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How Intuit Built a Paved Road for Debuggability!

Anusha Ragunathan & Kevin Downey, Intuit Inc

Agenda

01 Background

02 Problem

03 Interactive debugging using Ephemeral Containers

04 1-click debugging using Argo Workflows

05 Takeaways


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Background

AI-driven expert platform

Modern Dev Experience

Enables Intuit engineers to develop code in a fast, secure, and compliant fashion; from app experiences to runtime and traffic management to smart operations.

9x
Increase in dev productivity since 2019

~1M
Active CPU cores

40M+
AIOps inference/day

2500+
services

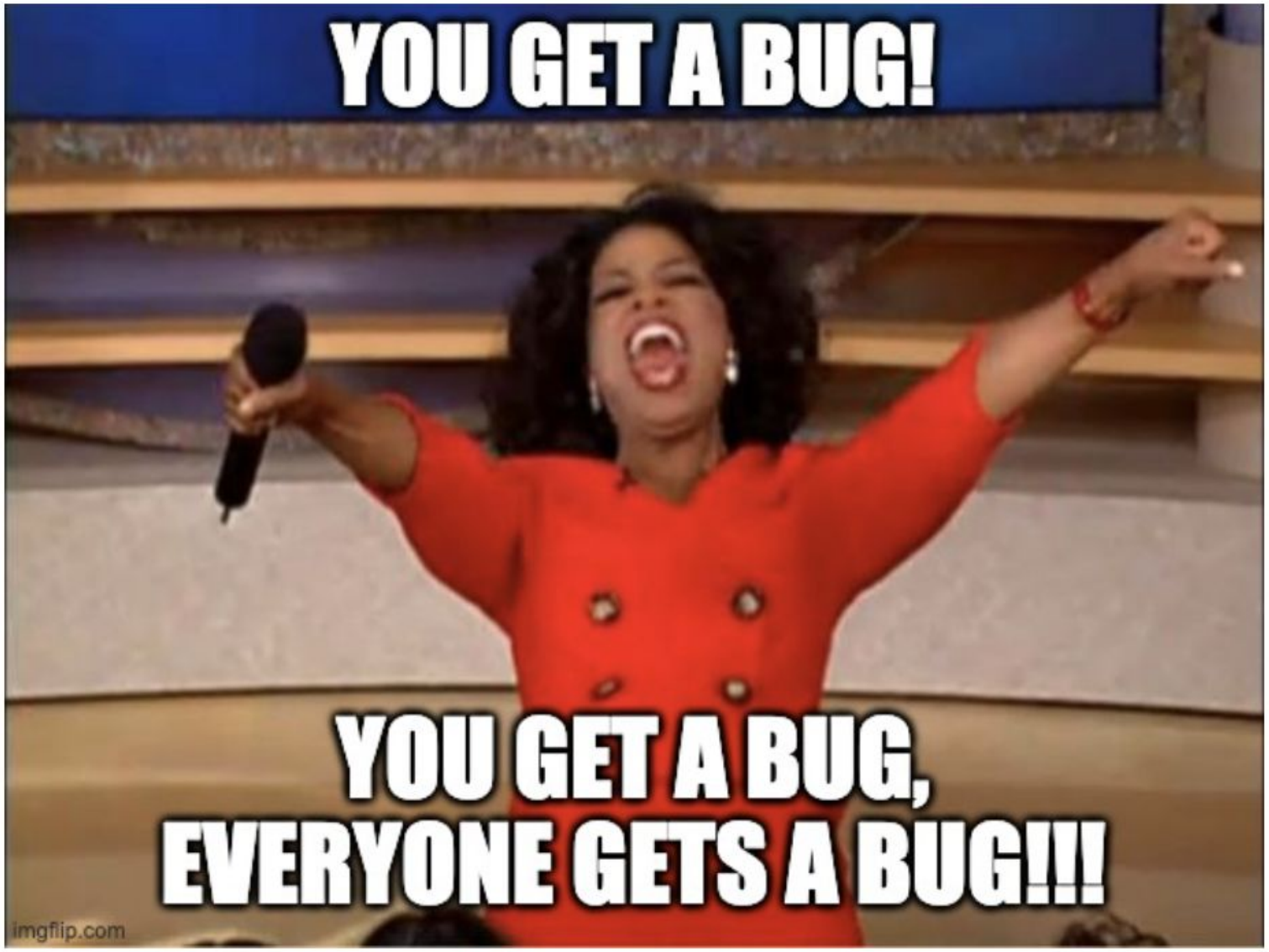
315
Kubernetes clusters

28k+
namespaces

1k+
teams


Problem

Bugs! Bugs! Bugs!

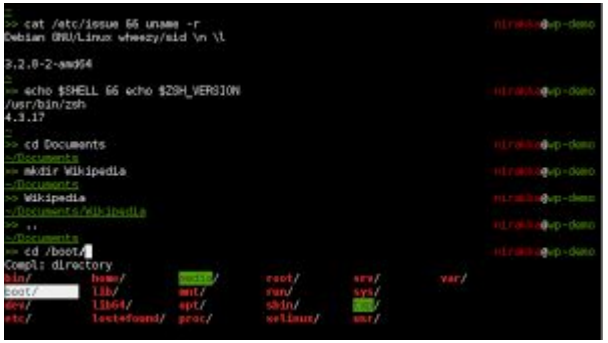


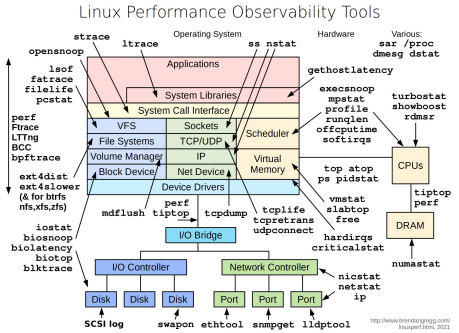
Problem 1: Debug Tooling Setup

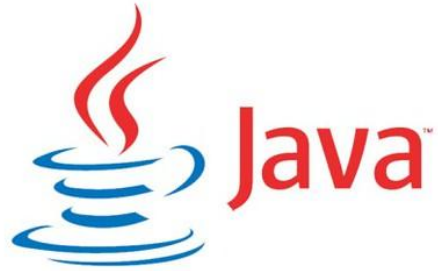
kubectl exec <pod> -c <app-ctr>











Problem 2: Abstractions & Debugging

Application Developer

Application Intent

```yaml
apiVersion: iks.intuit.com/v1beta1
kind: ExpressApplication
metadata:
  name: kubecon2023-java
spec:
  components:
  - type: webservice
    name: arag-java
    image: docker.intuit.com/sandbox-sandbox/arag-java/service/arag-java:0.0.3
    traits:
    - type: sizing
      properties:
        vertical:
          size: small
        horizontal:
          size: small
```

Platform Abstraction

Kubernetes

Problem 2: Abstractions & Debugging

Before Platform Abstraction

I have access to my namespace

kubectl events

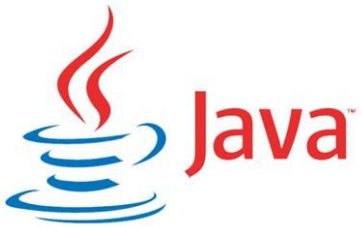
kubectl exec

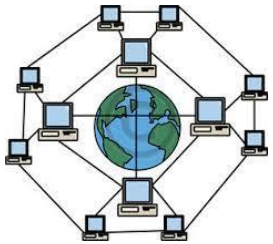
kubectl debug

After Platform Abstraction

I don't have access to my namespace

Problem 3: Fragmented Expertise





Fragmented Debug Expertise;

Takes longer for incident debugging, root cause and resolve.

Solution: Debuggability Paved Road

Accelerate developer velocity and reduce MTTR.

Debugging super powers offered through a Debuggability Paved Road.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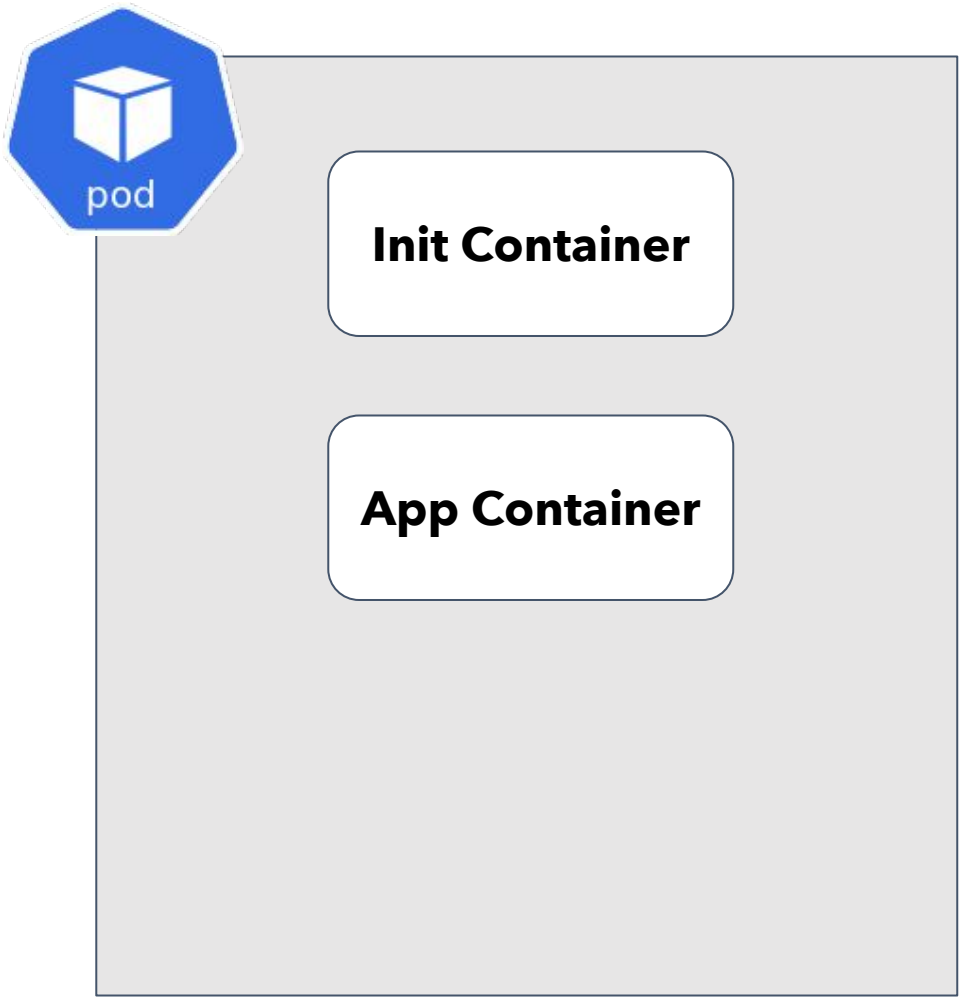
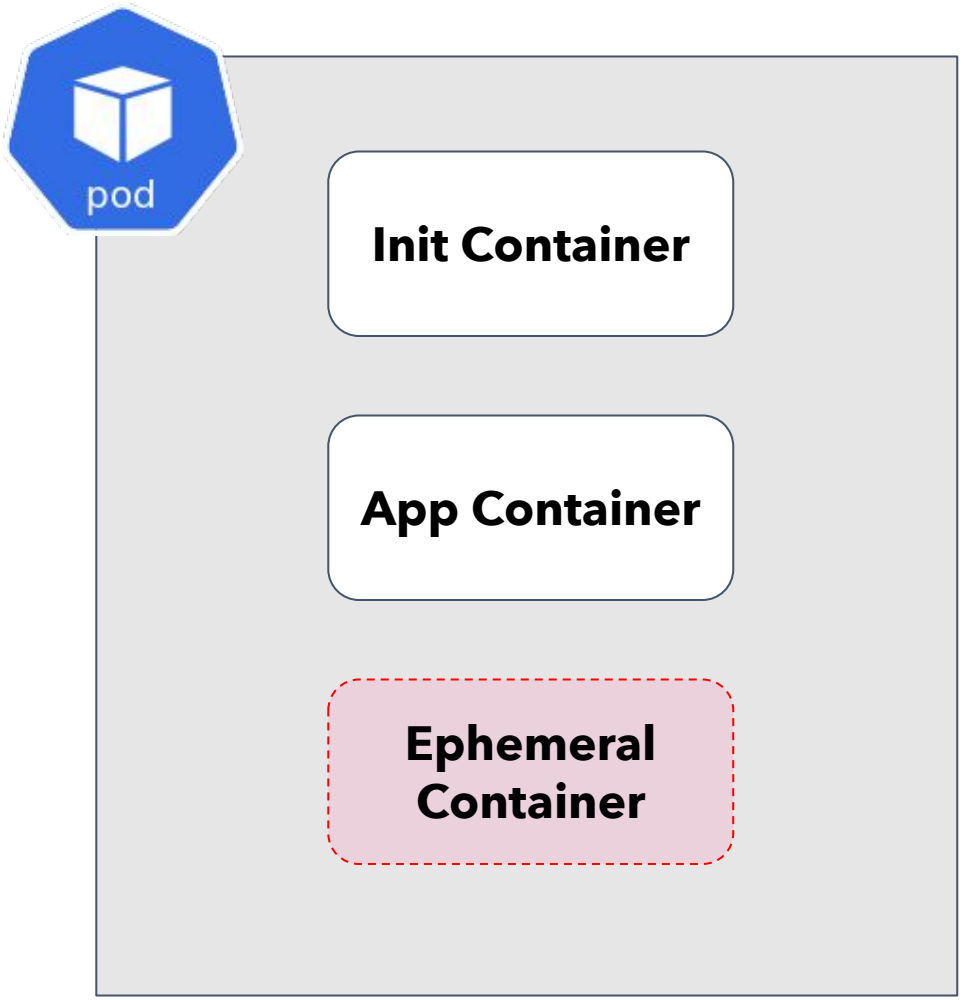
Interactive Debugging Using Ephemeral Containers

Ephemeral Containers

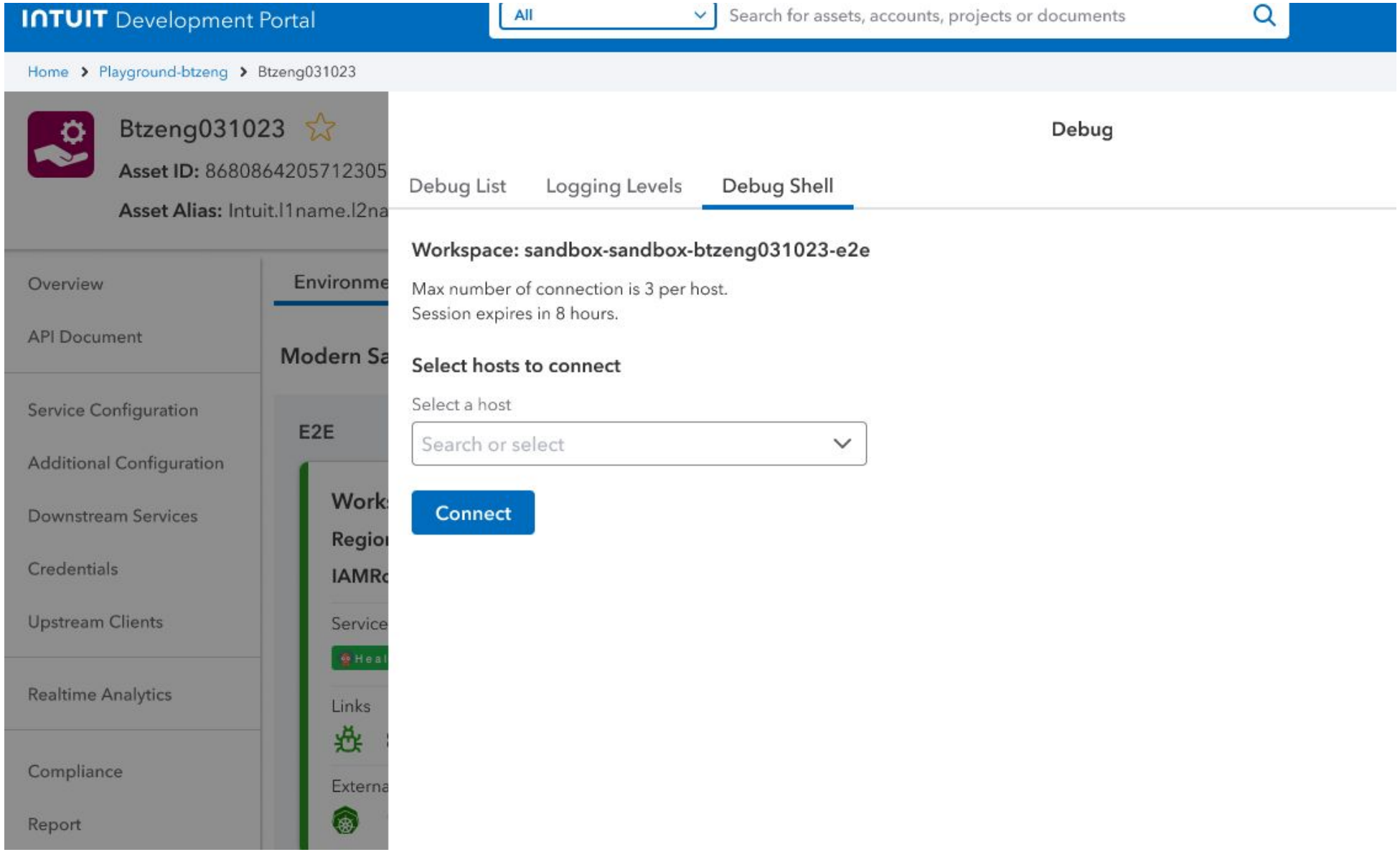
Before Kubernetes 1.23



Kubernetes 1.23 - Ephemeral Ctrs Beta
Kubernetes 1.25 - Ephemeral Ctrs GA



Debug Shell UI Access

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Debug Shell Demo

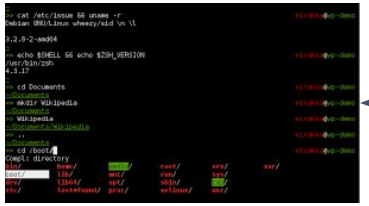
Interactive Debugging Using Ephemeral Containers

App developer

Request debug shell on target namespace, region and pod

Start HTTP session with auth token

Upgrade connection to Websocket



Debug Shell

Multi-Cluster Orchestrator

Obtain kubeconfig of target namespace

Use Kubernetes client-go API to launch an ephemeral container in the target pod

Bi-directional streaming server

Launch ephemeral containers

Establish SPDY connection

Namespace

pod

App container

Ephemeral Container

What's in the debug container image ?

- Shell
- Package manager
- General purpose Linux debugging tools (eg, strace, lsof)
- Language specific debugging tools (eg, jmx for Java)
- Cloud provider tools (eg, aws cli)
- Network debugging tools (eg, tcpdump, netstat, arp, nslookup)
- Storage debugging tools (eg, fdisk)
- Misc

Ephemeral Containers: Security

- Session termination after an inactive interval of 30 minutes.
- **RBAC** controlled.
- OPA **policies** extend to debug container as well
- **Audit** records
- **Throttling** limits on:
  - per pod
  - per user
  - number of concurrent debug sessions per cluster
  - number of concurrent debug sessions across all clusters.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1-Click Debugging Using Argo Workflows

1-Click Debugging Using Argo Workflows: Intro

- Argo is a Cloud Native Computing Foundation (CNCF) graduated project.
- Open Source with an Active Community

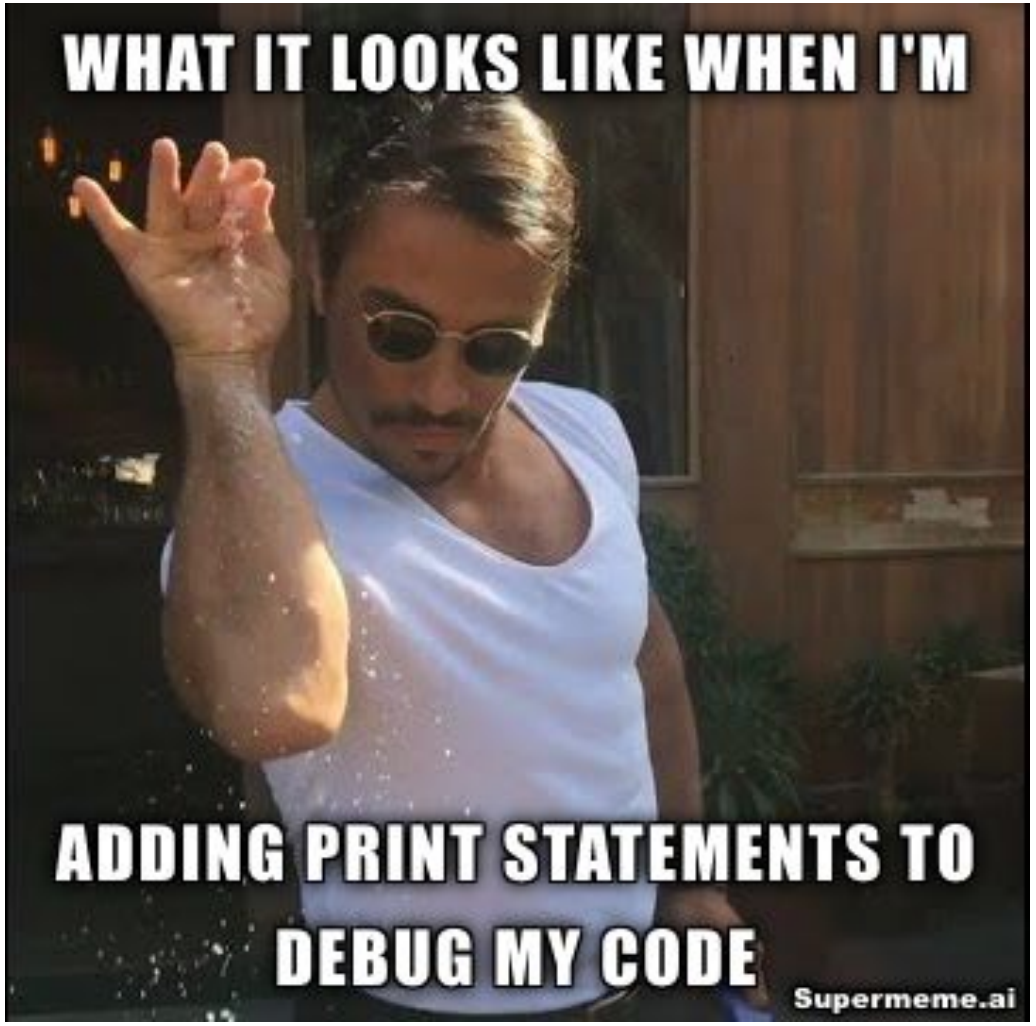
Argo Workflows

Kubernetes-native workflow engine supporting DAG and step-based workflows.

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Workflow
metadata:
  generateName: whalesay-
spec:
  entrypoint: whalesay
  templates:
  - name: whalesay
    container:
      image: docker/whalesay:latest
      command: [cowsay]
      args: ["Hello, Argo!"]
```

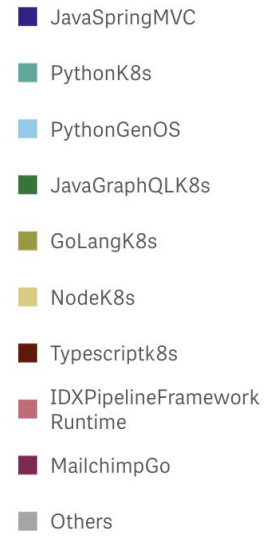
1-Click Debugging Using Argo Workflows: Problem

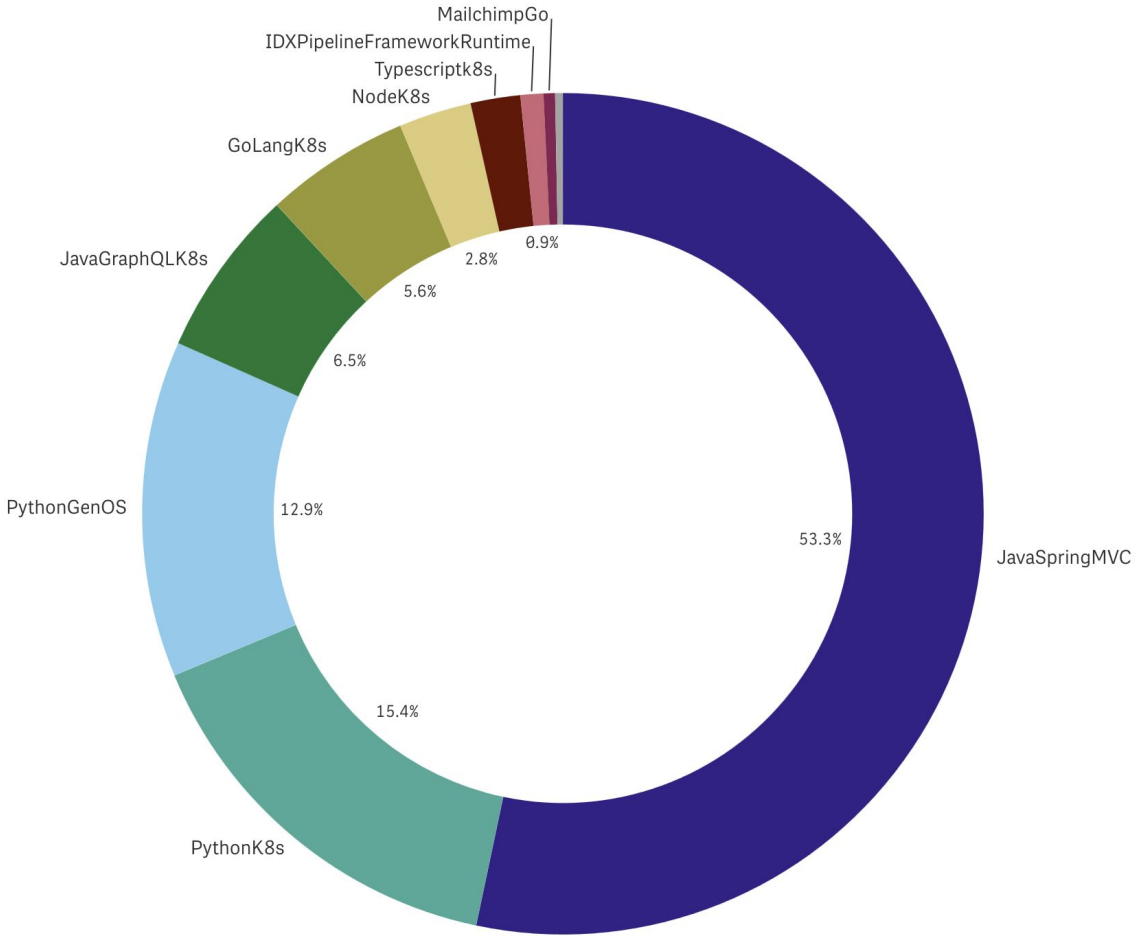
- Developers will need to occasionally debug **running code**.
- Specific debugging techniques are required based on the the **language** and **framework**.
- Preserving application **context** when debugging is important.
- Having the right **tools** or **access** can be a challenge.



1-Click Debugging Using Argo Workflows: Language and Frameworks

- **Intuit** primarily uses **Java Spring** for web services, though we support multiple languages and frameworks.
- We currently support debugging tools for **Java**, **Golang** and soon **Python**.





1-Click Debugging Using Argo Workflows: Application Context

Spring Boot Actuator is a sub-project of Spring Boot. It adds several production grade services to your application with little effort on your part.

application-debug.yml

```
---
management:
 endpoints:
   web:
     exposure:
       include:
["prometheus","threaddump","heapdump"]
 endpoint:
   prometheus:
     enabled: true
   threaddump:
     enabled: true
   heapdump:
     enabled: true
```

manifest.yaml

```
containers:
 - env:
   - name: SPRING_ACTIVE_PROFILES
     value: e2e,debug
```

Exposes the following endpoints:

- /actuator/prometheus
- /actuator/threaddump
- /actuator/heapdump

Debugging using Argo Workflows: Thread & Heap Dumps

Troubled Pod?
- 100% CPU
- Memory Leaks
- Garbage Collection
- Deadlocks
- Performance Bottlenecks

Debug

Workspace Name: sandbox-sandbox-kubecon23javaairdemo-qal
Workspace Region: USW2
Language: java

Debug List

Once workflow completes, downloaded files will be stored for 24 hours

State	Timestamp	Operation	Host	Expires	Action
Search host...					
✓	Friday, November 3rd, 4:09:36 pm	threaddump	kubecon23-java-air-demo-rollout-7dd77848bb-4dmpr	Saturday, November 4th, 4:09:36 pm	Download

1-1 of 1 1

Debug Action

Add a thread/heap dump for your application instance by selecting host and type of debug.**You can trigger Thread Dumps for multiple hosts at once, but only for Heap Dump, as it can cause Downtime to users.**
It can take up to **2 hours** to complete a Heap Dump. To know more refer to the documentation

Select Debug Type

(•) Thread Dump ( ) Heap Dump

Select Host(s)

Add to Debug List

Done

- User interacts with **Developer portal UI** to take a thread or heap dump against a target Pod.
- Developer can later download the artifact for analysis using their favorite tools.
- These downloads are available only for 24hrs.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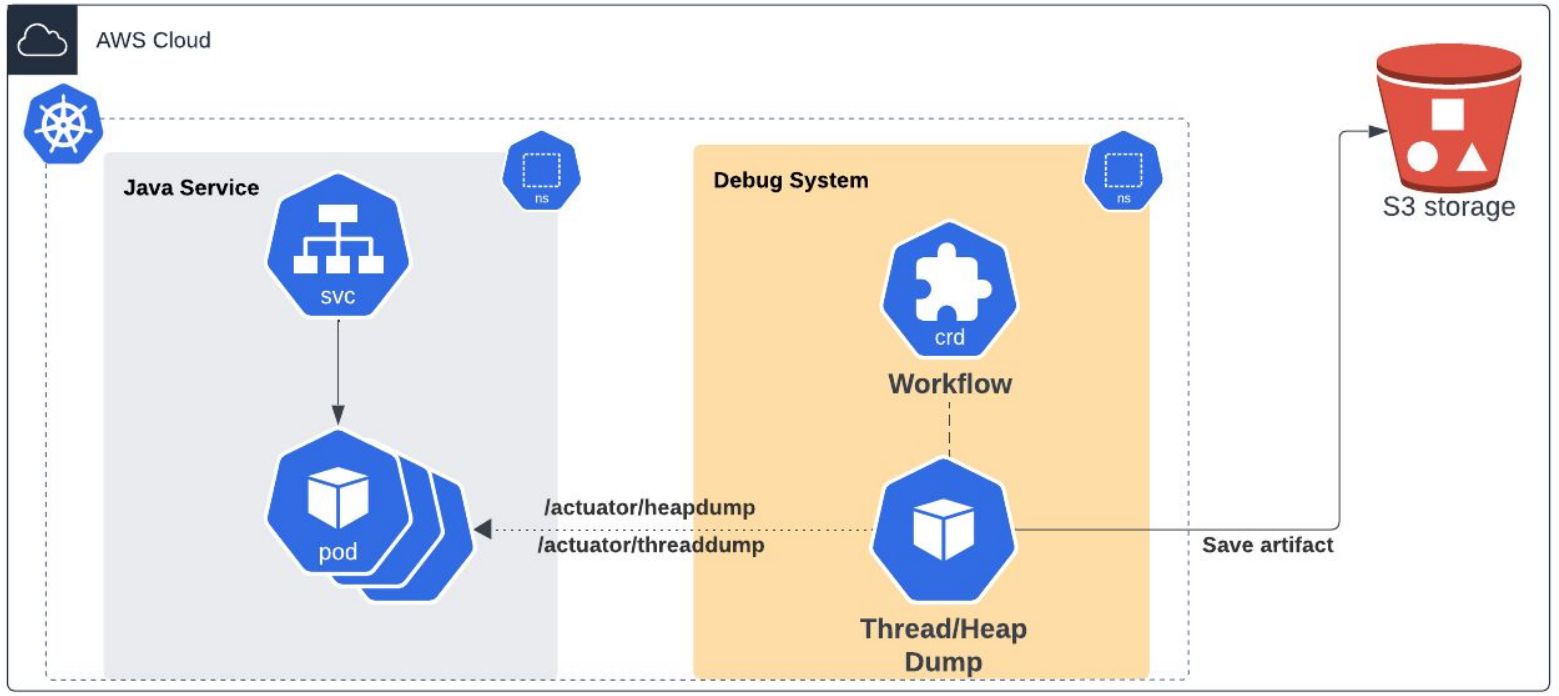
Demo

1-Click Debugging Using Argo Workflows: How it works




```
k get wf -n debug-system
NAME                                                STATUS      AGE
ws-d-sandbox-sandbox-kubecon23javaairdem-74da5-n2s5s  Succeeded   64m
ws-d-sandbox-sandbox-kubecon23javaairdem-a4a9b-l8fdq  Succeeded   4m19s
ws-d-sandbox-sandbox-kubecon23javaairdem-d751a-v2kxp  Succeeded   85m
```

- The workflow will execute a **Thread/Heap dump** based on the request against the target Pod.
- The result is sanitized and packaged up to **S3** for later download.
- Audit events are recorded at each step.

Debugging using Argo Workflows: Security & AuthZ

- **Auditing** metadata is collected at every step.
- Downloads/Uploads use **RBAC** and IAM **authorization**.
- AWS **pre-signed** urls are generated to encapsulate the expire time.
- Protecting the management endpoints we use via **NetworkPolicy**.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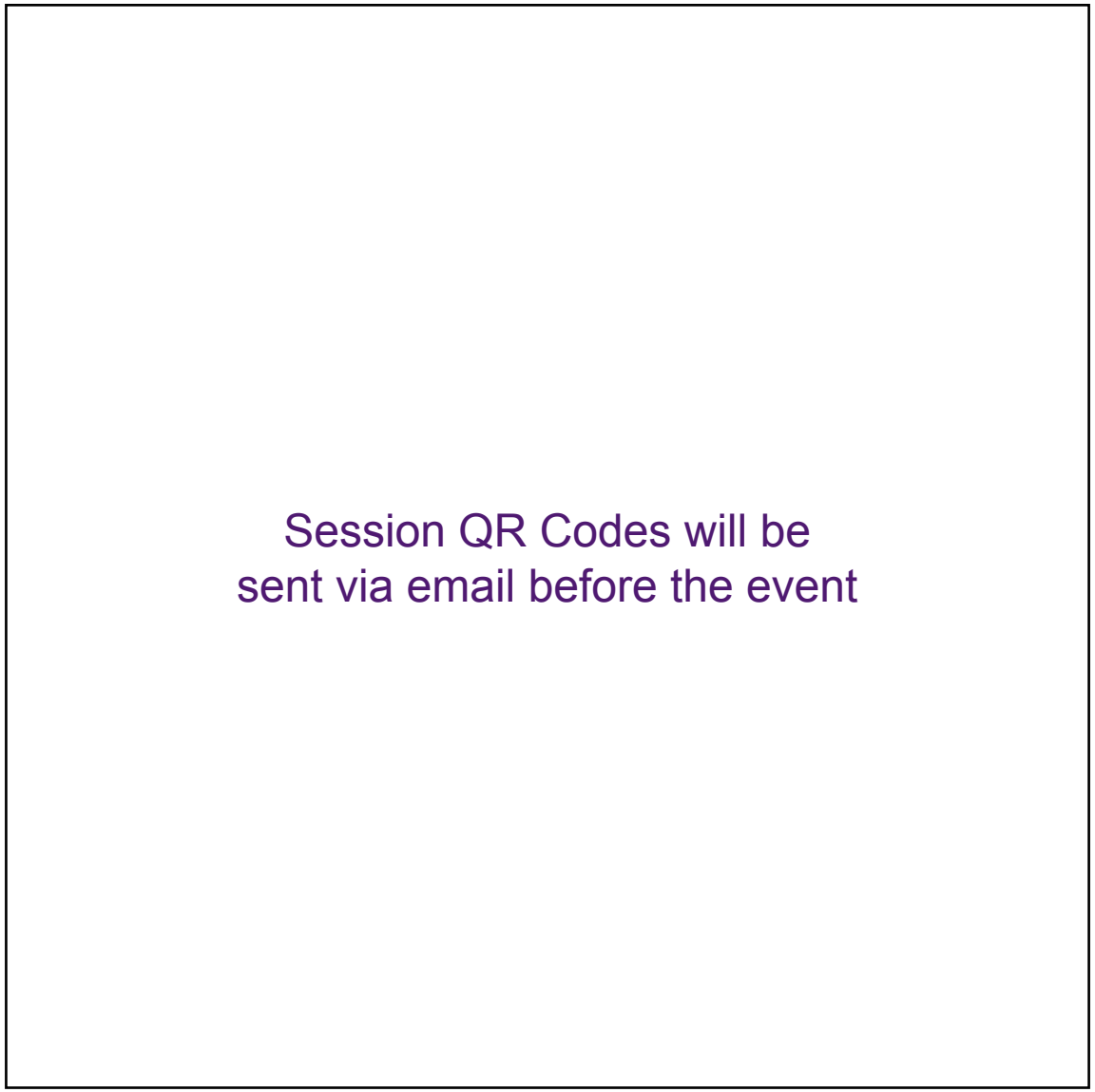
Takeaways

Takeaways

- Enhance developer velocity & improve MTTR by reducing friction to take debugging actions.
- Automate and secure access to sensitive data during the debugging process.
- Facilitate seamless collaboration among developers through auditable, downloadable artifacts.
- Democratize debugging tools.



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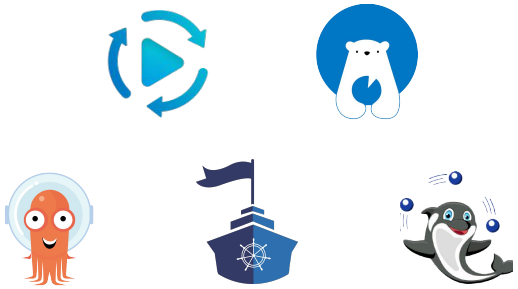

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