



Cloud Agnostic Design Patterns and Tips

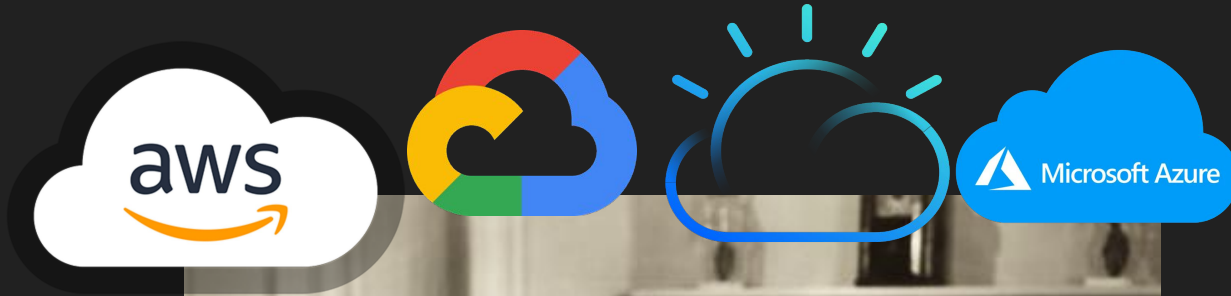
(for Serverless and Java)

Kevin Dubois,
Principal Developer Advocate, Red Hat

The Cloud

Red Hat
Developer

DevNation




@kevindubois

Kevin Dubois



- ★ Principal Developer Advocate at Red Hat 🎩
- ★ Java Champion  
- ★ Based in Belgium 🇧🇪
- ★ Speak English, Dutch, French, Italian 🇮🇹
- ★ Open Source Contributor (Quarkus, Camel, Knative, ..)
- ★ Community Member (BeJUG, BeCNCf)


@kevindubois@mastodon.social


 @kevindubois.com

 youtube.com/@thekevindubois

 linkedin.com/in/kevindubois

 github.com/kdubois

Cloud Computing:

Respond more quickly to demand

No provisioning/managing of hardware

High availability, Disaster Recovery, Resilience

Grow your application in a manageable way

Use only the resources you need! €€ 🌳🌳

...



(Some) Components of an Application Platform



Developer Tools



CI/CD
GitOps



Networking



Monitoring



Logging



Container
Registry

All services

myApplications

All services

Services by category

Compute

- EC2
- Lightsail
- Lambda
- Batch
- Elastic Beanstalk
- Serverless Application Repository
- AWS Outposts
- EC2 Image Builder
- AWS App Runner
- AWS S3

Containers

- Elastic Container Registry
- Elastic Container Service
- Elastic Kubernetes Service
- Red Hat OpenShift Service on AWS

Storage

- S3
- EFS
- FSx
- S3 Glacier
- Storage Gateway
- AWS Backup
- AWS Elastic Disaster Recovery

Database

- RDS
- ElastiCache
- Neptune
- Amazon QLDB
- Amazon DocumentDB
- Amazon Keyspaces
- Amazon Timestream
- DynamoDB
- Amazon MemoryDB for Redis

Migration & Transfer

Customer Enablement

- AWS IQ
- Managed Services
- Activate for Startups
- Support
- AWS re:Post Private

Robotics

- AWS RoboMaker

Blockchain

- Amazon Managed Blockchain

Satellite

- Ground Station

Quantum Technologies

- Amazon Braket

Management & Governance

- AWS Organizations
- CloudWatch
- AWS Auto Scaling
- CloudFormation
- AWS Config
- OpsWorks
- Service Catalog
- Systems Manager
- Trusted Advisor
- Control Tower
- AWS Well-Architected Tool
- AWS Health Dashboard
- AWS Chatbot
- Launch Wizard
- AWS Compute Optimizer
- Resource Groups & Tag Editor
- Amazon Grafana
- Amazon Prometheus
- AWS Lake Formation

Machine Learning

- Amazon SageMaker
- Amazon Augmented AI
- Amazon CodeGuru
- Amazon DevOps Guru
- Amazon Comprehend
- Amazon Forecast
- Amazon Fraud Detector
- Amazon Kendra
- Amazon Personalize
- Amazon Polly
- Amazon Rekognition
- Amazon Textract
- Amazon Transcribe
- Amazon Translate
- AWS DeepComposer
- AWS DeepRacer
- AWS Panorama
- Amazon Monitron
- AWS HealthLake
- Amazon Lookout for Vision
- Amazon Lookout for Equipment
- Amazon Lookout for Metrics
- Amazon Lex
- Amazon Comprehend Medical
- AWS HealthOmics
- Amazon Bedrock
- AWS HealthImaging
- Amazon Q

Analytics

- Athena
- Amazon Redshift
- CloudSearch
- Amazon OpenSearch Service
- Kinesis
- QuickSight
- Data Pipeline
- AWS Data Exchange
- AWS Lake Formation

Cloud Financial Management

- AWS Marketplace Subscriptions
- AWS Billing Conductor
- Billing and Cost Management

Front-end Web & Mobile

- AWS Amplify
- AWS AppSync
- Device Farm
- Amazon Location Service

Application Integration

- Step Functions
- Amazon AppFlow
- Amazon MQ
- Simple Notification Service
- Simple Queue Service
- SWF
- Managed Apache Airflow
- Amazon EventBridge
- AWS B2B Data Interchange

Business Applications

- Amazon Connect
- Amazon Honeycode
- Amazon Chime
- Amazon Simple Email Service
- Amazon WorkDocs
- Amazon WorkMail
- AWS Supply Chain
- AWS AppFabric
- AWS Wickr
- Amazon Chime SDK
- Amazon One Enterprise
- Amazon Pinpoint

End User Computing

- WorkSpaces
- AppStream 2.0





All services

- All
- Favorites
- Recents
- Recommended for you
- Categories
- AI + machine learning
- Analytics
- Compute
- Containers
- Databases
- DevOps
- General
- Hybrid + multcloud
- Identity
- Integration
- Internet of Things
- Management and governance
- Migration
- Mixed reality
- Monitor
- Networking
- Security
- Storage
- Web & Mobile

Search resources, services, and docs (G + I)

Microsoft Azure

Filter services

Service providers: All Release Status: All



AI + machine learning (22)

- Azure AI Studio [\[review\]](#)
- Azure Machine Learning
- AI Search
- Azure AI services
- Azure AI services multi-service account
- Azure AI Video Indexer
- Anomaly detectors
- Bot Services
- Computer vision
- Content moderators
- Custom vision
- Document intelligences
- Face APIs
- Inmersive readers
- Language
- Azure Synapse Analytics
- Metrics advisors
- Azure OpenAI
- Personalizers
- Speech services
- Translators
- Intelligent Recommendations Accounts

Analytics (21)

- Analysis Services
- Data factories
- Data Lake Analytics
- Data Lake Storage Gen1
- Azure Databricks
- HDInsight clusters
- Azure HDInsight on AKS clusters [\[preview\]](#)
- Microsoft Graph Data Connect [\[preview\]](#)
- Data Catalog
- Azure Data Explorer Clusters
- Data Share Inventions
- Data Shares
- Power BI Embedded
- Apache Kafka® & Apache Flink® on Confluent [\[beta\]](#)
- Event Hubs
- Log Analytics workspaces
- Managed Prometheus
- Stream Analytics clusters
- Stream Analytics jobs
- Azure Synapse Analytics
- Azure Synapse Analytics (private link hubs)

Compute (36)

- Availability sets
- Community images
- Azure compute galleries
- Disk Pools [\[preview\]](#)
- Host groups
- Image templates
- Images
- Lab accounts
- Proximity placement groups
- Restore Point Collections [\[preview\]](#)
- SSH keys
- Azure Virtual Desktop
- Virtual machine scale sets
- Virtual machines
- VM application definitions
- VM application versions
- VM image definitions
- VM image versions
- App Services
- Cloud services (extended support)
- Azure Spring App
- Virtual instances for SAP solutions
- Azure VMware Solution
- Container Apps
- Container Apps Environments
- Function App
- Kubernetes services
- BareMetal Instances [\[preview\]](#)
- Batch accounts
- Genomics accounts
- Qanerva Workspaces [\[preview\]](#)
- SAP HANA on Azure [\[preview\]](#)
- Azure Arc
- Citrix Virtual Apps Essentials
- Citrix Virtual Desktops Essentials

Containers (10)

- Container instances
- Container registries
- Kubernetes fleet manager
- Kubernetes services
- Azure Red Hat OpenShift clusters
- Service Fabric clusters
- Service Fabric managed clusters
- App Configuration
- Container App jobs
- Container Apps

Databases (22)

- SQL databases
- SQL elastic pools
- SQL managed instances
- SQL servers
- SQL virtual machines
- Azure Cosmos DB
- Azure Cosmos DB for MongoDB (RM)
- Azure Database for MariaDB servers
- Azure Database for MySQL flexible servers
- Azure Database for MySQL servers
- Azure Database for PostgreSQL flexible servers
- Azure Database for PostgreSQL servers
- Azure Arc data controllers
- PostgreSQL servers - Azure Arc [\[review\]](#)
- SQL managed instances - Azure Arc
- SQL Server - Azure Arc
- Azure Cache for Redis
- Azure Database Migration Services
- Elastic job agents [\[preview\]](#)
- Managed databases
- Oracle Database@Azure [\[preview\]](#)



Products & solutions

- All products
- Jump Start Solutions
- Solution deployments
- Categories
- Management
- Compute**
- Storage
- Analytics
- Networking
- Distributed Cloud
- Serverless
- Databases
- Operations
- Security
- CI/CD
- Artificial Intelligence
- Integration Services
- Tools
- Web3

Compute
Run scalable virtual machines and containers

Name	Description		
Compute Engine	VMs, GPUs, TPUs, disks	☰	▾
Kubernetes Engine	Managed Kubernetes / containers	☰	▾
VMware Engine	VMware as a service	☰	▾
Anthos	Enterprise hybrid multi-cloud platform	☰	▾
Batch	Jobs as a service		▾

Storage
Store long-term, short-term, VM, and Filestore securely

Name	Description		
Cloud Storage	Enterprise-ready object storage	☰	▾
Filestore	Fully managed NFS server	☰	▾
Storage Transfer	Secure and flexible way to move data	☰	▾
PowerScale	Cloud-native enterprise-grade file service		▾
NetApp Volumes	Fully Managed File Storage		▾

Analytics
Collect, store, process, and analyze large amounts of data

Name	Description		
BigQuery	Data warehouse/analytics	☰	▾

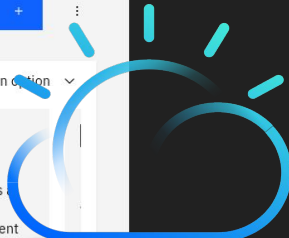


Dashboard

Edit dashboard Upgrade account Create resource +

For you

- Build**
Explore IBM Cloud with this selection of easy starter tutorials and services.
- Db2**
Get enterprise-level OLTP performance, 99.99% uptime SLA, automatic backups, compliance options and encryption at rest with Db2.
Popular 2 min
- Build with Watson**
Chatbots, insights, recognizers, and more. Explore the AI platform for business.
Popular 3 min
- Visit the IBM Cloud catalog**
Explore our unique product catalog that contains 190+ services and software for your business solutions.
Getting started 1 min
- Use Watson Assistant**
Watson Assistant lets you build conversational interfaces into any application, device, or channel.
Popular 2 min
- Use Watson Studio**
Watson Studio provides a suite of tools and a collaborative environment for data scientists, developers and domain experts.
Popular 2 min



News View all

- 6 ways to elevate the Salesforce experience for your users
- Public cloud vs. private cloud vs. hybrid cloud: What's the difference?
- Cyber recovery vs. disaster recovery: What's the difference?
- Modernizing payments without disrupting legacy checks systems

Recent support cases View all

You can view a summary of your support cases here after you submit them. [Learn more about how to get support.](#)

Planned maintenance View all

Clear skies!
You can view your scheduled maintenance events here.

IBM Cloud status View all

No issues

Usage View usage

User access Manage users

But...

What if ...

- Regulatory changes
- Outages
- Price changes, contract renegotiations
- Other vendor offers better hw / services
- New CIO/CTO
- Shadow IT
- ...

aws Services Search [Alt+S]

Console Home Console Home > All services

myApplications All services

All services

Services by category

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 - Batch
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- Storage**
- Customer Enablement**
 - AWS IQ
 - Managed Services
 - Activate for Startups
 - Support
 - AWS rePost Private
- Robotics**
 - AWS RoboMaker
- Blockchain**
 - Amazon Managed Blockchain
- Satellite**
 - Ground Station



Free trial status: €271.02 credit and 51 days remaining. Activate your full account to get unlimited access to all of Google Cloud—use any remaining credits, then pay only for what you use.

Google Cloud Kevin

Search (/) for resources, docs, products, and more

Products & solutions

All products

Jump Start Solutions

Solution deployments

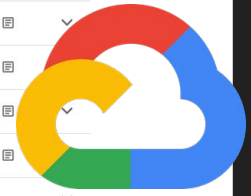
Categories

- Management
- Compute

Compute

Run scalable virtual machines and containers

Name	Description
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VMware Engine	VMware as a service
Anthos	Enterprise hybrid multi-cloud platform
Batch	Jobs as a service



Microsoft Azure

All services

Categories

- AI + machine learning
- Analytics
- Compute
- Containers
- Database
- DevOps
- General
- Hybrid + multcloud
- Identity
- Integration
- Internet of Things
- Management and governance
- Migration
- Mixed reality
- Monitor
- Networking
- Security
- Storage
- Web & Mobile

Analytics (2):

- Analysis Services
- Microsoft Graph Data Connect
- Table Hubs
- Real-time analytics
- Log Analytics workspace

Compute (36):

- Availability sets
- Linux accounts
- VM application definitions
- Virtual instances for SAP solutions
- Batch accounts
- Machine Learning Accounts
- Containers (10)
- Container instances
- App Configuration
- SQL databases
- Azure Database for MariaDB servers
- SQL managed instances - Azure Arc
- Community images
- Privately placed groups
- VM application definitions
- Azure VMware Solution
- Generics accounts
- Azure compute galleries
- Reserve Priced Collections
- VM image definitions
- Container Apps
- OpenShift Workspaces
- SQL managed instances
- SQL elastic pools
- Azure Database for MySQL flexible servers
- SQL Server - Azure Arc
- Agent Cache for Redis



IBM Cloud Search resources and products Catalog Manage Kevin Dubois's Account

Dashboard

For you

Build
Explore IBM Cloud with this selection of easy starter tutorials and services.

Db2
Get enterprise performance, uptime SLAs, backups, options at rest with...

Use Watson Assistant
Watson Assistant lets you build conversational interfaces into any application, device, or channel.

Use Watson Studio
Watson Studio provides a suite of tools and a collaborative environment for data scientists, developers and domain experts.

News
6 ways to elevate the Salesforce experience for your users
Public cloud vs. private cloud vs. hybrid cloud: What's the difference?
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Modernizing payments without disrupting legacy checks systems

Recent support cases
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IBM Cloud status
No Issues



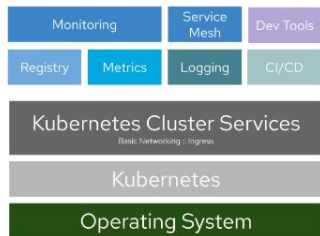
So ... ?

Hybrid / Multi Cloud!?

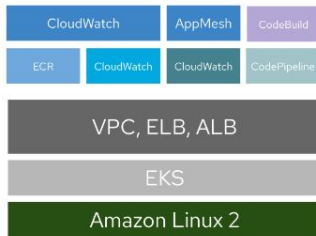
Building an application platform on each cloud



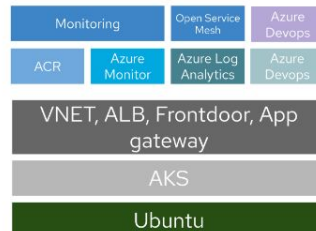
The required Parts



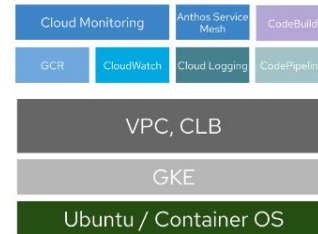
The AWS Car



The Azure Car



The Google Cloud Car

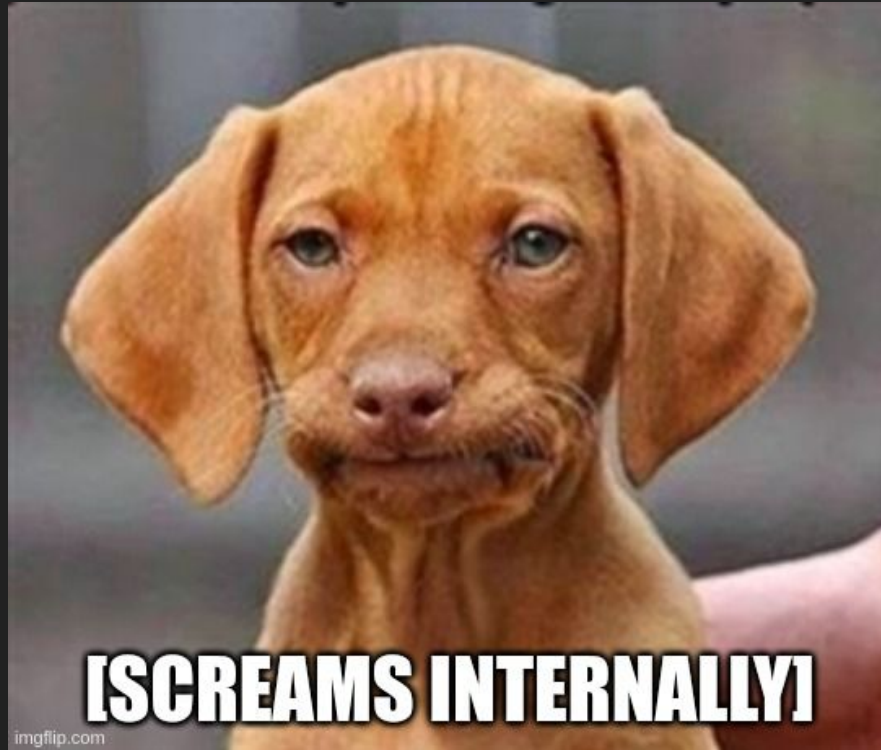


3 different cars

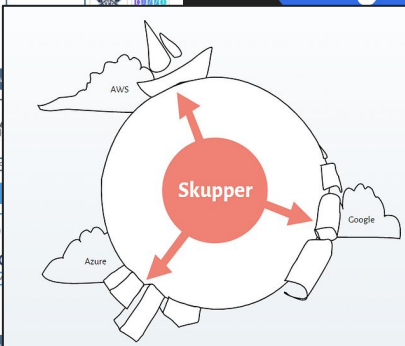
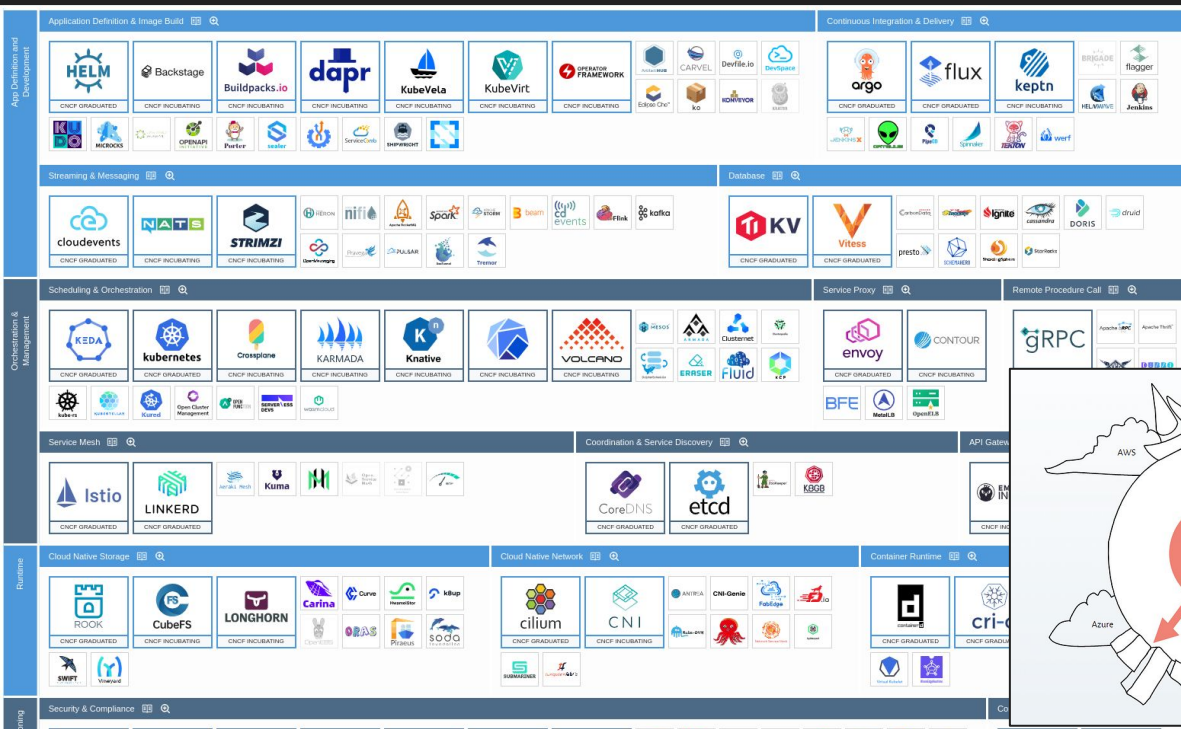
- Different component versions
- Different life cycles
- Different support models
- Different developer and ops tooling



3 different drivers and pit crews needed



Open Source & Cloud Native Ecosystem FTW!



Multicloud communication for Kubernetes

Skupper is a layer 7 service interconnect. It enables secure communication across Kubernetes clusters with no VPNs or special firewall rules.

With Skupper, your application can span multiple cloud providers, data centers, and regions.

What about Serverless?

Serverless



“Serverless computing refers to the concept of building and running **applications** that **do not require server management**. It describes a finer-grained **deployment model** where applications, bundled as one or more functions are uploaded to a platform and then **executed**, **scaled**, and **billed** in response to the exact **demand** needed at the moment”

-- CNCF Definition,

<https://www.cncf.io/blog/2018/02/14/cncf-takes-first-step-towards-serverless-computing/>

What factors are leading you to overspend?

Select all that apply.

Overprovisioning — for example, workloads using more resources than necessary

70%

Lack of individual or team-level awareness or responsibility

45%

Sprawl — such as resources not deactivated after use

43%

Technical debt — existing workloads not re-architected for scalability of cloud

43%

Lack of visibility and insight into consumption, budget and spending

40%

Presence of resource-hungry workloads

25%

Fluctuating consumption demands

23%

Poor planning and prediction on cloud consumption

23%

Absence of centralized, consistent or standardized processes and/or tools for insight and action across all our cloud providers

20%

Availability of a self-service infrastructure

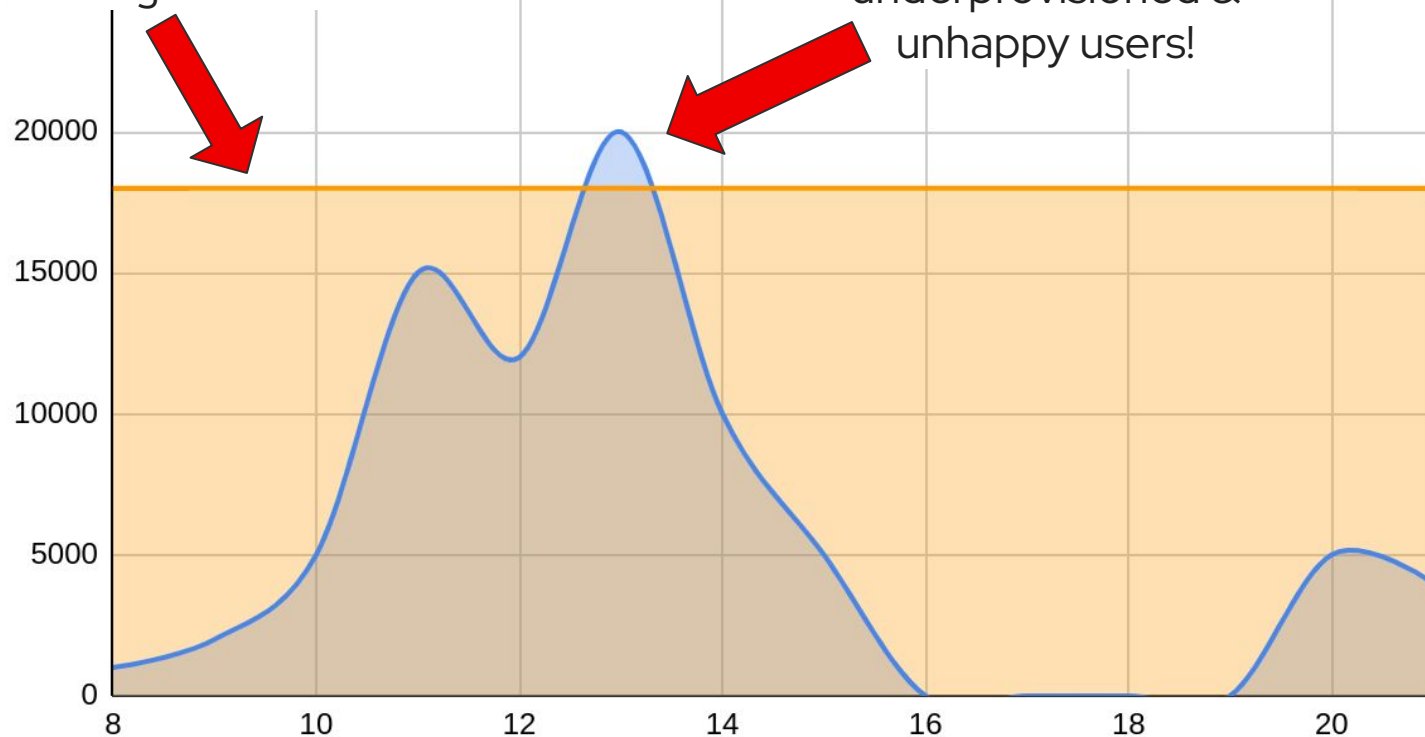
15%

Traditional Deployments

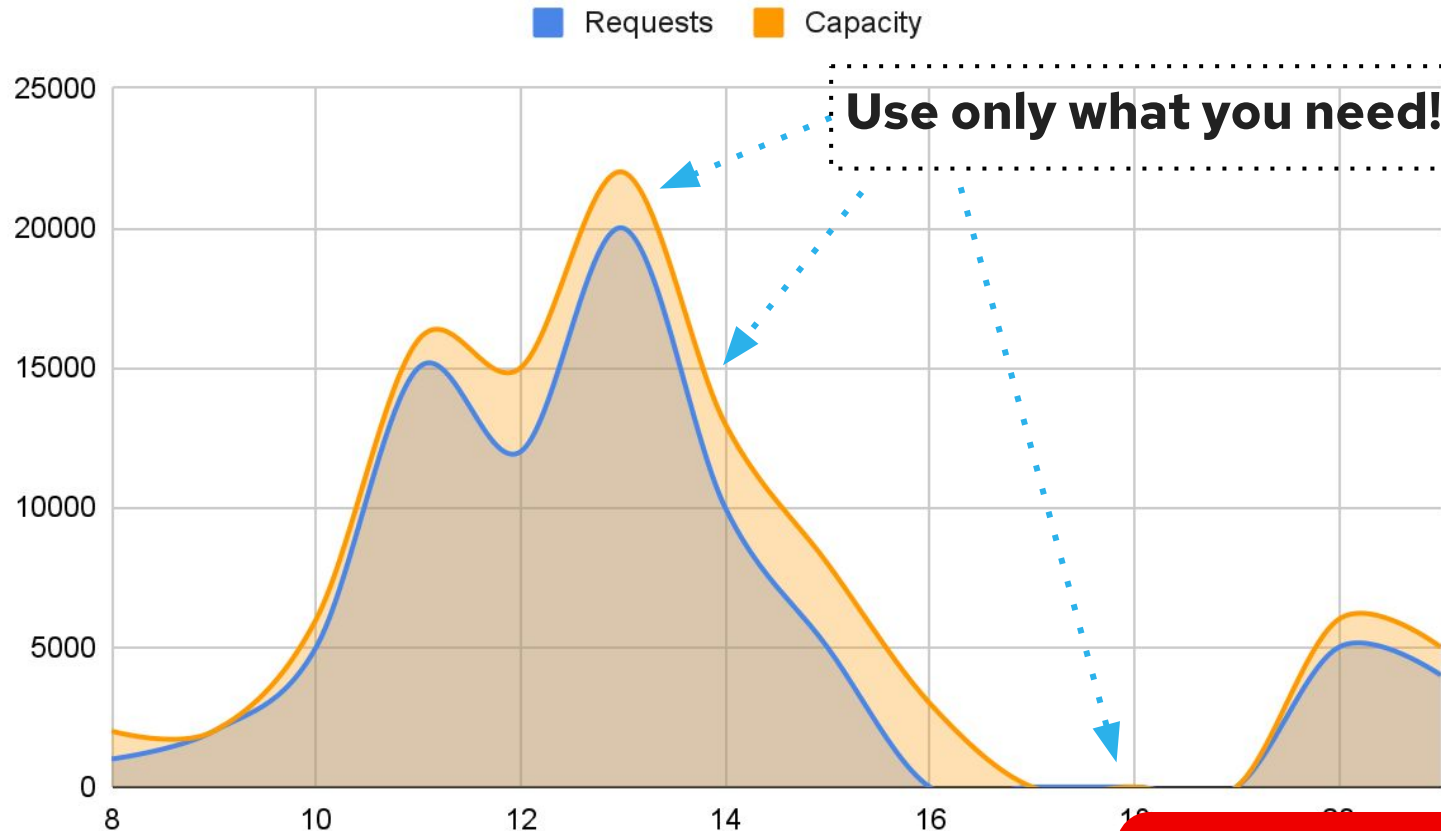
overprovisioned &
wasting resources

Requests Capacity

underprovisioned &
unhappy users!



Serverless



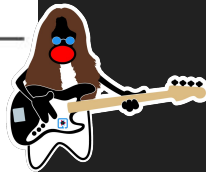
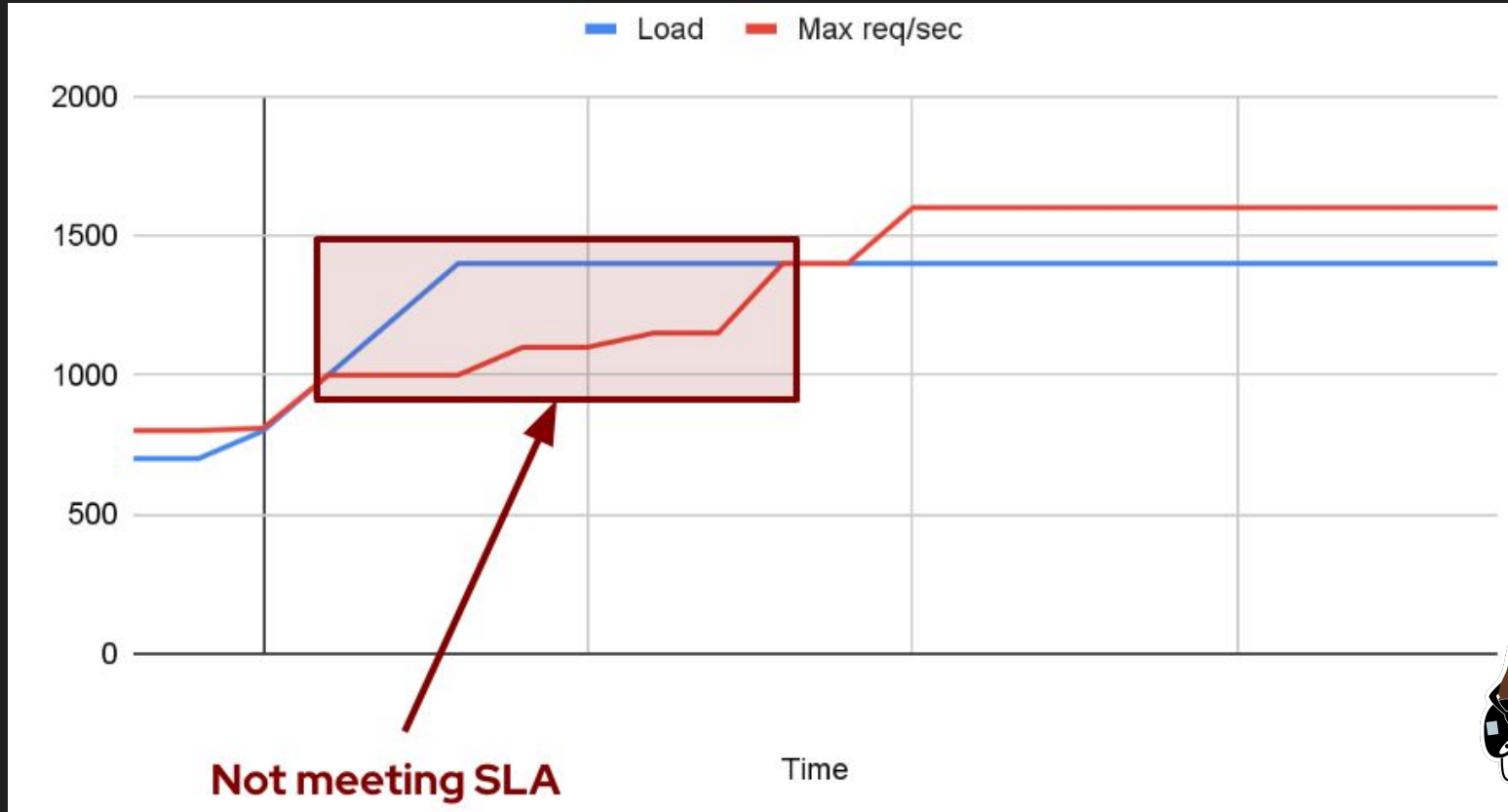
with Serverless

@kevindubois



Java & Serverless

JVM Scaling





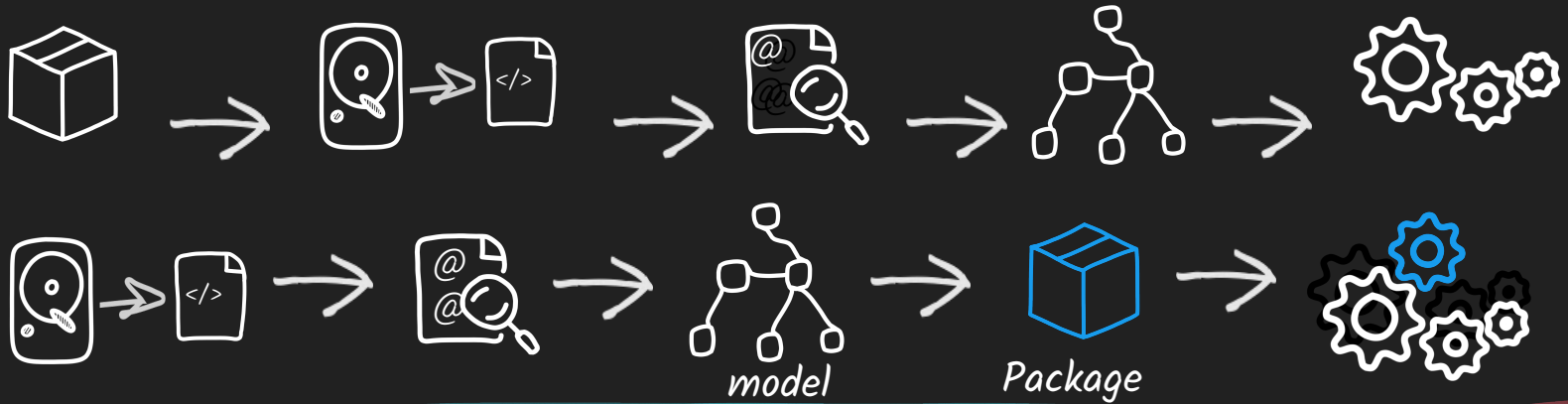
QUARKUS

SUPERSONIC. SUBATOMIC. JAVA

The Quarkus Way

Build Time

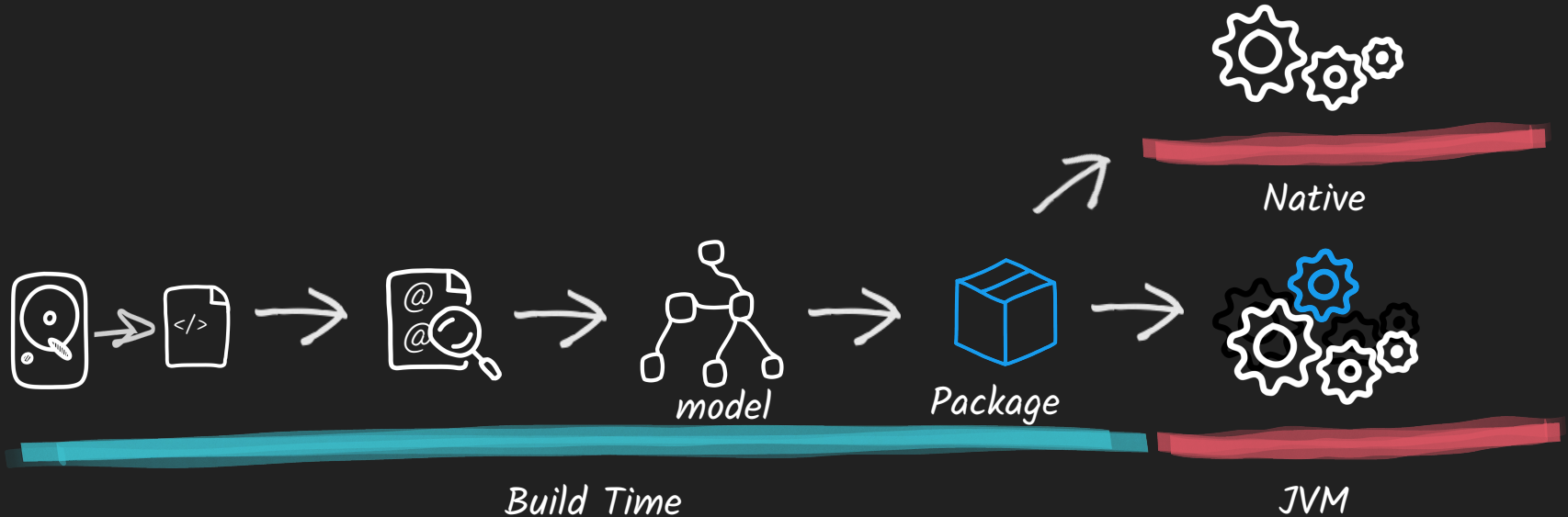
Runtime



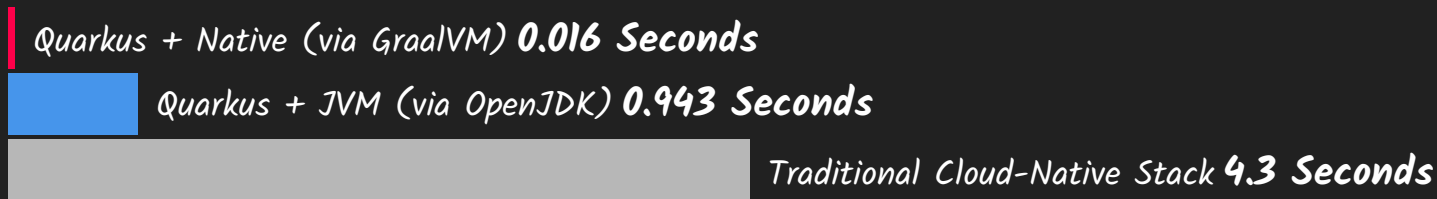
Build Time

Runtime

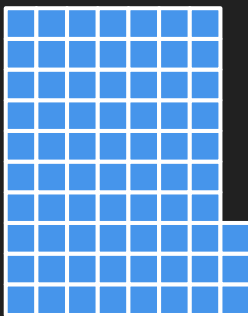
The Quarkus Way enables Native Compilation OOTB



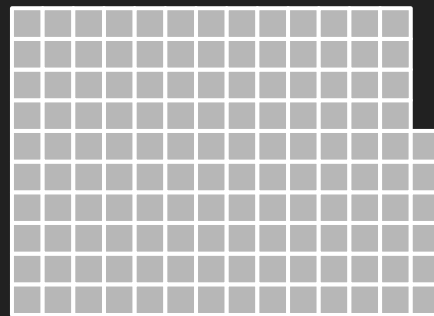
Supersonic, Subatomic Java



Quarkus + Native
(via GraalVM)
12 MB



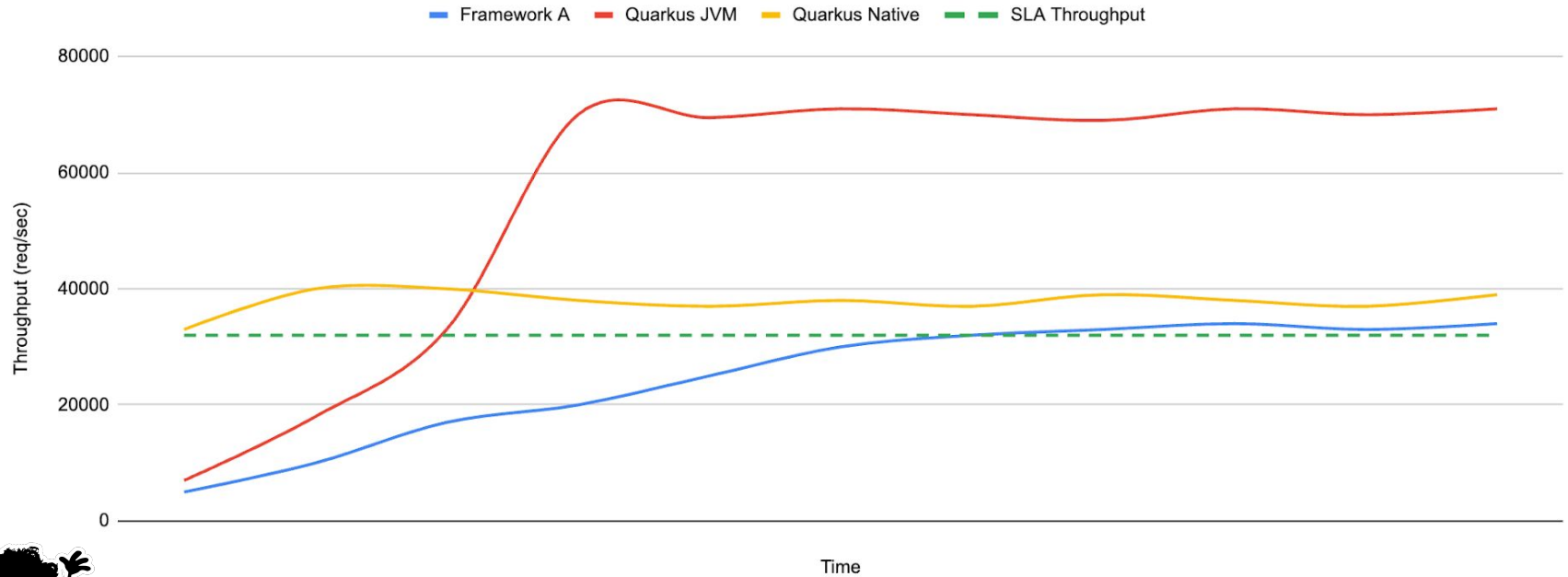
Quarkus + JVM
(via OpenJDK)
73 MB



Traditional
Cloud-Native Stack
136 MB

Java warmup time

Application Runtime Performance



1.0

AWS Lambda, Functions...

Built around the FaaS components and other services such as API Gateways. It enabled a variety of use cases but it is far from ideal for general computing and with room for improvements.

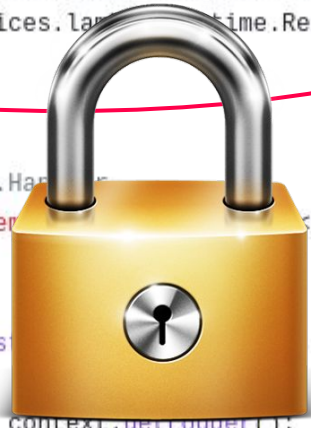
- HTTP and other few Sources
- **Functions only**
- **Limited execution time (5 min)**
- No orchestration
- Limited local development experience

FaaS





```
1 package example;
2
3 import com.amazonaws.services.lambda.runtime.Context;
4 import com.amazonaws.services.lambda.runtime.LambdaLogger;
5 import com.amazonaws.services.lambda.runtime.RequestHandler;
6
7 import java.util.Map;
8
9 // Handler value: example.Handler
10 public class Handler implements RequestHandler<Map<String,String>, Void>{
11
12     @Override
13     public Void handleRequest(Map<String,String> event, Context context)
14     {
15         LambdaLogger logger = context.getLogger();
16         logger.log("EVENT TYPE: " + event.getClass());
17         return null;
18     }
19 }
```



Writing cloud agnostic functions with Java & Quarkus



```
@WebServlet("/api/getLSBData")
public class LightSpeedBoosterServlet extends HttpServlet {

    private LsbRepository lsbRepository;

    @Override
    public void init() throws ServletException {
        lsbRepository = new LsbRepository();
    }

    @Override
    protected void doGet(HttpServletRequest request, HttpServletResponse response) throws Ser
    ... }

    @Override
    protected void doPost(HttpServletRequest request, HttpServletResponse response) throws Se
    ... }
}
```

```
import io.quarkus.funqy.Funqy;

public class GreetingFunction {
    @Funqy
    public String greet(String name) {
        return "Hello " + name;
    }
}
```

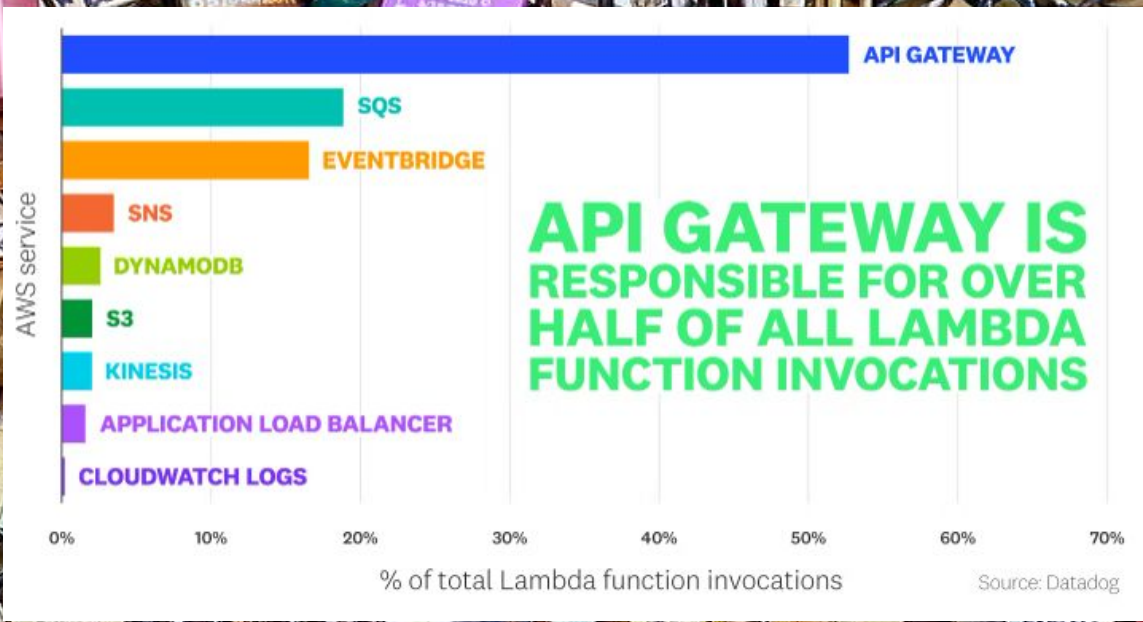
```
import io.cloudevents.CloudEvent;
import io.cloudevents.core.data.PojoCloudEventData;
import io.cloudevents.jackson.PojoCloudEventDataMapper;
import io.quarkus.funqy.Funqy;
import static io.cloudevents.core.CloudEventUtils.mapData;

public class LandingRequestFunction {

    @Funqy
    public void landingRequest(CloudEvent ce) {
    ... }
}
```



```
quarkus create app funqy \  
-x quarkus-funqy-amazon-lambda
```



1.0

AWS Lambda, Functions...

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- **Functions only**
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1.5

Serverless Containers

With the advent of containers & Kubernetes, many frameworks and solutions started to auto-scale containers. Cloud providers created offerings using managed services completely abstracting Kubernetes APIs.

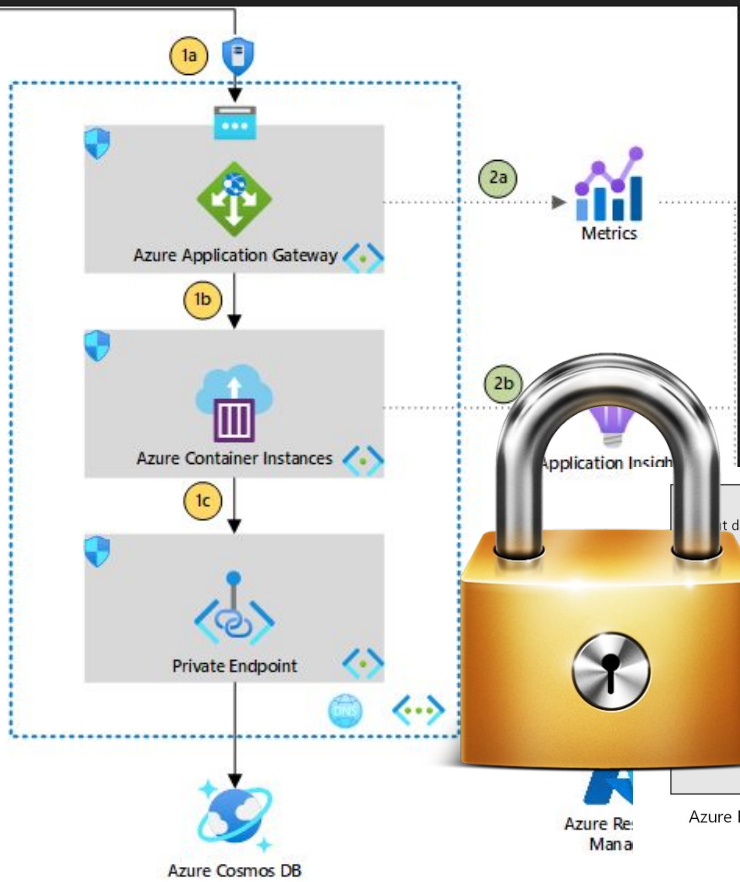
- **Fargate, Cloud Run, Container Instances**
- **Knative, KEDA, etc**
- Kubernetes based auto-scaling
- **Microservices and Functions**
- Easier to debug & test locally
- **Polyglot & Portable**

Serverless is evolving...

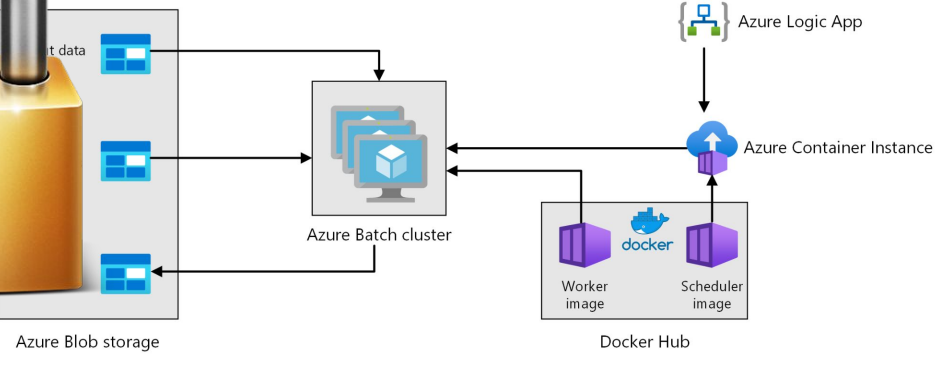




Public users



Azure Resource Manager



@kevindubois

Knative



<https://github.com/knative>





Knative

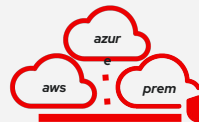


Knative is an **Open Source, Cloud Agnostic** Solution to build Serverless and Event Driven Applications on Kubernetes



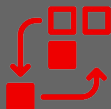
Containers made easy

Simplified developer experience to deploy applications/code on serverless containers **abstracting infrastructure** & focusing on what matters.



Ready for the Hybrid Cloud

Truly portable serverless running anywhere Kubernetes runs, that is on-premises or on any public cloud. Leverage data locality and SaaS when needed.



Immutable revisions

Deploy new features: performing canary, A/B or blue-green testing with gradual traffic rollout with no sweat and following best practices.



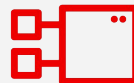
Any programming language

Use any programming language or runtime of choice. From Java, Python, Go and JavaScript to **Quarkus**, SpringBoot or Node.js.



Automatic scaling

No need to configure number of replicas, or idling. **Scale to zero** when not in use, auto scale to thousands during peak, with built-in reliability and fault-tolerance.



Event Driven Architectures

Build **loosely coupled & distributed apps** connecting with a variety of built-in or third-party event sources or connectors powered by Operators.




```
$ kn func create -l quarkus myfunc  
$ kn func deploy
```

```
$ kn service create myservice --image=xyz
```



1.0

AWS Lambda, Functions...

Built around the FaaS components and other services such as API Gateways. It enabled a variety of use cases but it is far from ideal for general computing and with room for improvements.

- HTTP and other few Sources
- **Functions only**
- **Limited execution time (5 min)**
- No orchestration
- Limited local development experience

1.5

Serverless Containers

With the advent of containers & Kubernetes, many frameworks and solutions started to auto-scale containers. Cloud providers created offerings using managed services completely abstracting Kubernetes APIs.

- **Fargate, Cloud Run, Container Instances**
- **Knative, KEDA, etc**
- Kubernetes based auto-scaling
- **Microservices and Functions**
- Easier to debug & test locally
- **Polyglot & Portable**

2.0

Integration & State

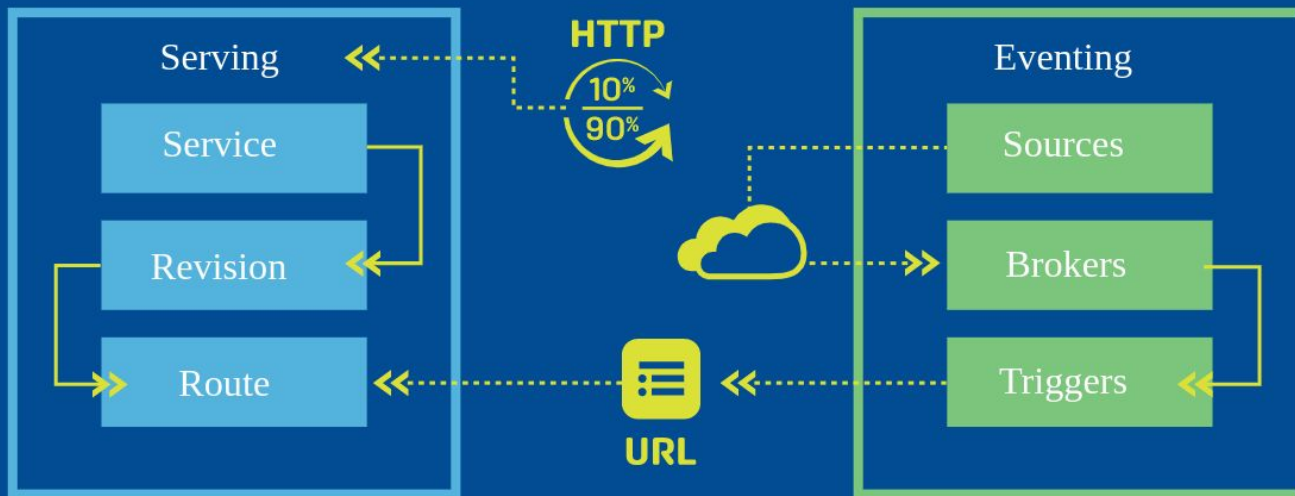
The maturity and benefits of Serverless are recognized industry wide and it adds the missing parts to make pattern suitable for general purpose workloads and used on the enterprise.

- Basic state handling
- **Enterprise Integration Patterns**
- Advanced Messaging Capabilities
- **Blended with your PaaS**
- Enterprise-ready event sources
- **Solutions and outcome focused**



Knative Components

Knative has two main components that empower teams working with Kubernetes. Serving and Eventing work together to automate and manage tasks and applications.



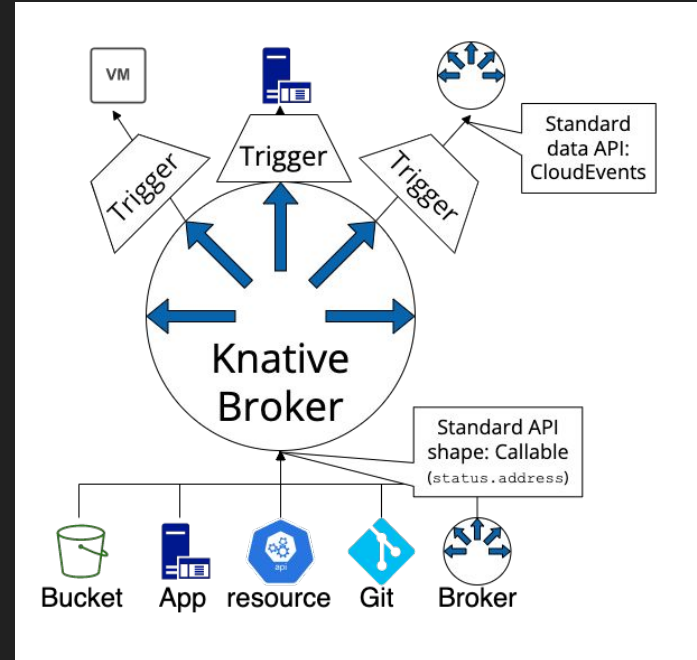
Knative Eventing



Eventing is a set of APIs for routing events from **Producers** to **Consumers** (known as **Sinks**)

CloudEvent specification

allows for the creation of Serverless components that are driven by Event rather than Traffic



CloudEvents



cloudevents

CNCF graduated project - <https://cloudevents.io/>

Provides a **common event schema**
=> **Interoperability, portability**

Extensible through extension attributes

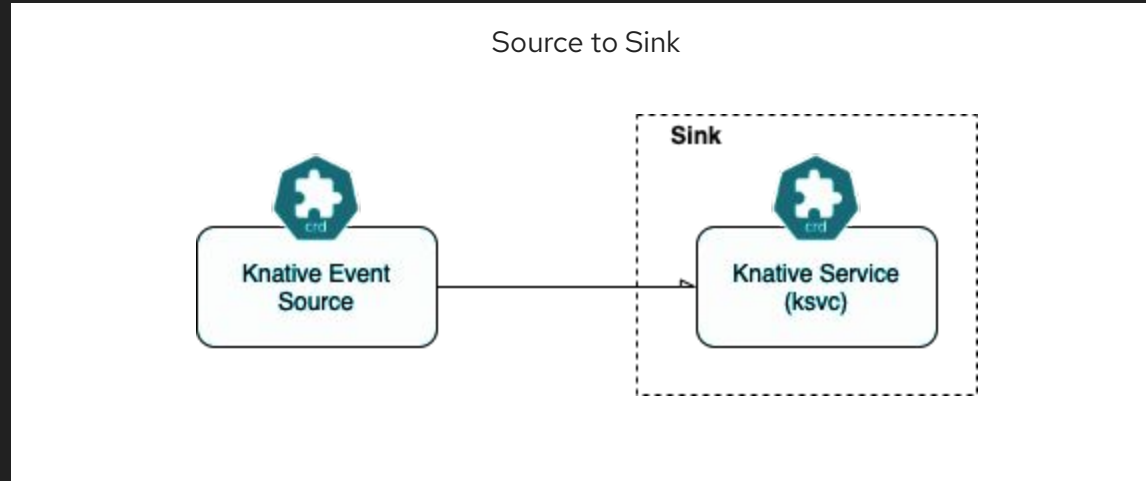
SDKs for different programming languages

Protocol-agnostic (HTTP, AMQP, MQTT, ...)

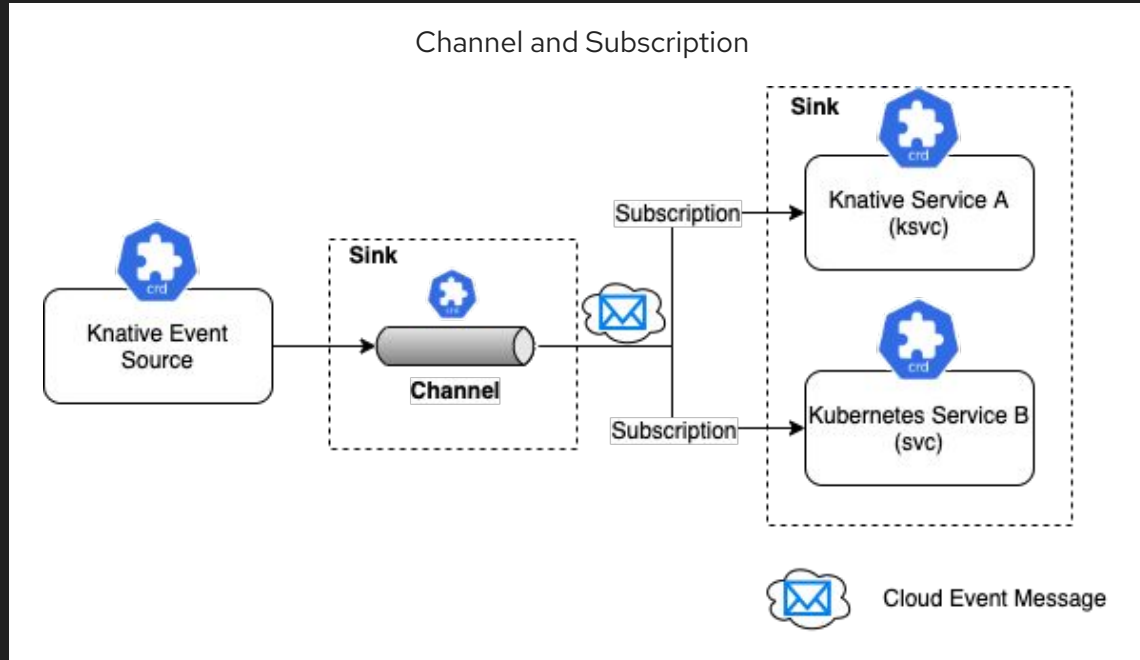
Wide adoption



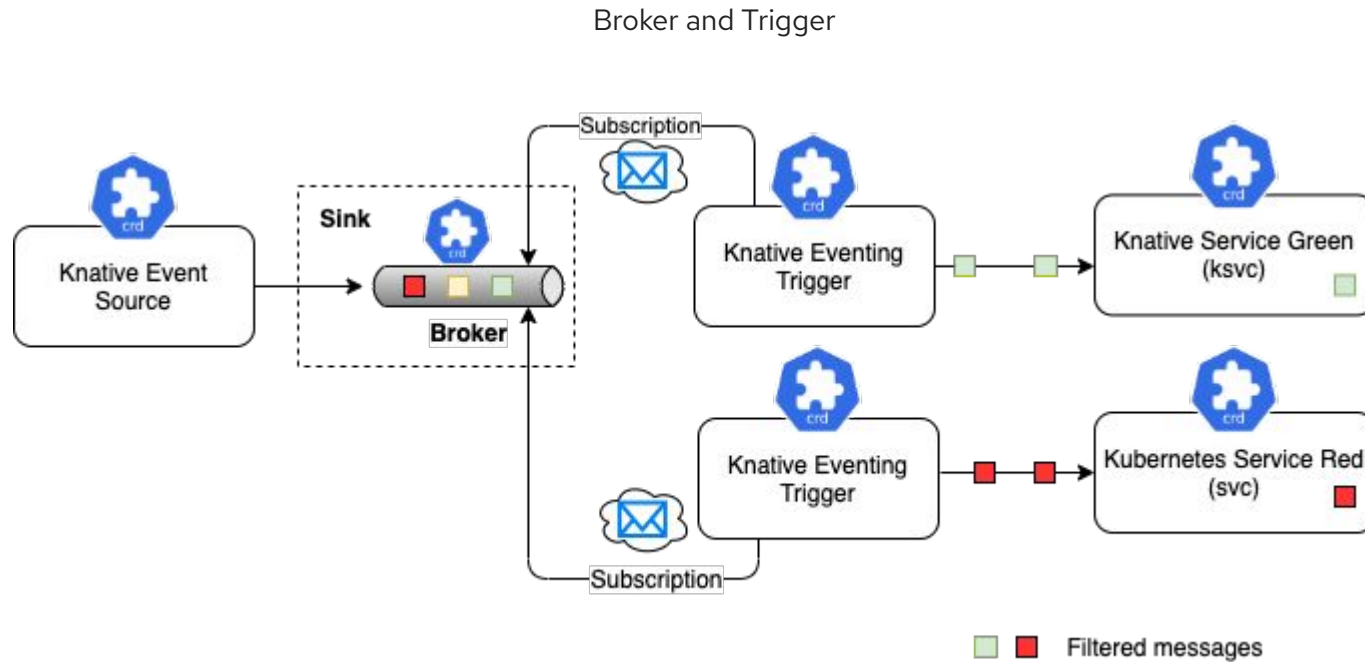
Usage Patterns



Usage Patterns



Usage Patterns

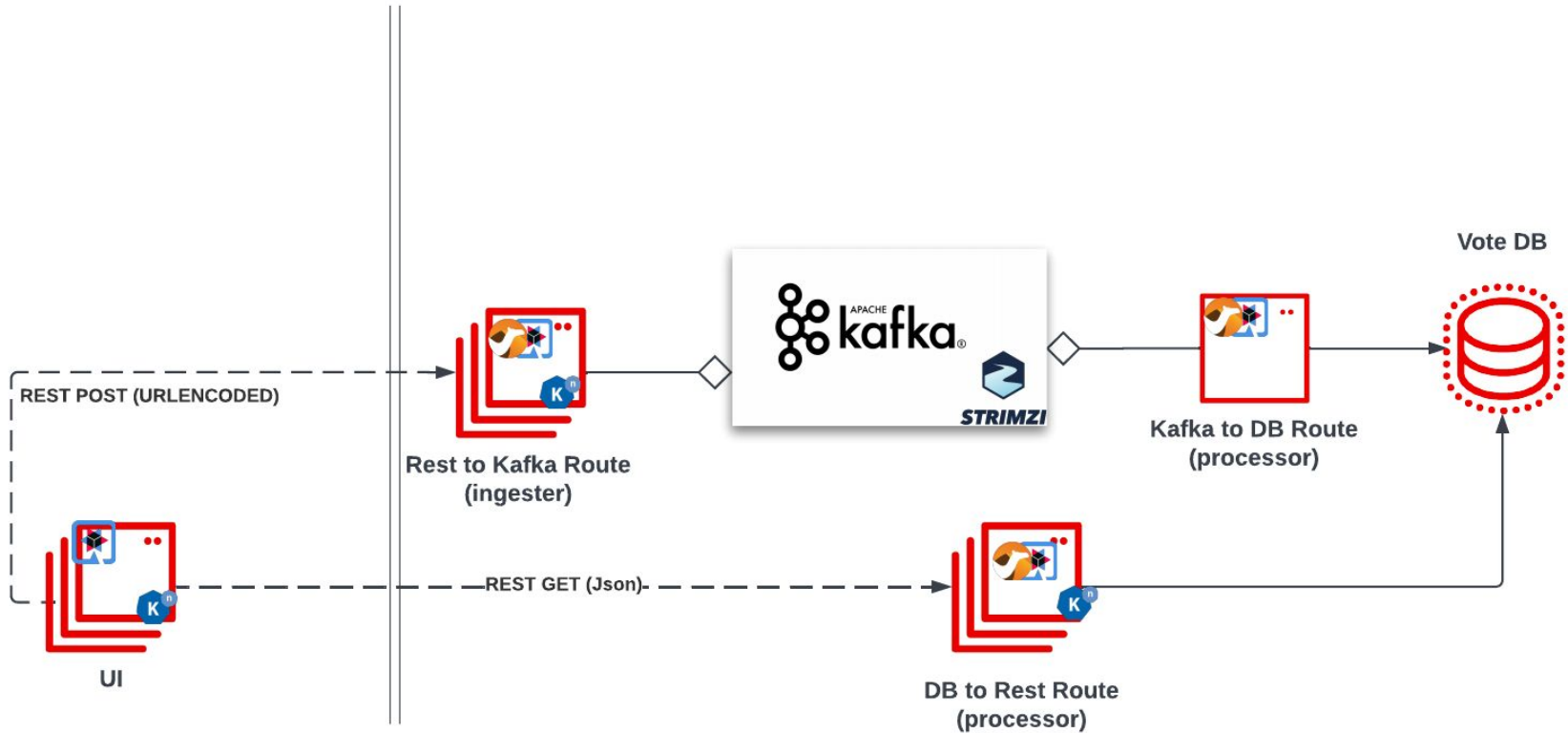




Who wins?

Position	Name	Count	
1	Intellij	1	Vote for Intellij!
2	VScode	1	Vote for VScode!
3	Eclipse	0	Vote for Eclipse!
4	Vim	0	Vote for Vim!
5	Other	0	Vote for Other!
6	Openshift Dev Spaces	0	Vote for Openshift Dev Spaces!

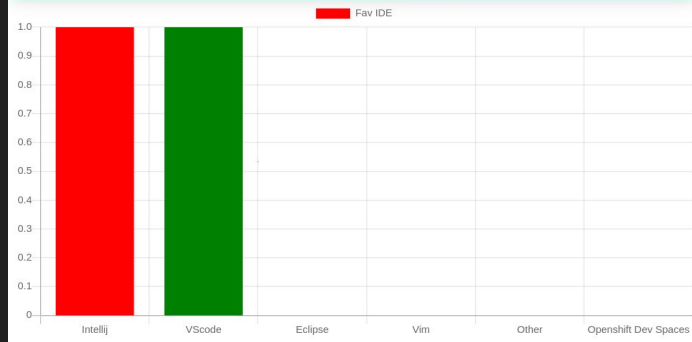






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5	Other	0	Vote for Other!
6	Openshift Dev Spaces	0	Vote for Openshift Dev Spaces!



github.com/kdubois/CamelQuarkusVoter

@kevindubois

Serverless + AI ?

<https://knative.dev/docs/about/case-studies/deepc/>

@kevindubois

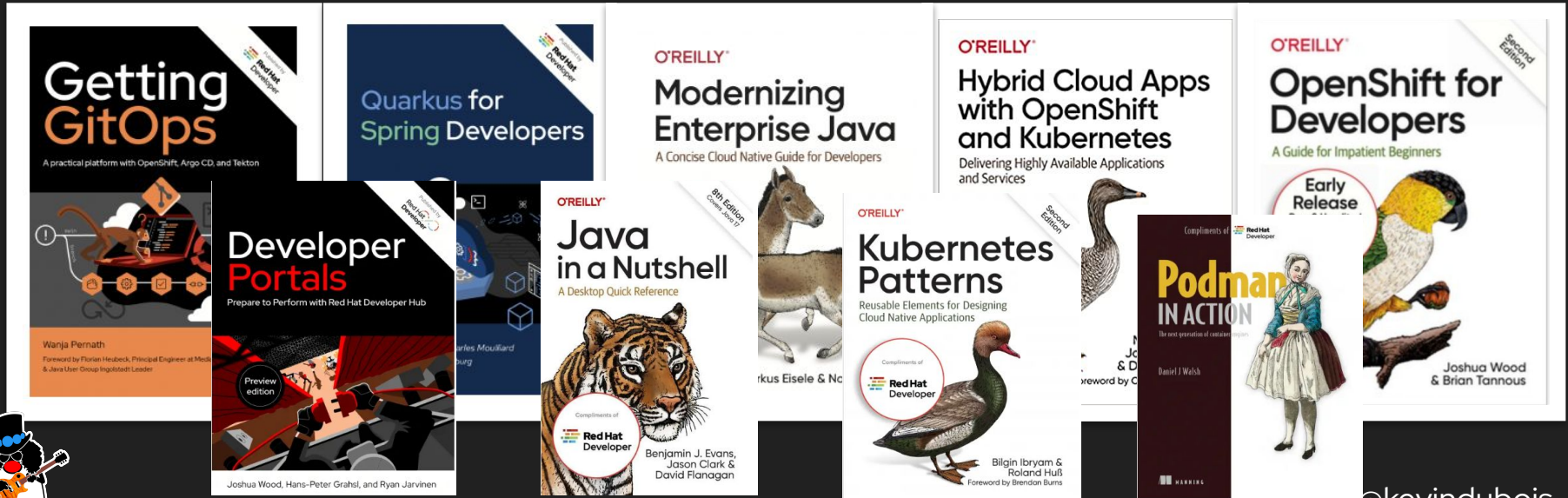
Wrapping it up...

- Cloud providers offer a LOT of cool stuff
- We need to be mindful of cloud lock-in
- Serverless is much more than just FAAS
- Use Open Source when you can,
 proprietary services when you must
- If you find yourself limited by Open Source solutions,
 contribute and participate!



Free Developer e-Books & tutorials!

developers.redhat.com/eventtutorials



OpenShift Sandbox:

We changed the default deployment type to Serverless



github.com/serverless-java-in-action



github.com/kdubois/CamelQuarkusVoter



Serverless Java in Action

Kevin Dubois & Daniel Oh



Manning Early Access Program

In MEAP, you get **early access** to books and liveVideos as they're being created. You get new content as it's available and the finished product the instant it's ready.



Thank you!



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