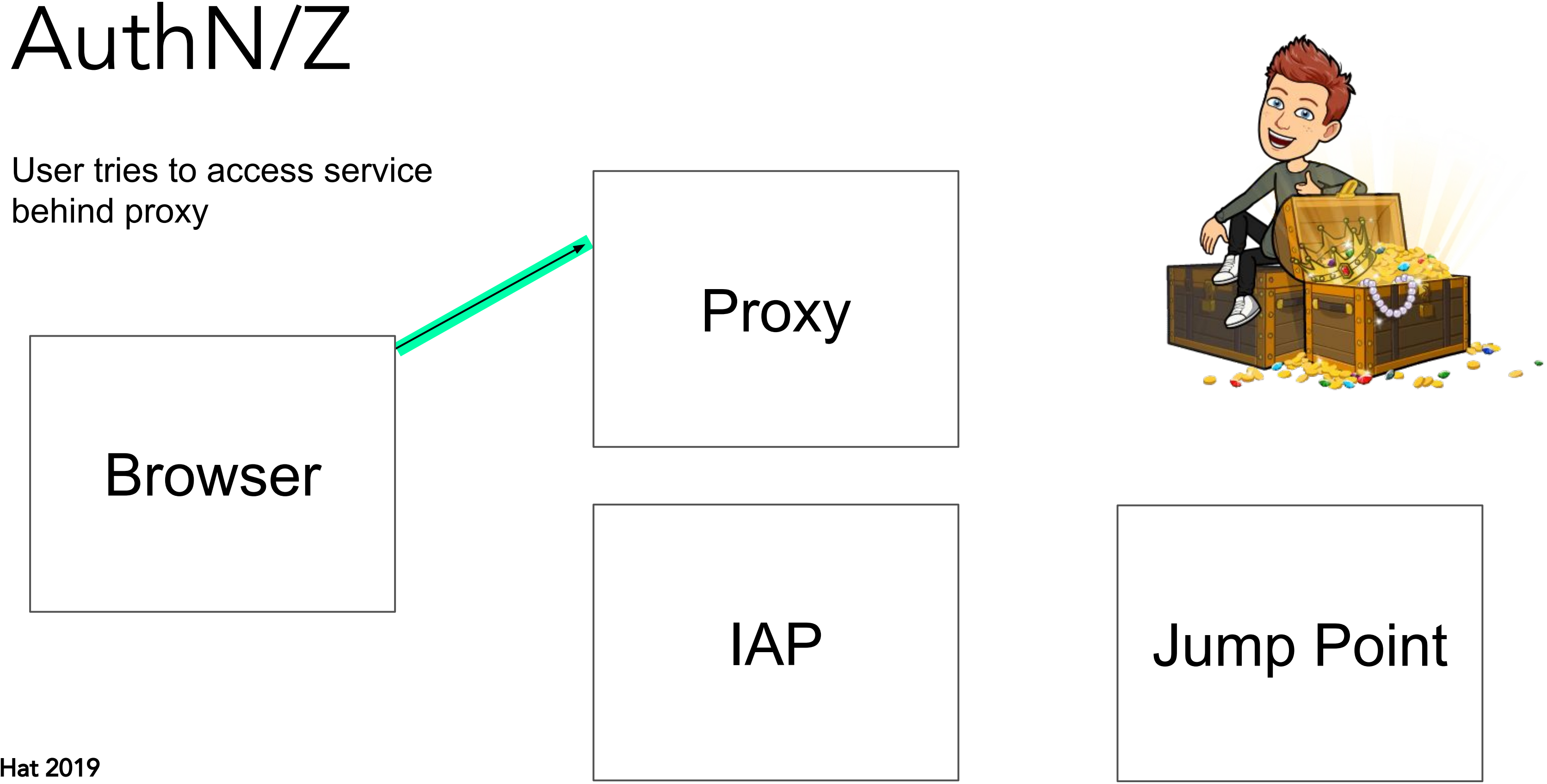
1. Configuration
2. Authentication and Authorization
3. Proxying Requests

Stateless AuthN/Z Proxy Architecture: Configuration



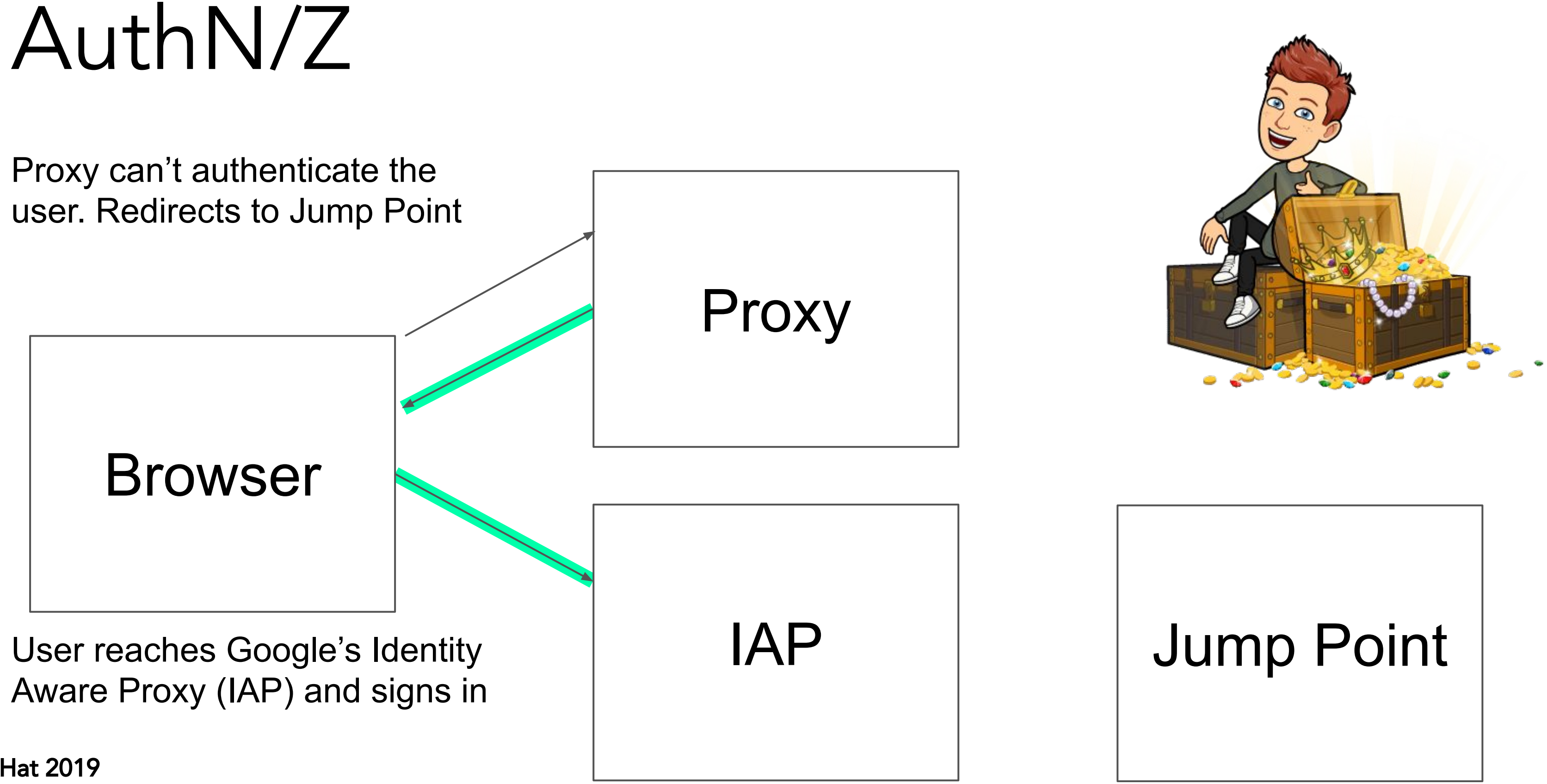
Stateless AuthN/Z Proxy Architecture: AuthN/Z

User tries to access service behind proxy



Stateless AuthN/Z Proxy Architecture: AuthN/Z

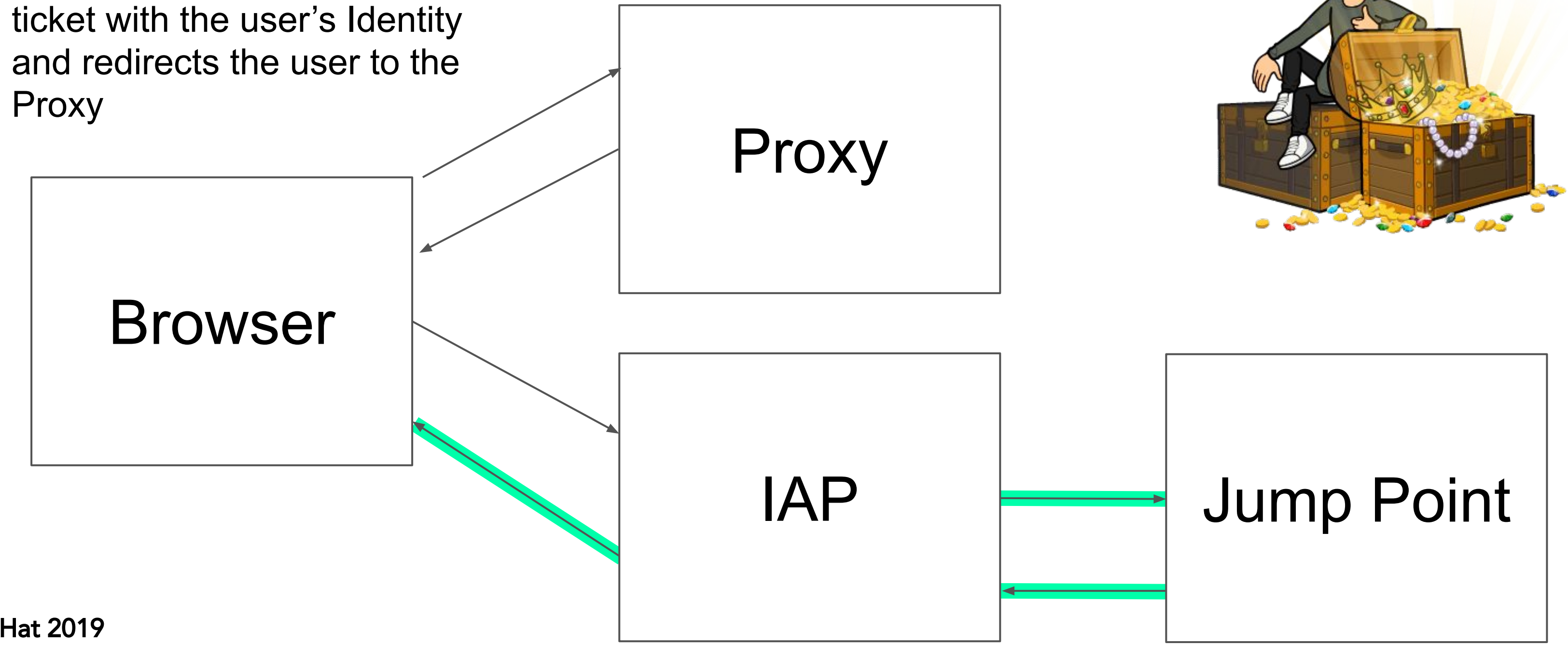
Proxy can’t authenticate the user. Redirects to Jump Point



User reaches Google’s Identity Aware Proxy (IAP) and signs in

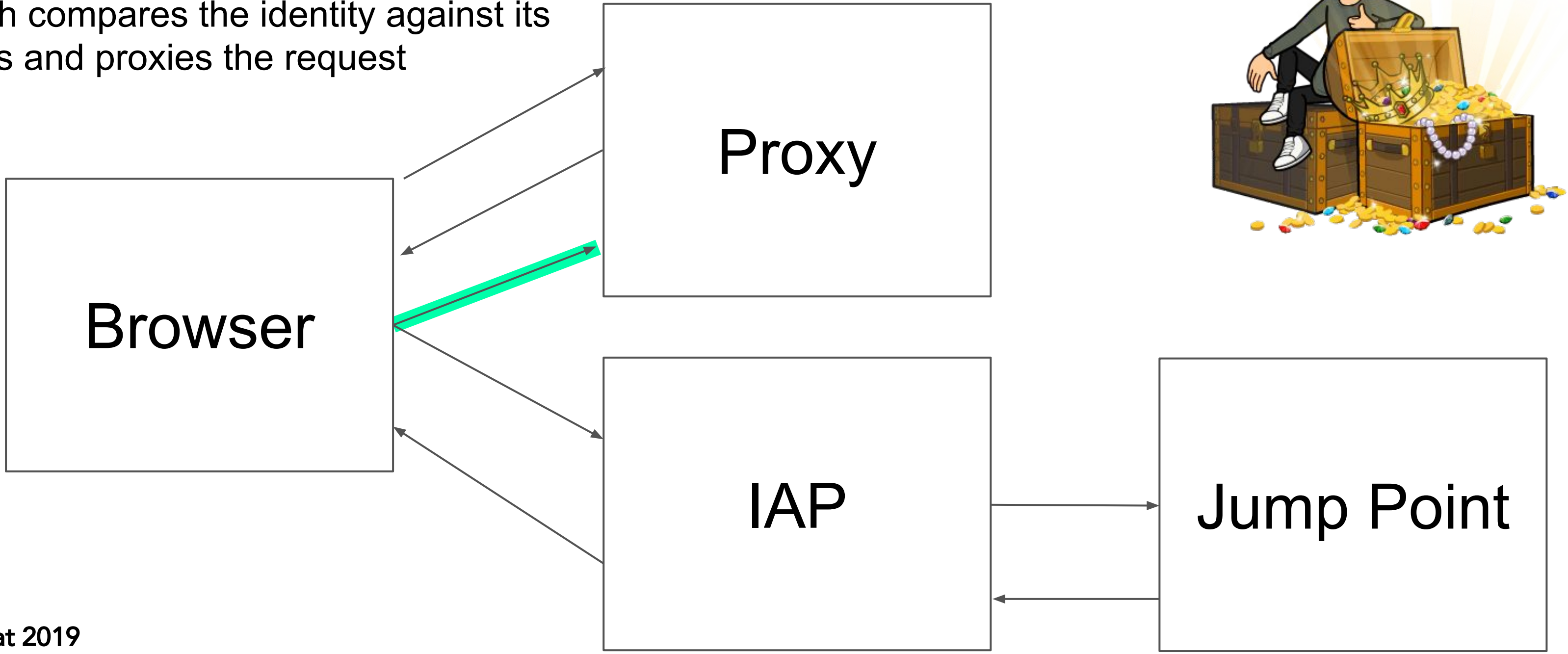
Stateless AuthN/Z Proxy Architecture: AuthN/Z

The Jump Point creates a ticket with the user's Identity and redirects the user to the Proxy



Stateless AuthN/Z Proxy Architecture: AuthN/Z

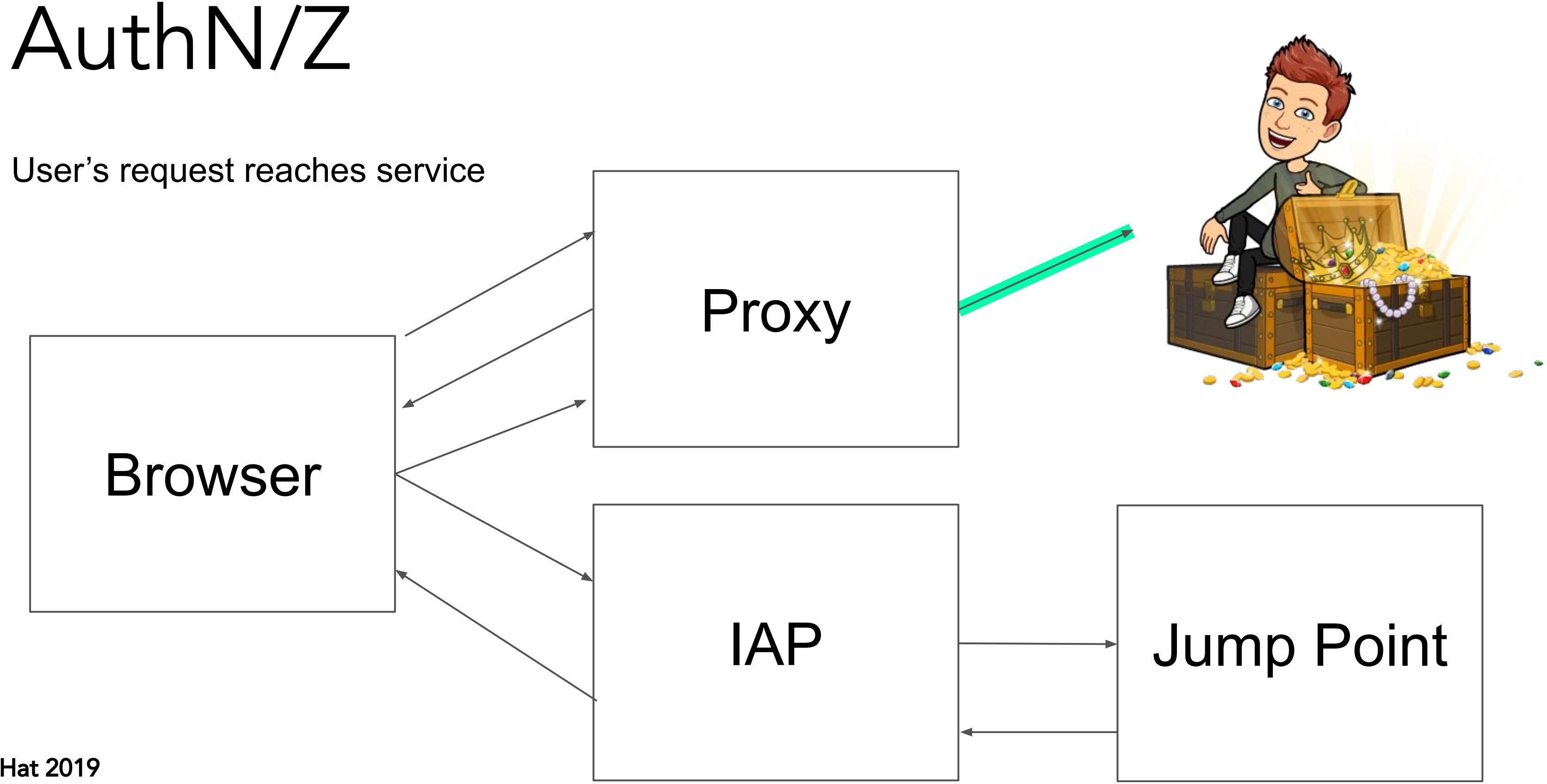
User forwards the ticket to the proxy, which compares the identity against its ACLs and proxies the request



BlackHat 2019

Stateless AuthN/Z Proxy Architecture: AuthN/Z

User’s request reaches service



Proxy

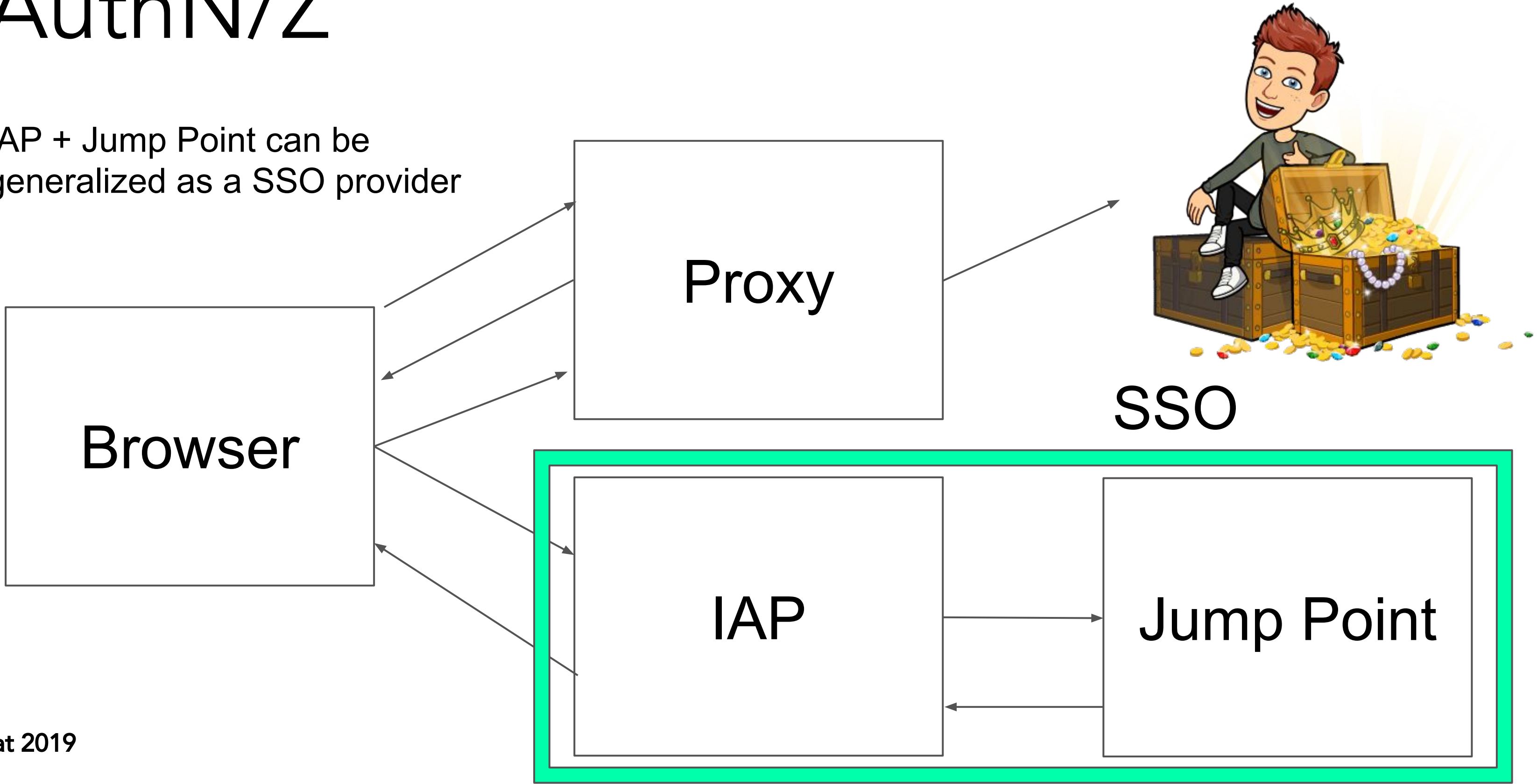
Browser

IAP

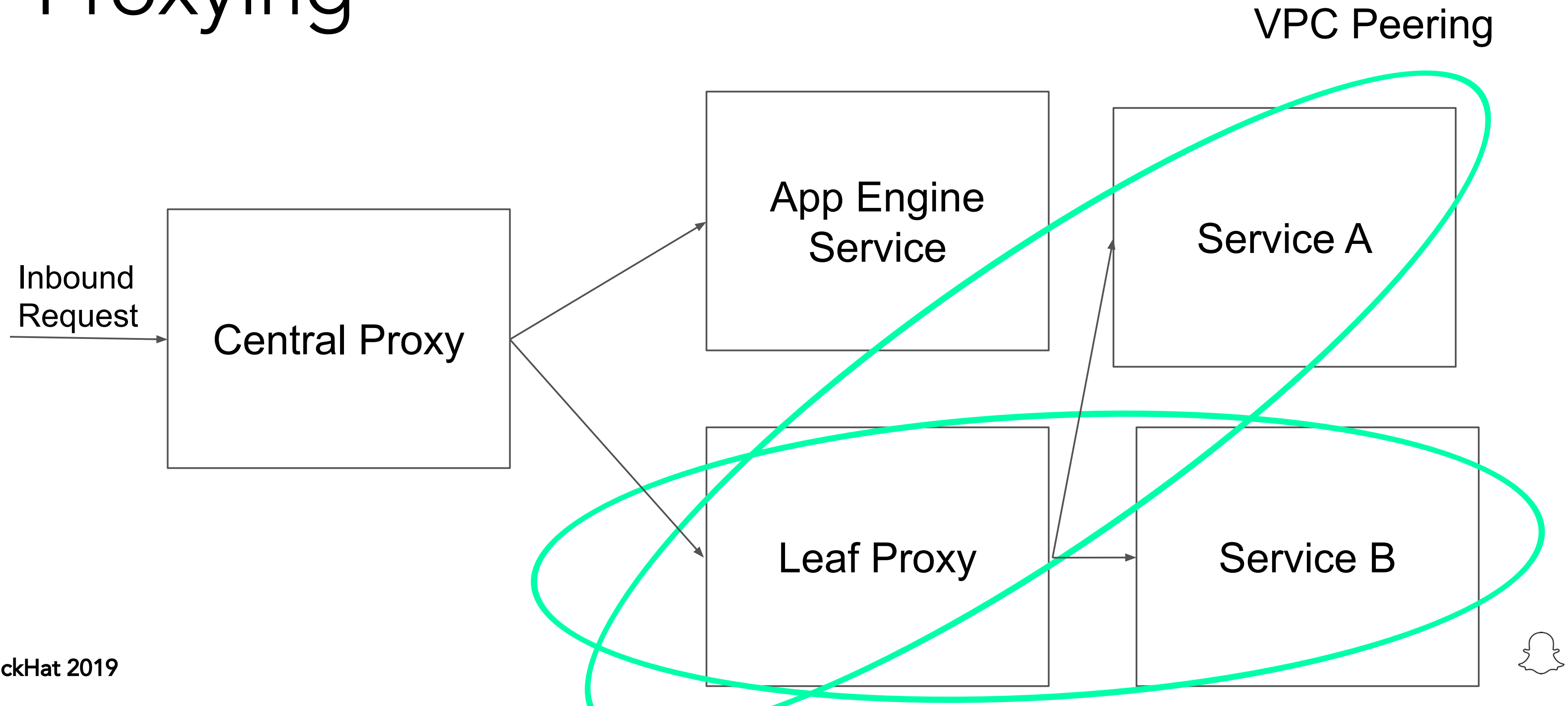
Jump Point

Stateless AuthN/Z Proxy Architecture: AuthN/Z

IAP + Jump Point can be generalized as a SSO provider



Stateless AuthN/Z Proxy Architecture: Proxying



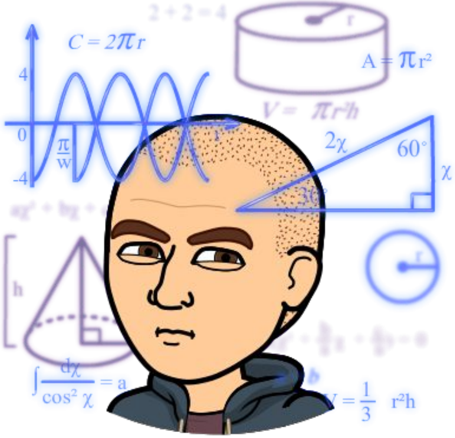
Stateless AuthN/Z Proxy Challenges

1. Higher latency, particularly for App Engine
2. Double Billing - twice the egress

Managed Services

Managed Services: Goals

1. Low Latency
2. Cheap
3. Granular Auth N/Z
4. Visibility



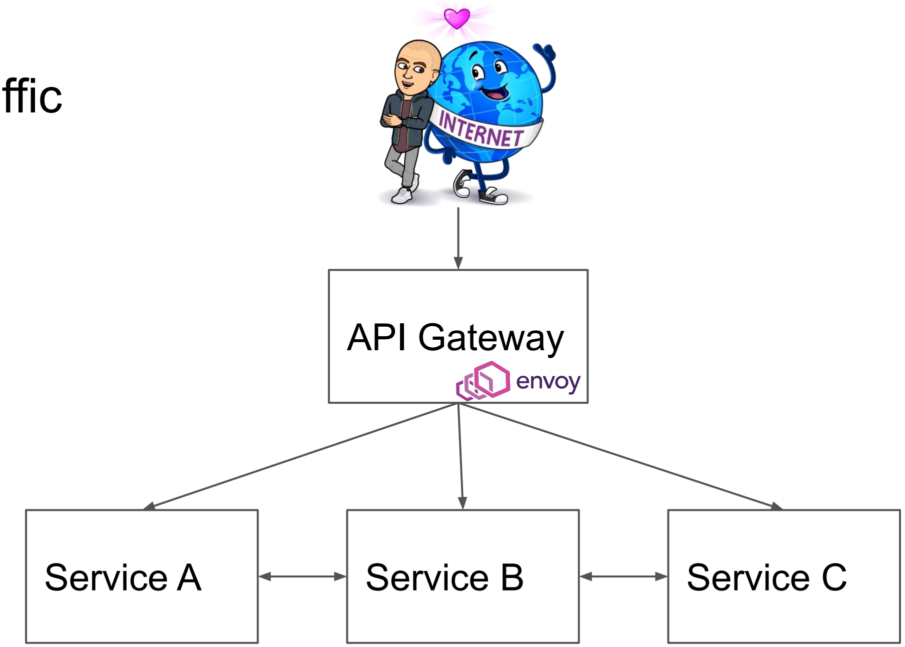
Managed Services: Components

1. API Gateway
2. Service Mesh
3. Configuration Controller
4. Service Sidecar

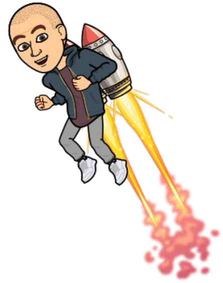
envoy

Managed Services: API Gateway

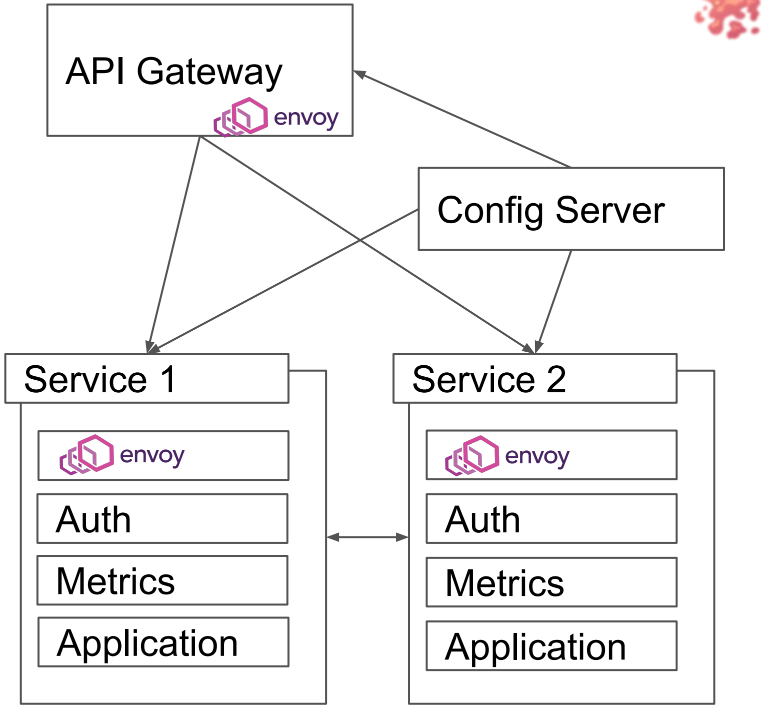
1. Envoy as a front-proxy
2. Single entry point for external traffic
3. Set of audited AuthN filters
4. Centrally managed



Managed Services: Service Mesh



1. Centrally managed and visible routing
2. Envoy provides
   a. Authentication
   b. Encryption
   c. Metrics
3. Not routable from Internet except via API Gateway

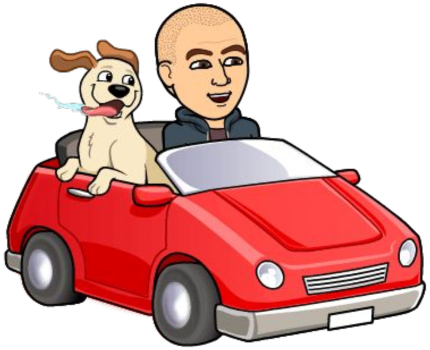


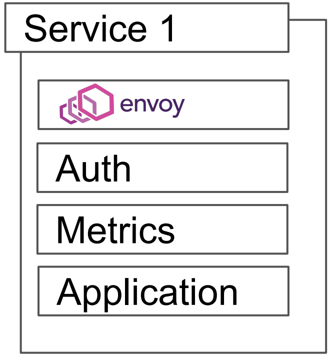
Managed Services: Configuration Controller

1. Central component to manage routes
2. Routes need to be approved by owners
3. Authentication included automatically based on configuration state

Managed Services: Service Sidecar

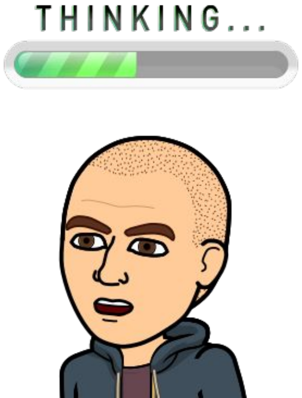
1. Envoy as a sidecar
2. Connects to CA to establish identity
3. Fetches config from central configuration service
4. Authenticates all incoming traffic
5. Exposes a port locally for service egress





Managed Services: Challenges

1. Onboarding: configuration changes require approval
2. Noisy Neighbors: single account/VPC means that cloud quotas are shared by all services
3. Central Point of Failure



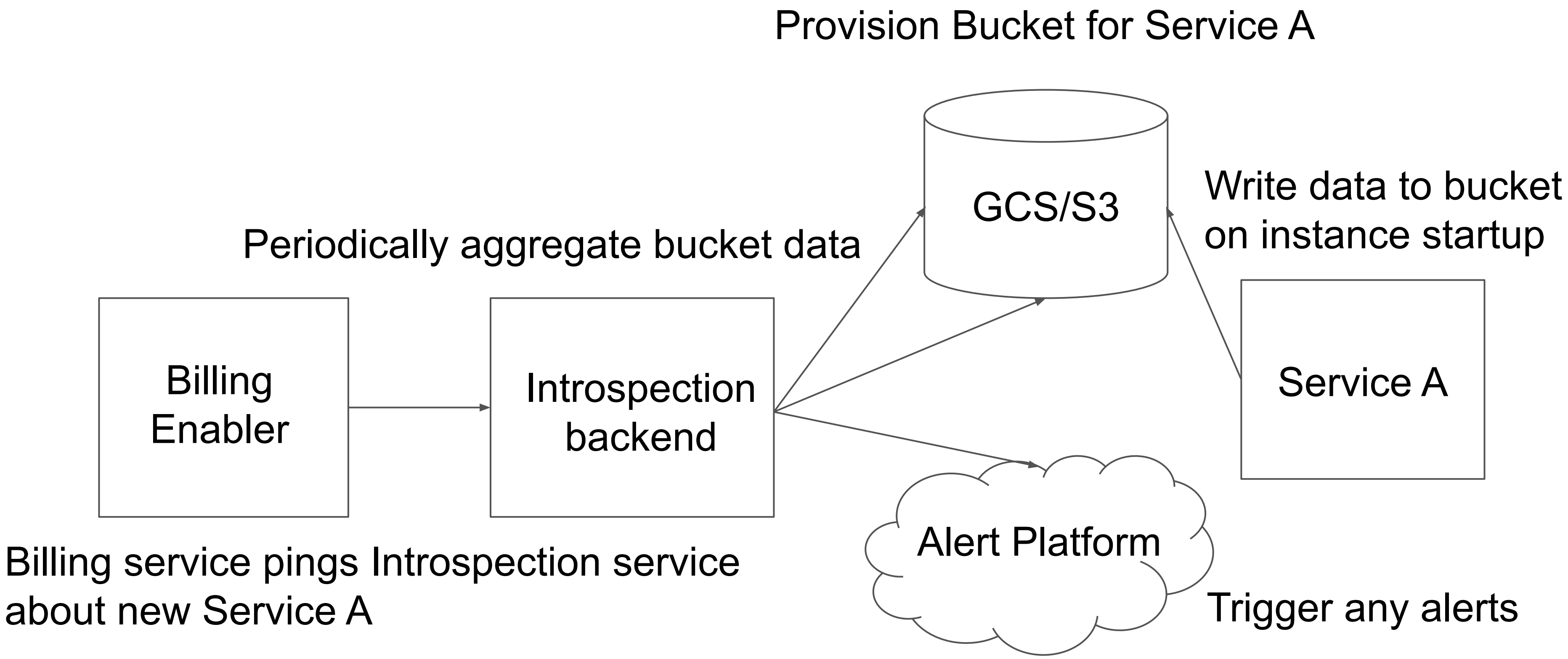
What about the non-migrated services?

Introspection

Introspection Library

- Easy to integrate
  - Single line of code
  - Supports all service frameworks
- Gathers security-critical information
  - Routes
  - Auth Controls (Filters, decorators, annotations, etc.)
  - Packages
  - Service Metadata
- Runs on instance startup
- Triggers high signal alerts

Introspection Architecture



Provision Bucket for Service A

Write data to bucket on instance startup

Periodically aggregate bucket data

Billing service pings Introspection service about new Service A

Trigger any alerts

Core Infrastructure

- **Firewall Manager:** Gate services by default
- **Stateless Proxy:** Allow authenticated access to services
- **API Gateway & Service Mesh:** Production environment to run services with controls
- **Introspection:** Understand service state

Revisiting Goals

- **Flexibility:** Minimum opinions about development environments and cloud feature use*
- **Scalability:** No need for developer instrumentation
- **Granularity:** By default all services are gated with granular authN and authZ
- **Automatability:** Reduce operational costs

*if developers want high QPS or to receive user traffic, there will be necessary changes

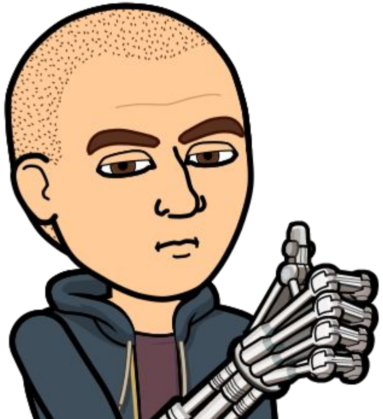
Order of Operations

Step 1: Lay the Foundation

- Create a central hook that provides ways to make future changes
- Inventory all new services

Step 2: Start Simple

- Gate services in development to just corporate IPs
- Build Firewall Manager

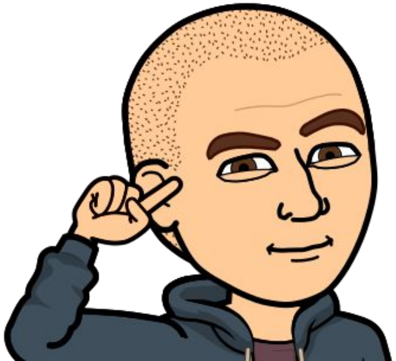


Step 3: Add Granularity

- Transition from IP-based auth to service identities
- Build Stateless AuthN/Z Proxy
- As things transition to production perform manual review

Step 4: Understand Production

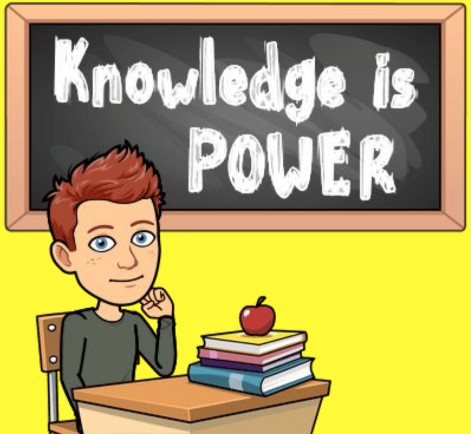
- Learn how your services change over time
- Build out an Introspection library



Step 5: Provide Robust Controls in Production

- Build out a central gateway and service mesh
- Migrate existing services

Lessons Learned



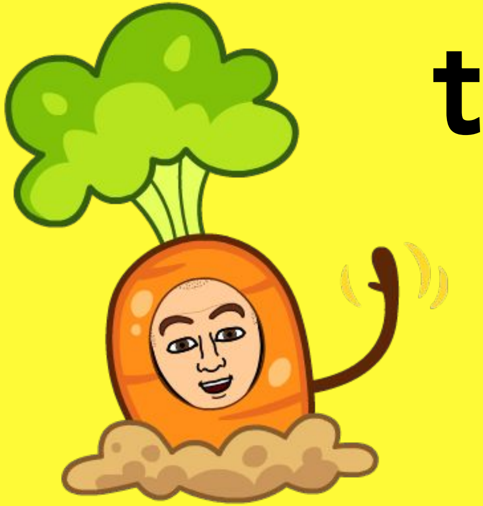
Security is Engineering

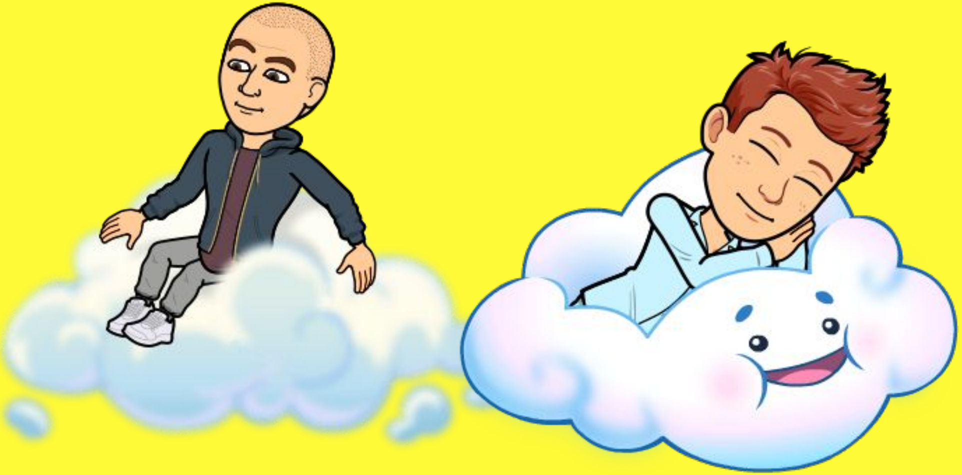
Gain a central hook into your fleet early

Visibility before enforcement

Make your security posture something you can reason about - no black boxes

Offer other engineering teams a carrot





Thank you