Building serverless applications with IBM Cloud Functions

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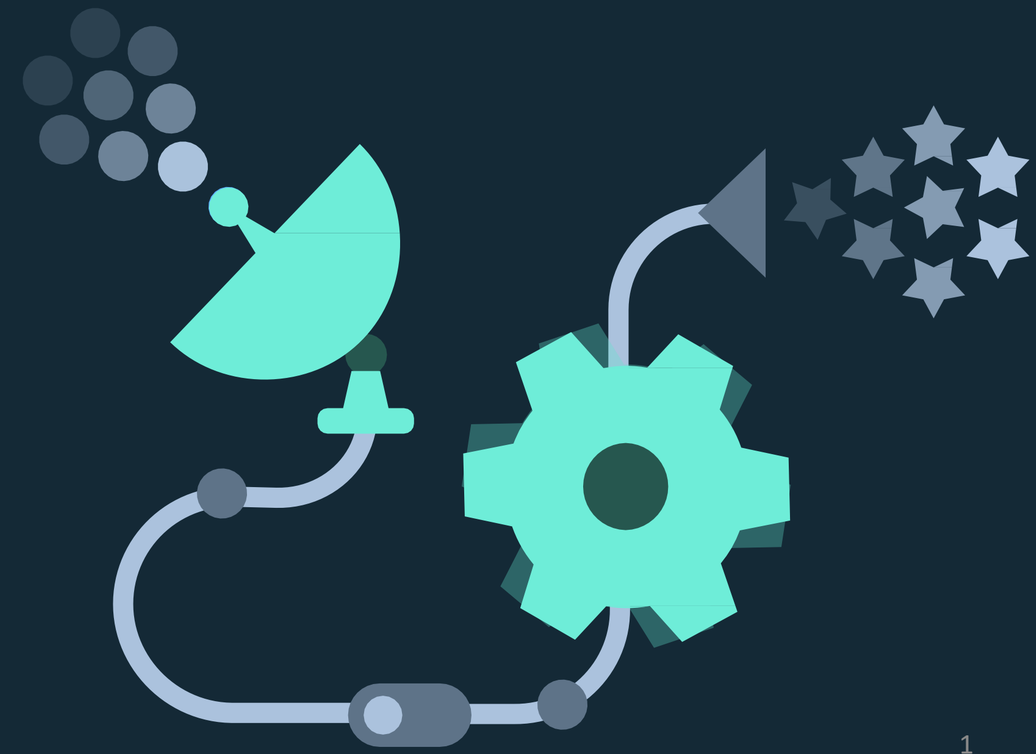
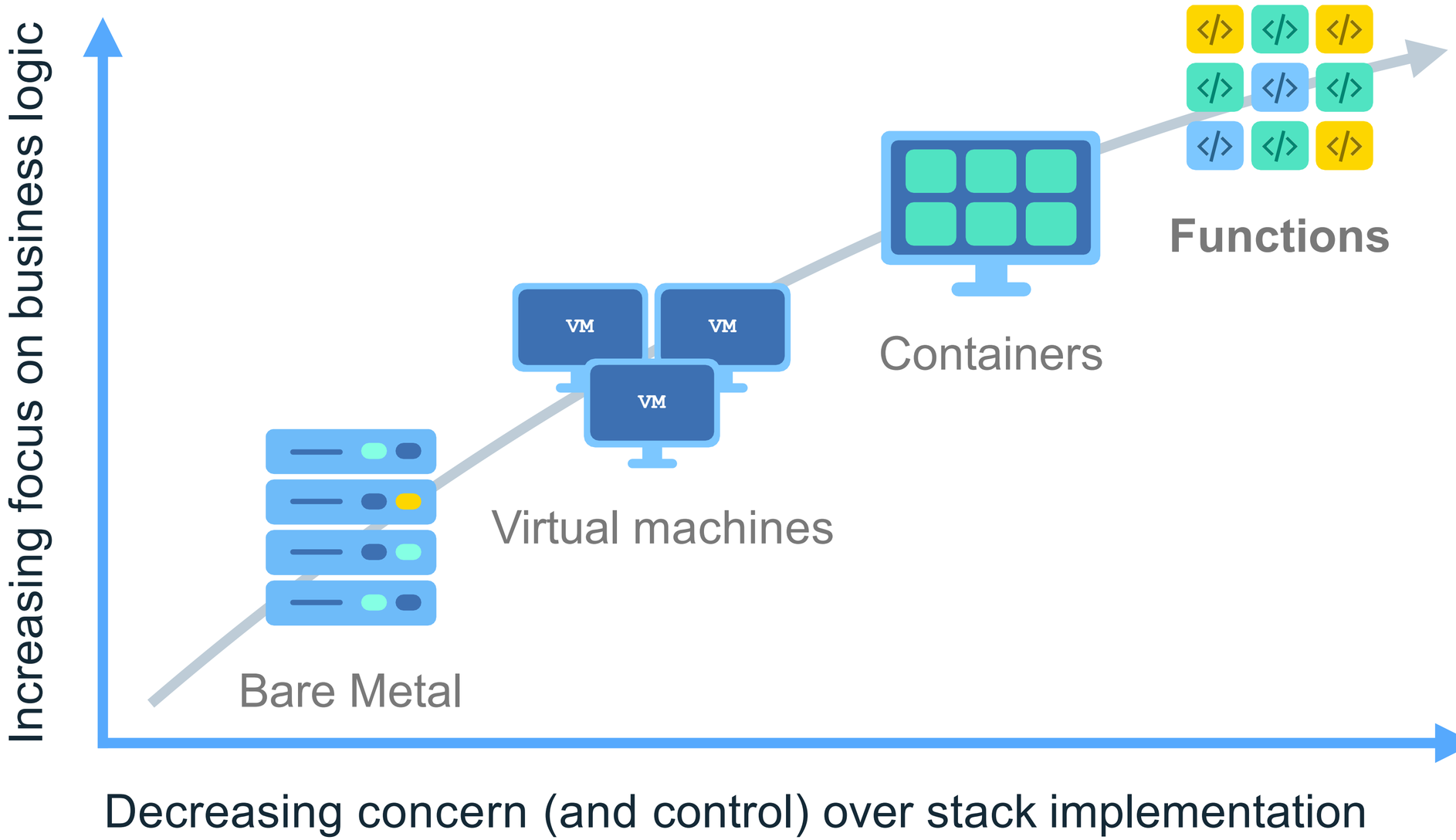
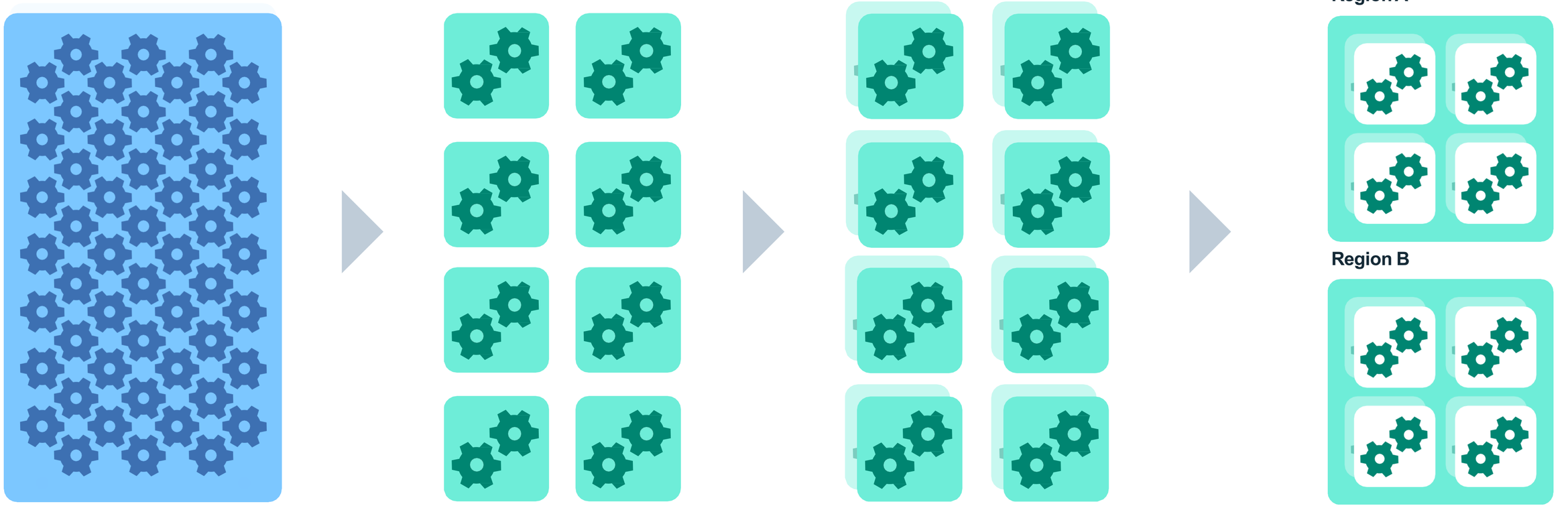


Serverless developers focus more on code, less on infrastructure



Microservices can be hard to manage at scale



Monolithic Application

Break-down into microservices

Make each microservice HA

Protect against regional outage

Emerging workloads are a good fit for event-driven programming

Execute logic in response to database change

Perform analytics on sensor input messages

Provide cognitive computing via chatbots

Schedule tasks performed for a short time

Invoke auto scaled APIs and mobile backends

Runs code **only** on-demand on a per-request basis

No management and operation of **infrastructures**

Focus on developing **value-adding code** and on driving **innovations**

No servers

Just code

Traditional model

Worry about scaling

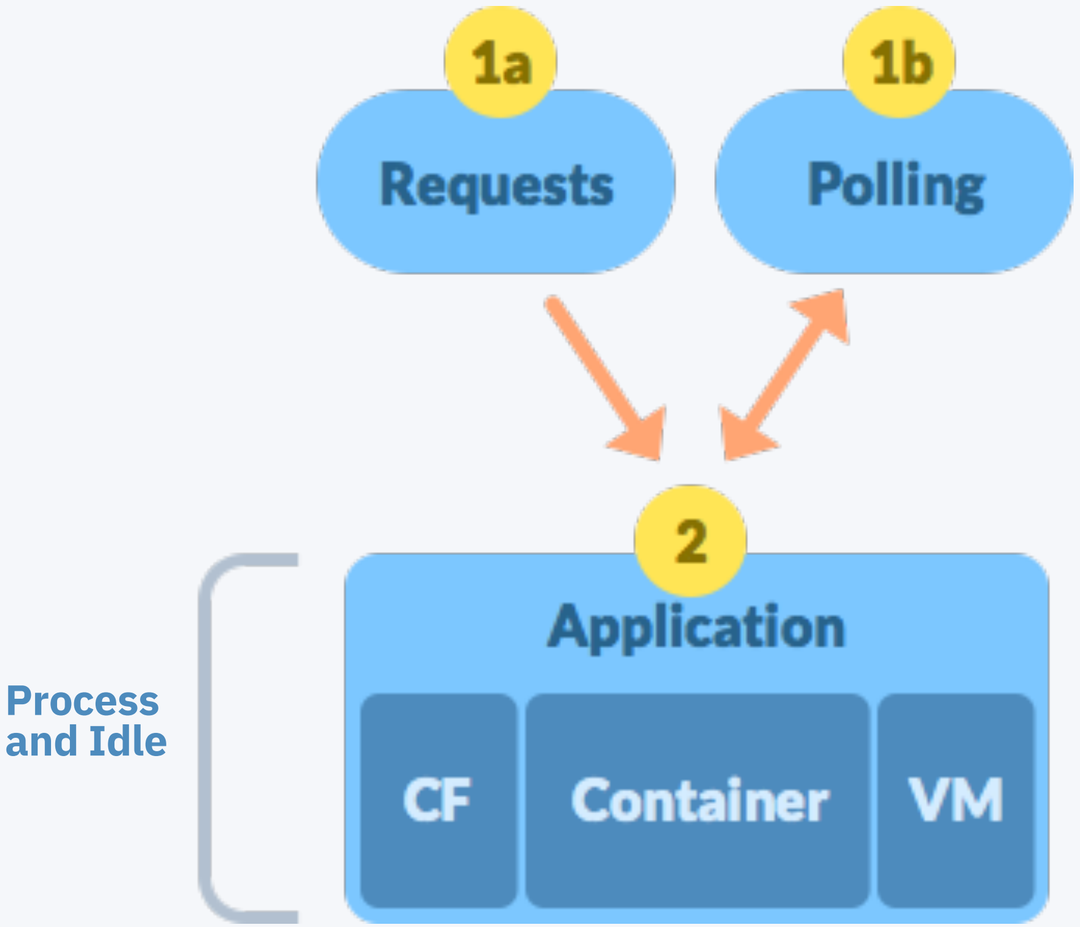
- When to scale? (mem-, cpu-, response time-, etc. driven?)
- How fast can you scale?

Worry about resiliency & cost

- At least 2 processes for HA
- Keep them running & healthy
- Deployment in multiple regions

Charged even when idling / not 100% utilized

Continuous polling due to missing event programming model



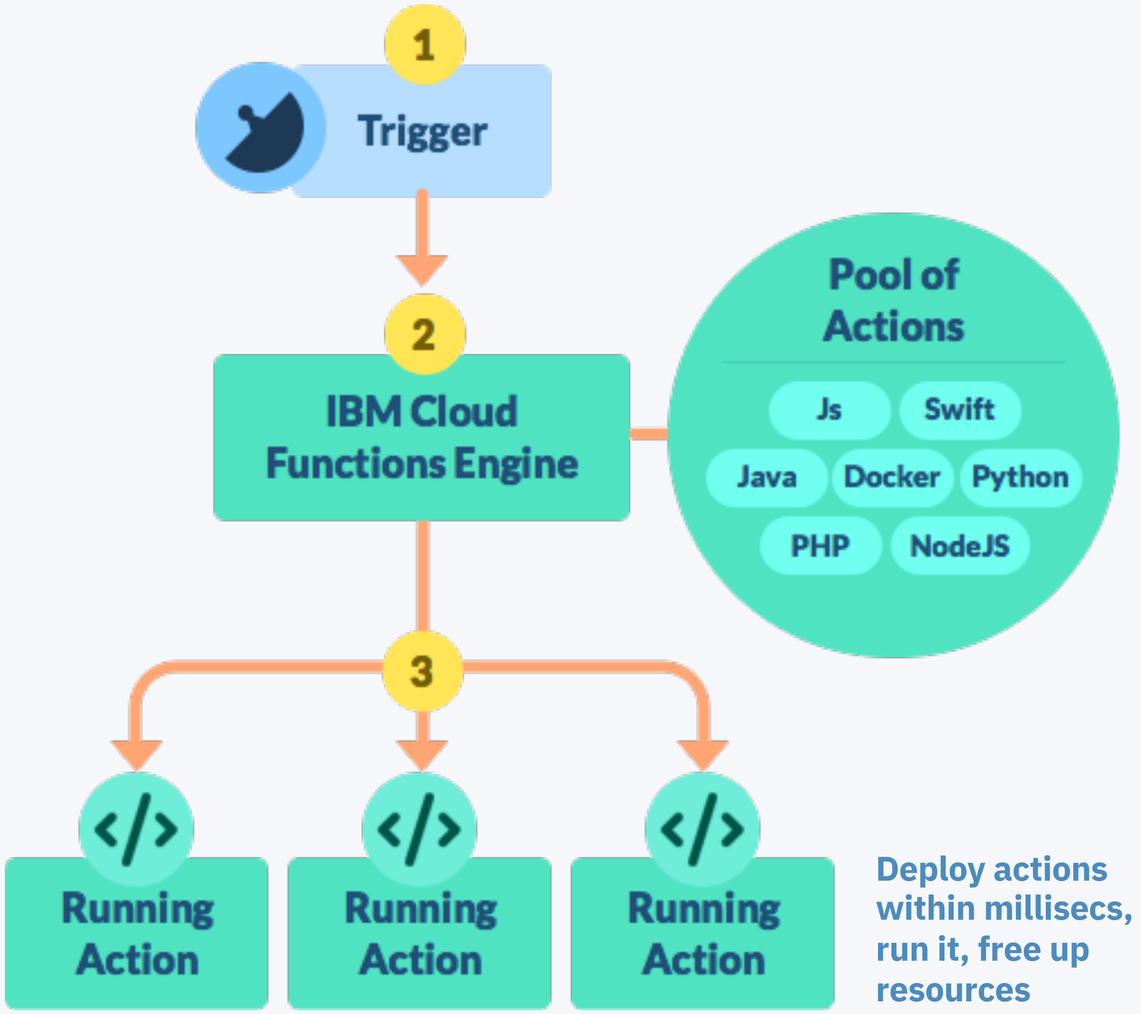
Serverless model

Scales inherently
- One process per request

No cost overhead for resiliency
- No long running process to be made HA / multi-region

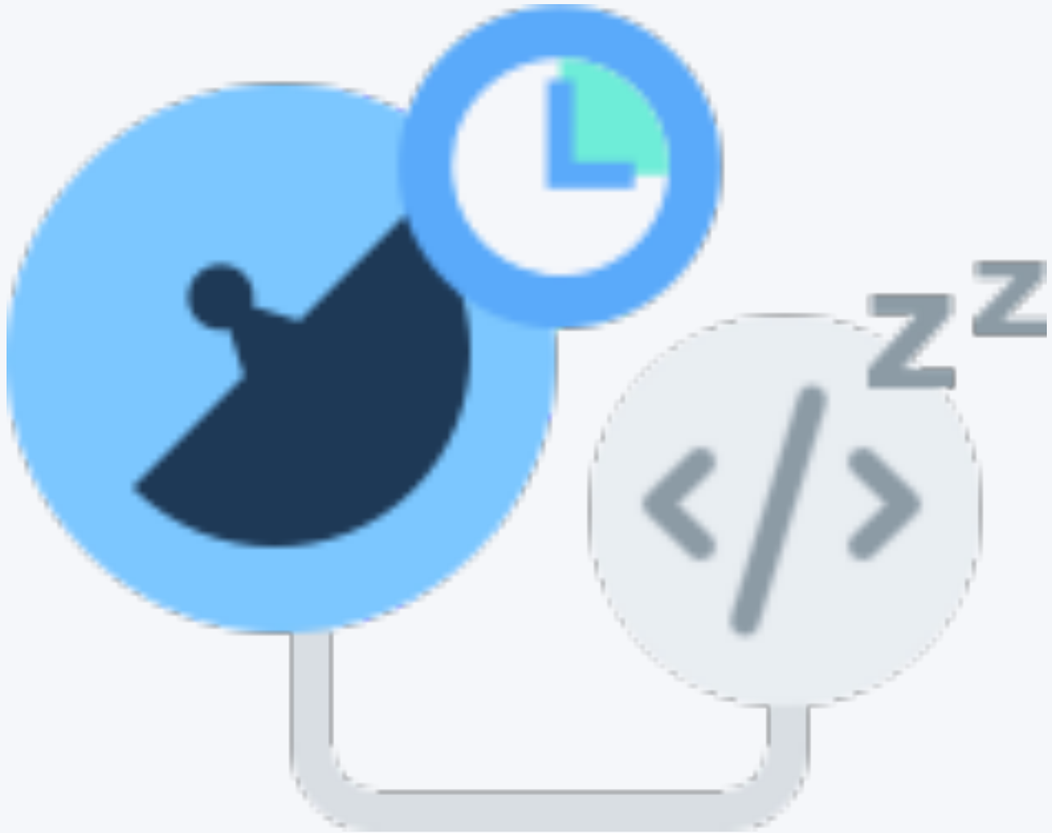
Introduces event programming model

Charges only for what is used
- Only worry about code
- Higher dev velocity, lower operational costs



Runs code **only** on-demand on a per-request basis

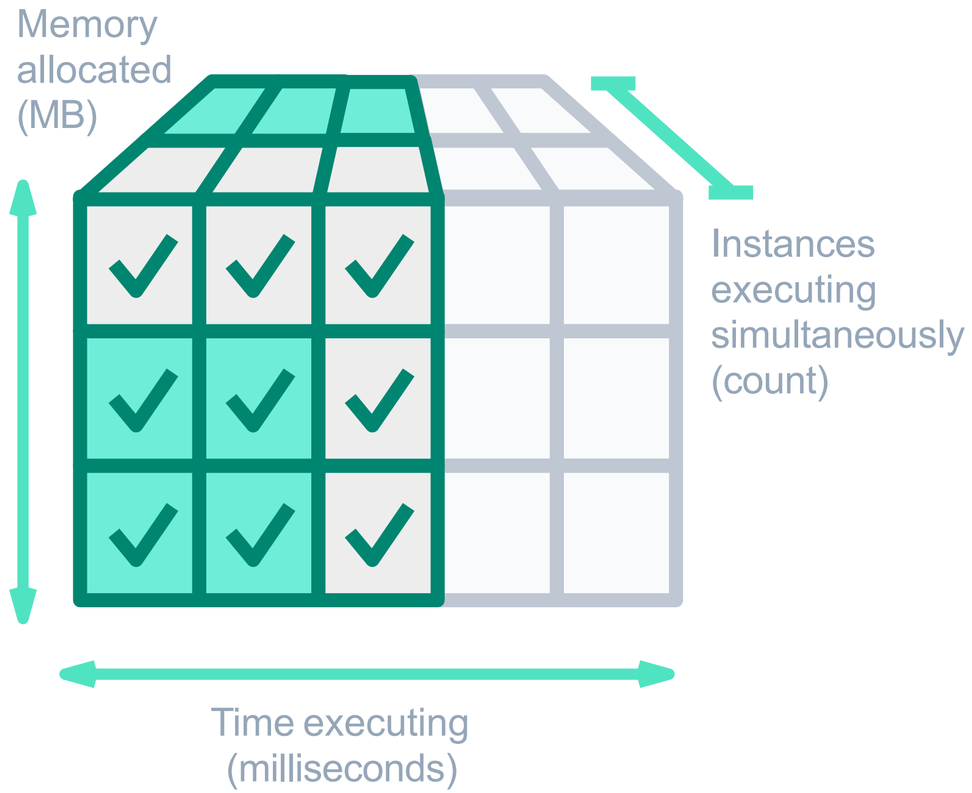
Only **pay** for resources being used, instead of resources idling around



New cost models more accurately charge for usage

Cloud resource cost better matches business value gained

Not a silver bullet, but this can result in substantial savings for many workloads



OpenWhisk enables these serverless, event-driven workloads

OpenWhisk is an opensource cloud platform that **executes code** in **response to events**

Provides serverless deployment and operations model

Runs code only on-demand on a per-request basis

Optimized utilization, fine-grained metering at any scale

Flexible, extensible, polyglot programming model

Open source and open ecosystem

Ability to run in public, private and hybrid cloud models

Any language or binary is supported

Natively supported languages (performance-optimized)

- JS/NodeJS
- Swift
- Java
- Python
- PHP
- Ruby
- Go
- .NET

Executable binaries & any other application or language via Containers

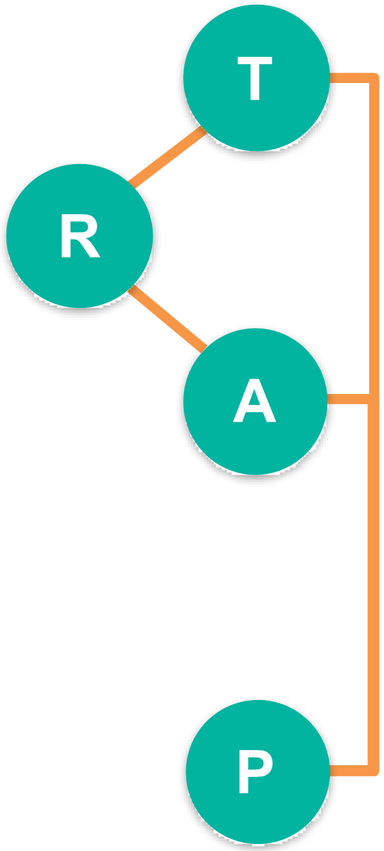
- Docker
- Rust
- C
- C++
- bash
- ...

Developers work with triggers, actions, rules and packages

Data sources define events they emit as **Triggers**

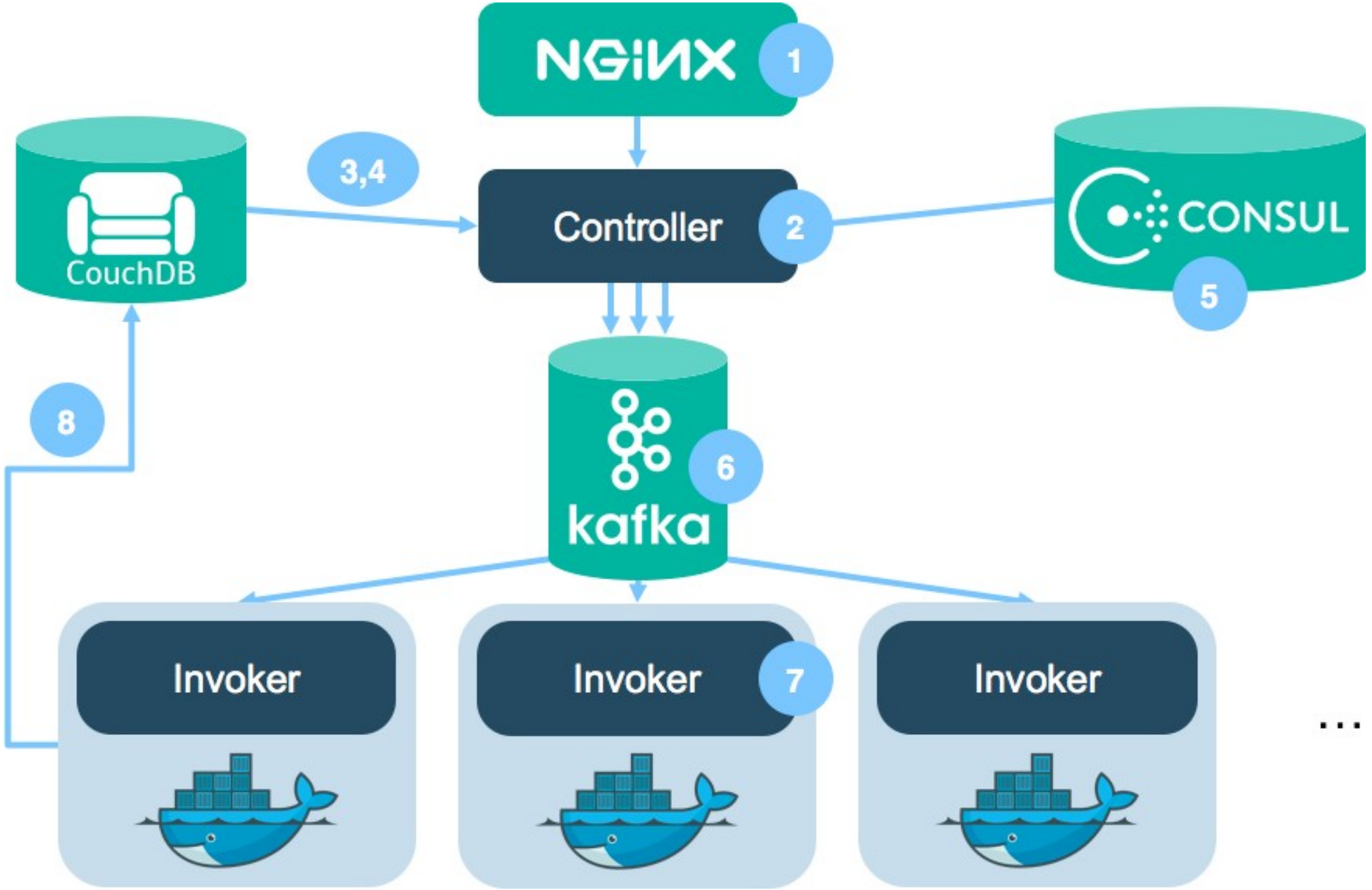
Developers map **Actions** to **Triggers** via **Rules**

Packages provide integration with external services



OpenWhisk is built on solid open source foundations

APACHE OpenWhisk™



The OpenWhisk ecosystem is growing

APACHE OpenWhisk™

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Serverless platform can address many of the 12 Factors

I	**Codebase**	Handled by developer (Manage versioning of functions themselves)
II	**Dependencies**	Handled by developer, facilitated by serverless platform (Runtimes and packages)
III	**Config**	**Handled by platform** (Environment variables or injected event parameters)
IV	**Backing services**	**Handled by platform** (Connection information injected as event parameters)
V	**Build, release, run**	**Handled by platform** (Deployed resources immutable and internally versioned)
VI	**Processes**	**Handled by platform** (Single stateless containers used)
VII	**Port binding**	**Handled by platform** (Actions or functions automatically discovered)
VIII	**Concurrency**	**Handled by platform** (Process model hidden and scales in response to demand)
IX	**Disposability**	**Handled by platform** (Lifecycle hidden from user, fast startup and elastic scale prioritized)
X	**Dev/prod parity**	Handled by developer (Developer is deployer. Scope of what differs narrower)
XI	**Logs**	**Handled by platform** (Developer writes to console.log, platform streams logs)
XII	**Admin processes**	Handled by developer (No distinction between one off processes and long running)

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Common use-cases

- Microservices / RESTful APIs
- Batch / Periodic Processing
- Operations Research / Combinatorial Optimization
- Machine Learning Models
- Blockchain Front End
- ETL Pipelines
- Chatbots
- Event Stream Processing

Serverless Application Platform

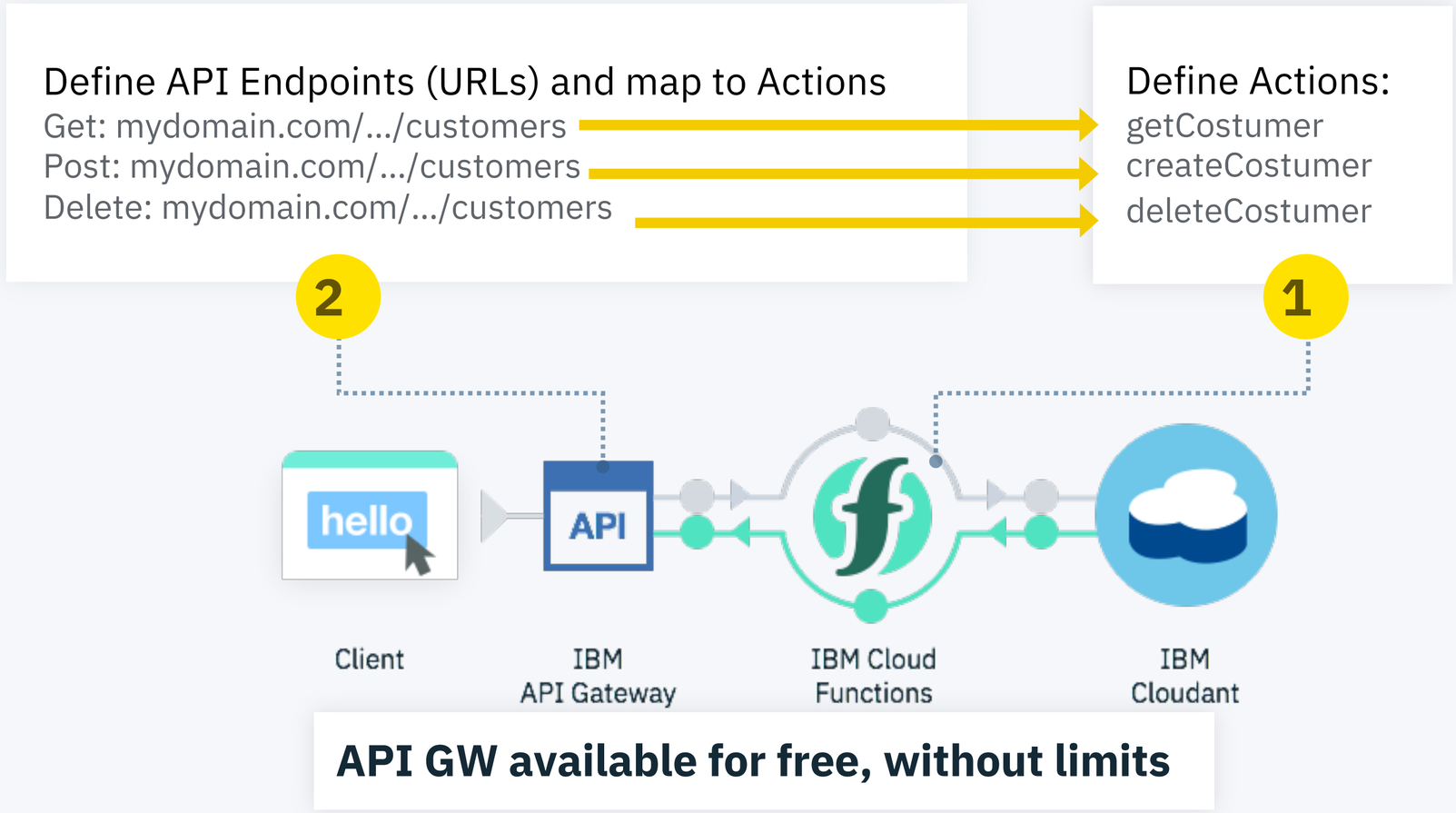
While IBM Cloud Functions is the key anchor point for serverless, there is a **growing set of services** from other domains **also delivering serverless attributes**

This enables customers to **build application topologies which are entirely serverless**

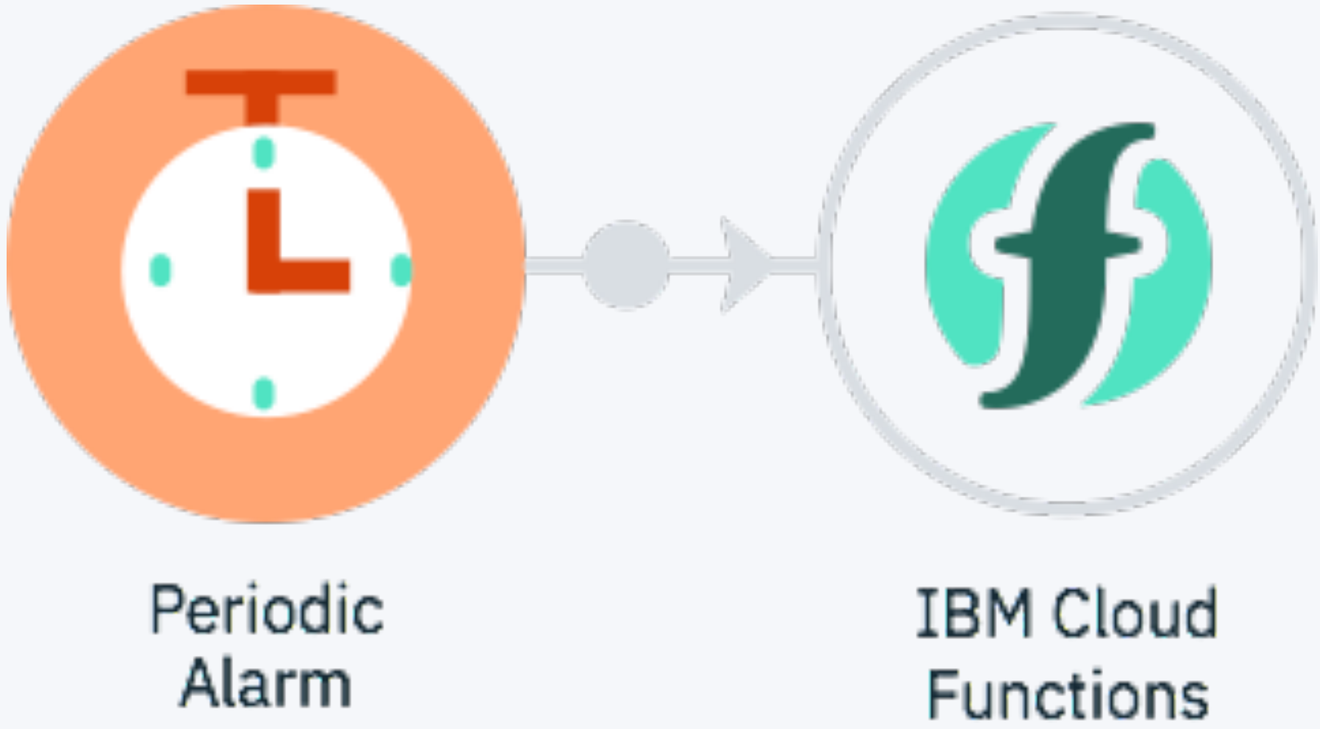
Cloud Functions | Cloudant | Object Storage | Event Streams | API Gateway | Watson services | SQL service

Microservices/ API Backends

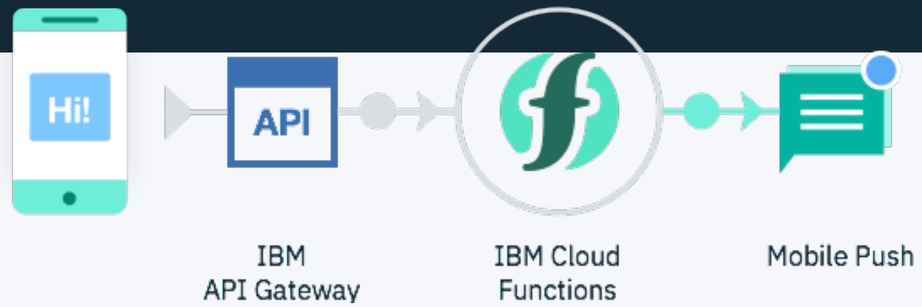
Allows to map API endpoints
to IBM Cloud Functions actions



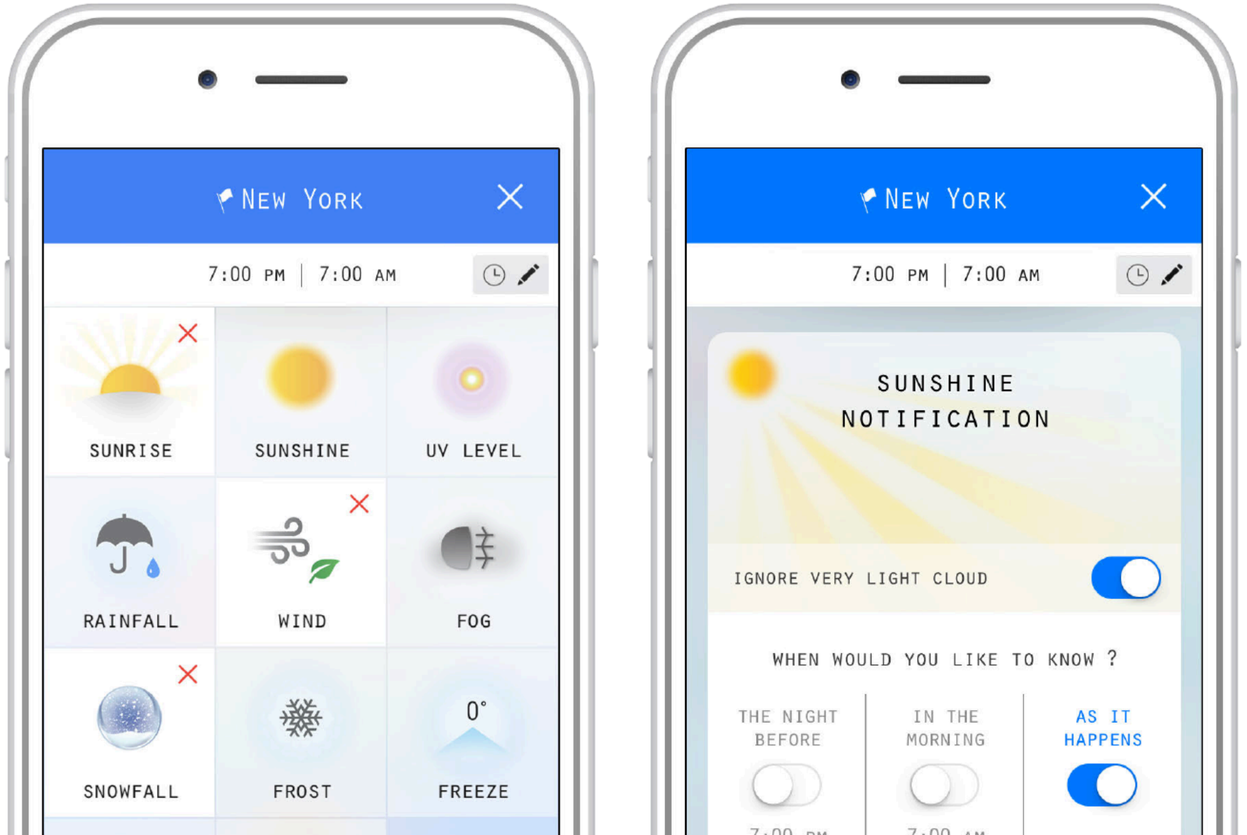
Batch / Scheduled tasks



Mobile backend

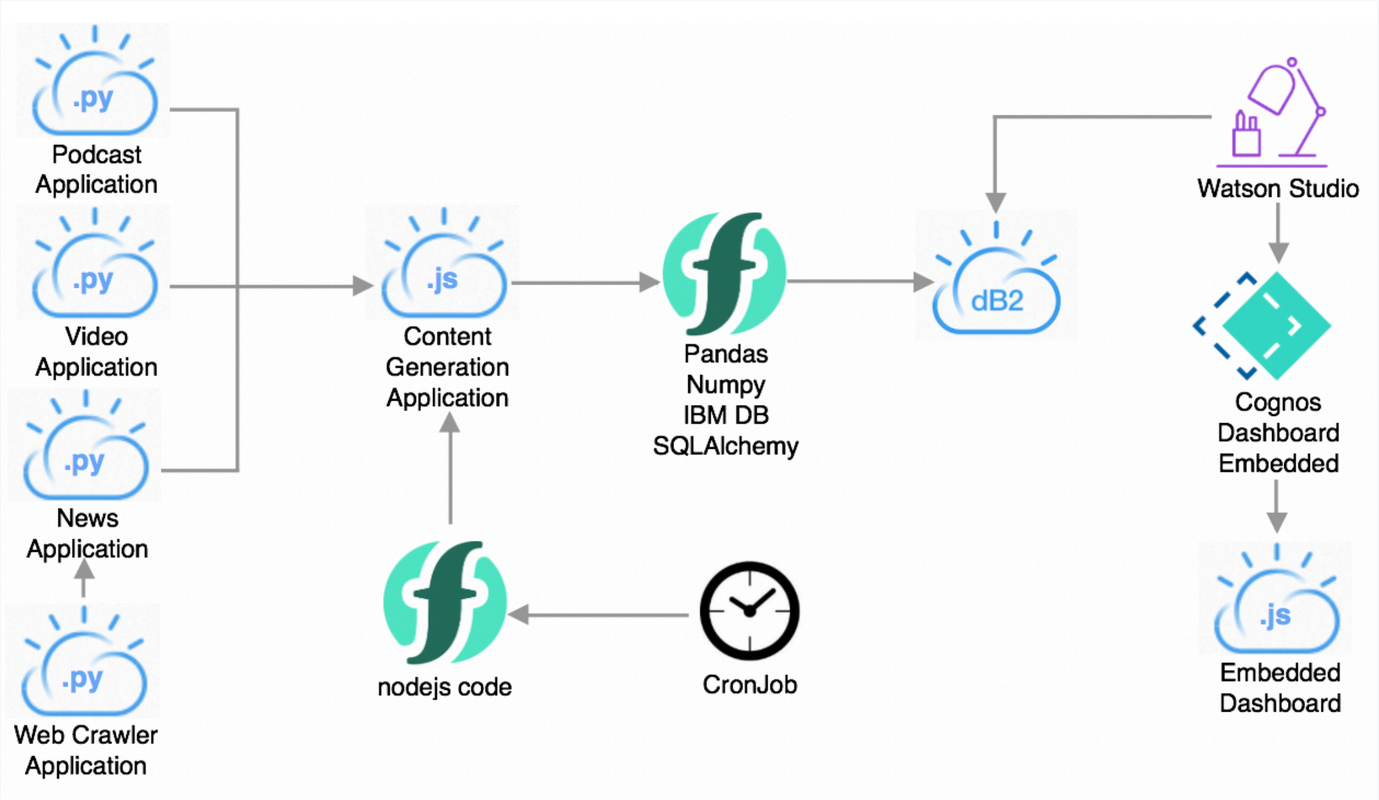


The Weather Gods
https://apps.apple.com/us/app/weather-gods/id1041512978



ESPN Fantasy Football

Cloud Functions is used to **compute the content** of user dashboards

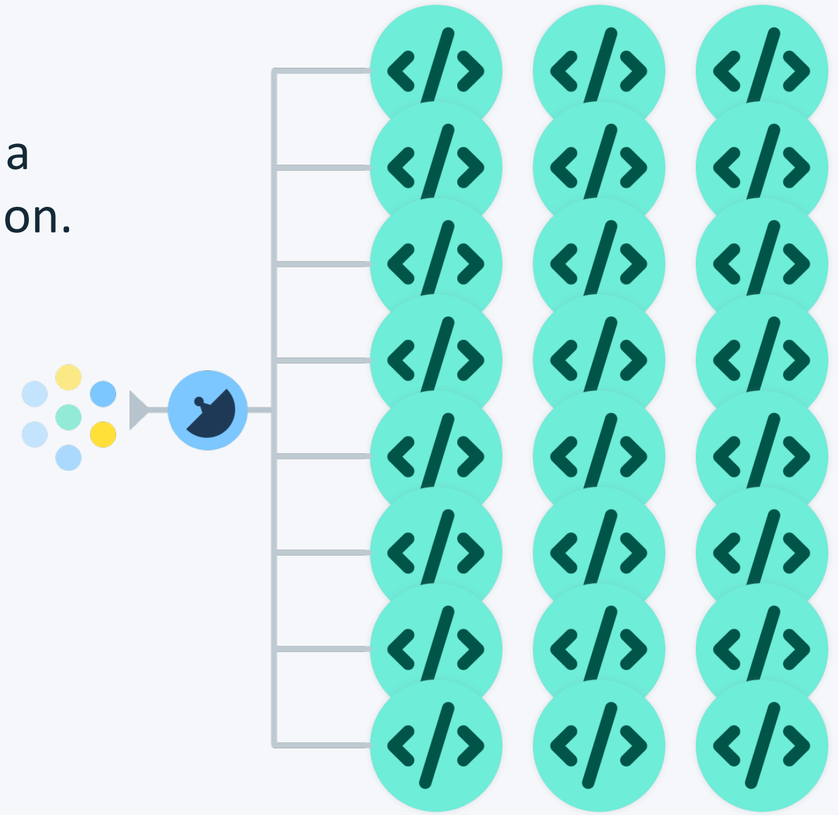


https://developer.ibm.com/articles/watson-behind-the-code-fantasy-football-2018-part7

Operations Research / Combinatorial Optimization

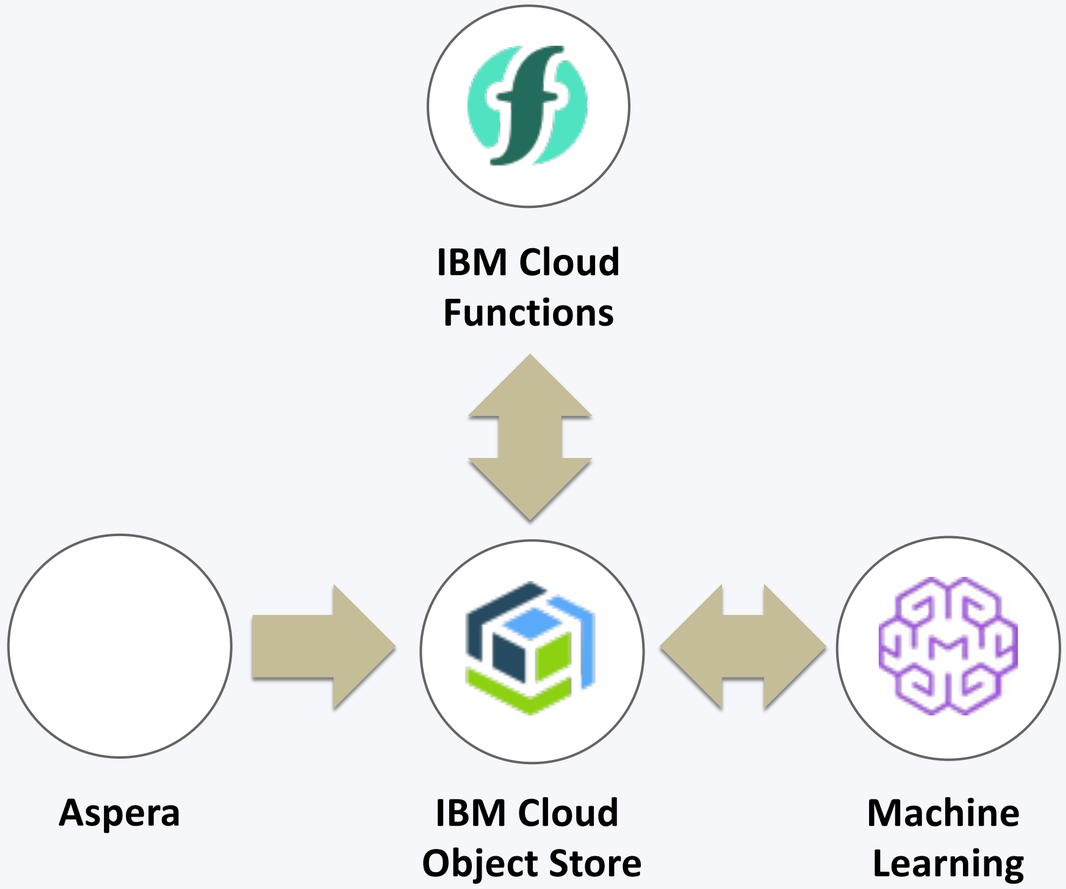
Any kind of **embarrassingly parallel task** is well-suited to be run on a serverless runtime. Each parallelizable task results in one action invocation.

- Map(-Reduce) operations
- Monte-Carlo Simulations
- Genetic Algorithms
- Hyperparameter tuning
- Web scraping
- Genome processing

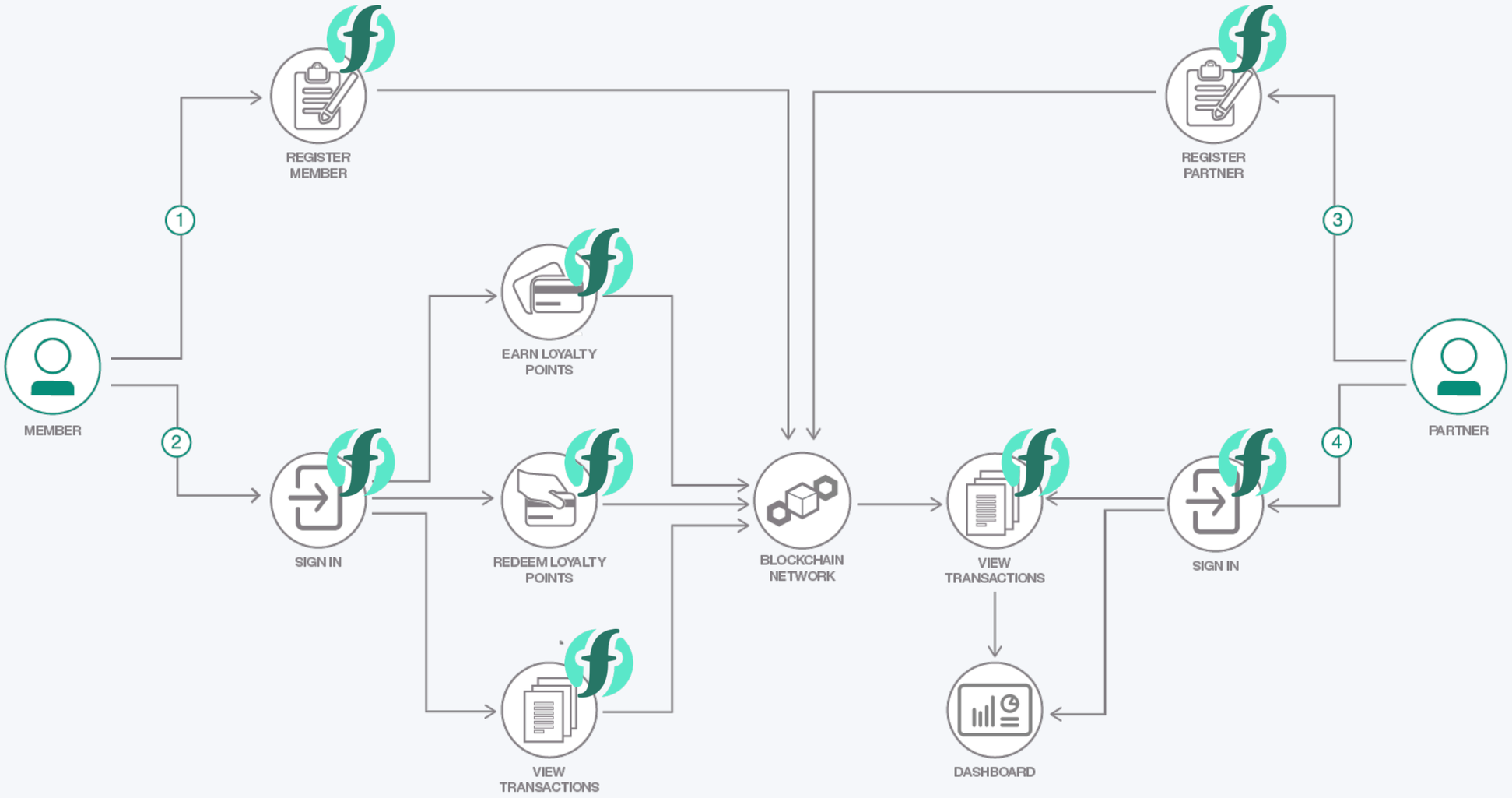


Example: Serverless AI Pipeline

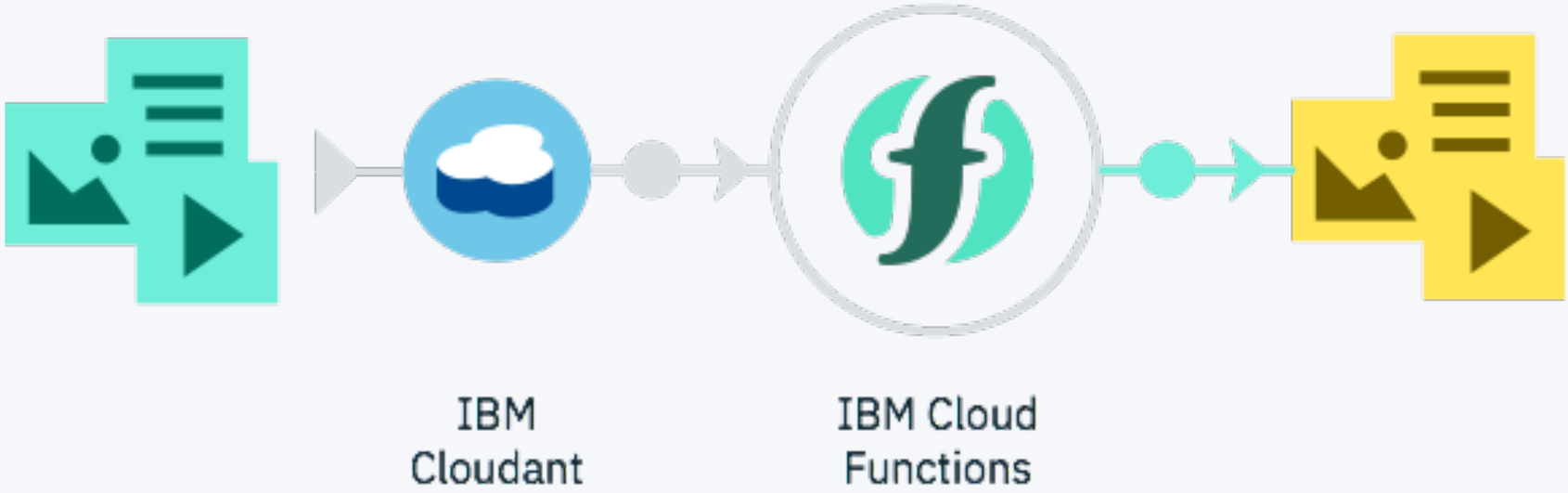
1. Serverless upload with Aspera
2. Serverless storage with COS
3. Serverless data preparation with Cloud Functions and PyWren
4. Machine learning with Watson Machine Learning



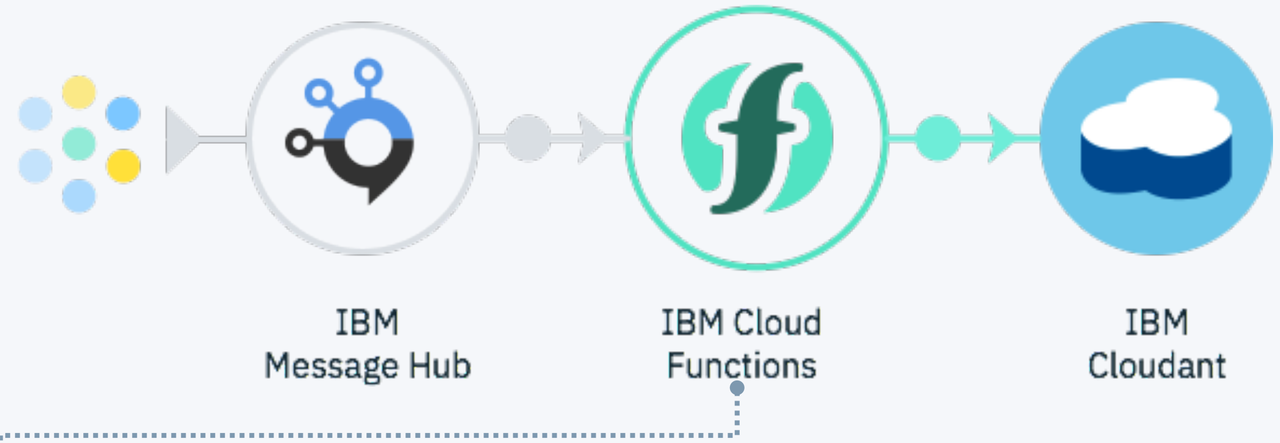
Blockchain APIs



Data-at-rest processing & ETL pipelines



Event stream processing via Message Hub



Ideally suited for working with all sorts of data stream ingestions (for validation, cleansing, enrichment, transformation, ...)

Business data streams (from other data sources)

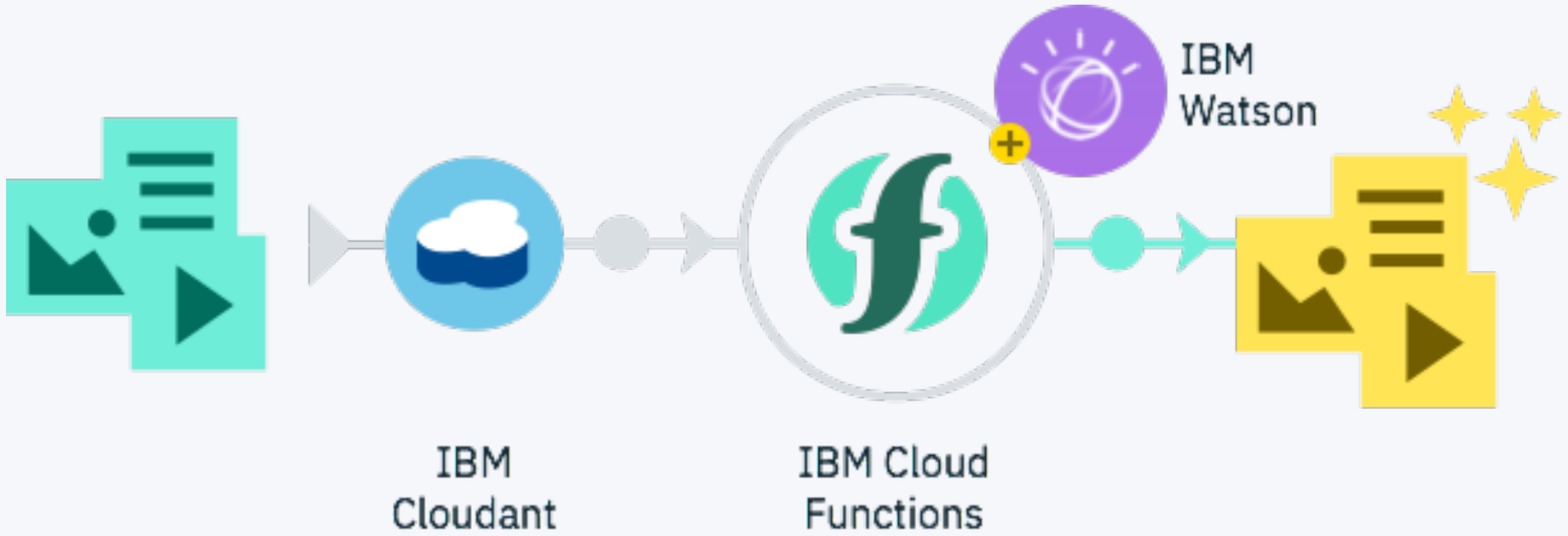
IoT sensor data

Log data

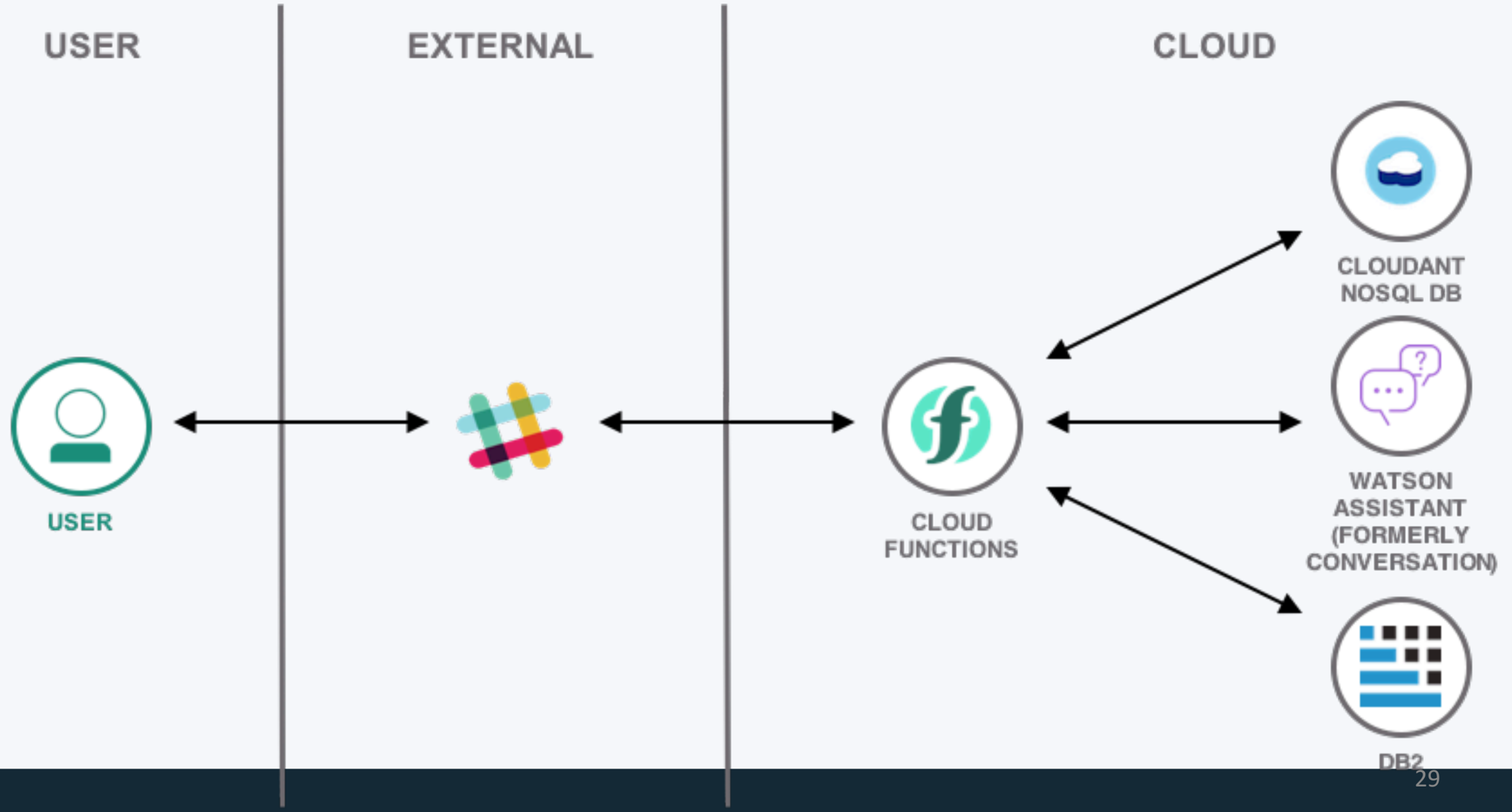
Financial (market) data

...

AI / Cognitive



Conversational applications

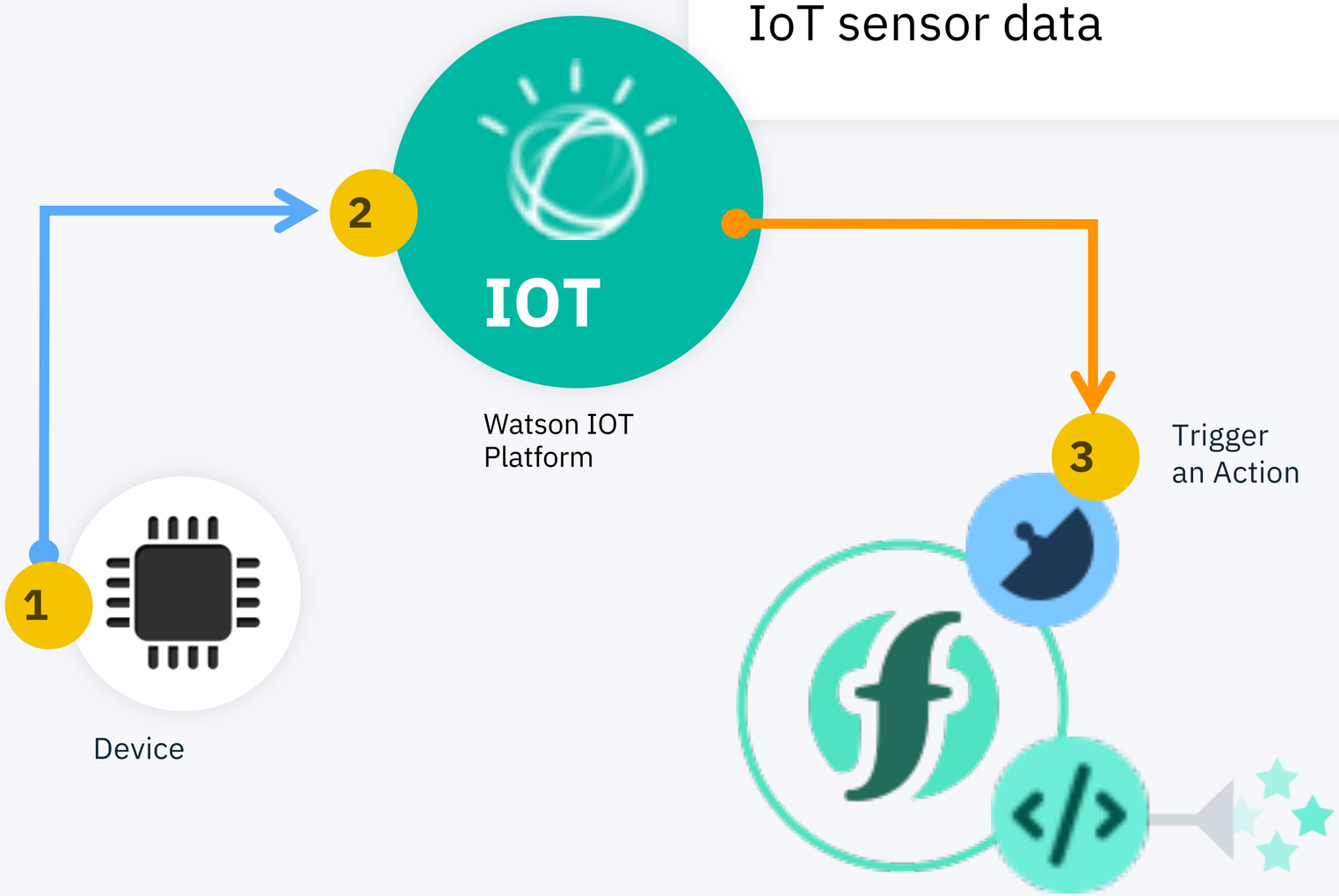


IoT

Trigger events based on IoT sensor data

Example, KONE

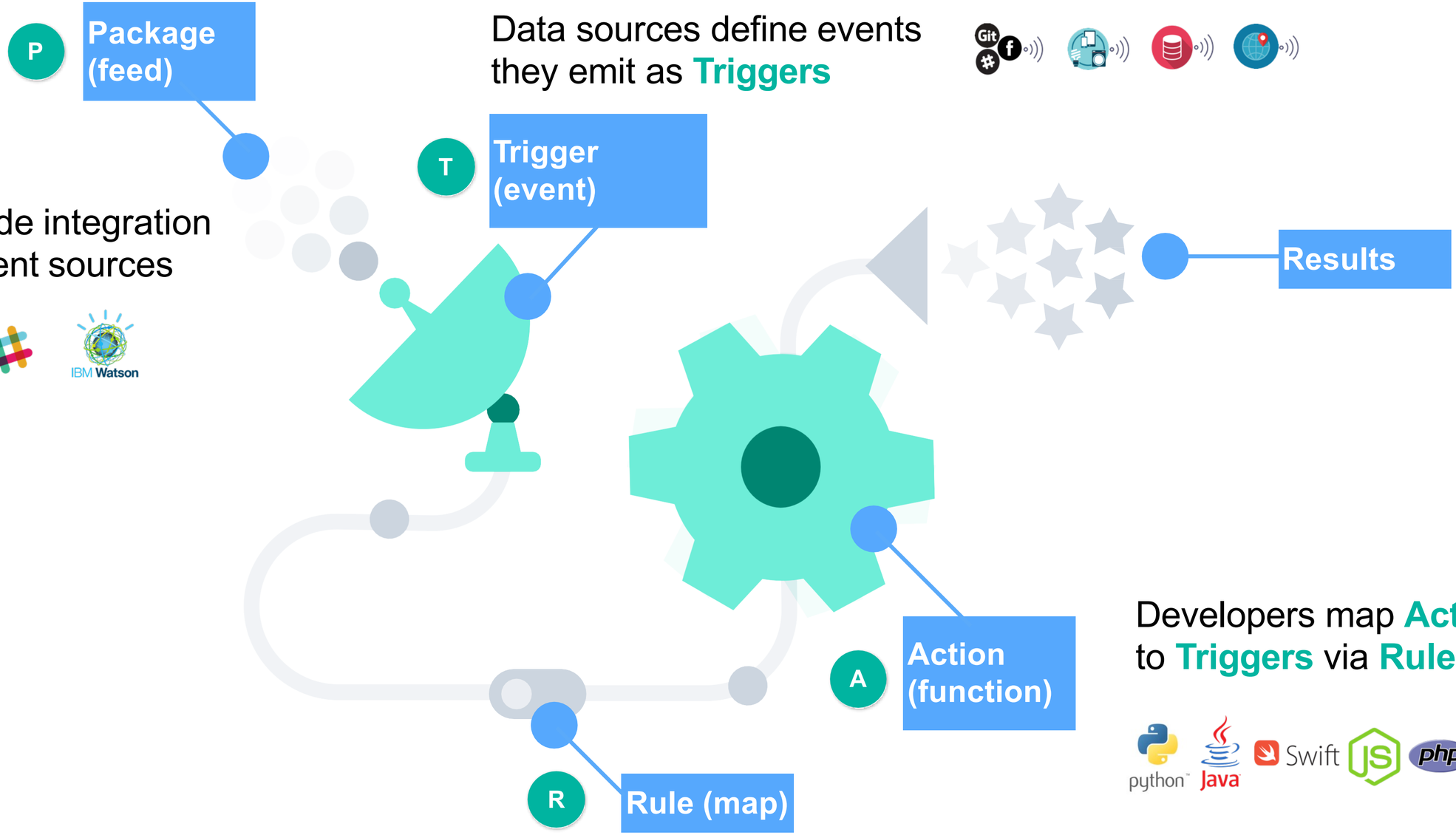
- Eliminate or reduce the time that KONE equipment goes out of service
- Sensor data from the equipment can reveal potential issues and risks before human eyes and ears can detect them
- Event-driven architecture that allocates the compute resources required to handle each incoming stream of data, automatically scaling as needed



https://www.ibm.com/cloud/blog/how-kone-uses-data-analytics-and-event-driven-maintenance-to-keep-cities-in-motion/

Apache OpenWhisk programming model

Developers work with packages, triggers, actions, and rules



Packages provide integration with external event sources

kafka · The Weather Company · IBM Watson

Developers map **Actions** to **Triggers** via **Rules**

python · Java · Swift · JS · php · docker

Triggers

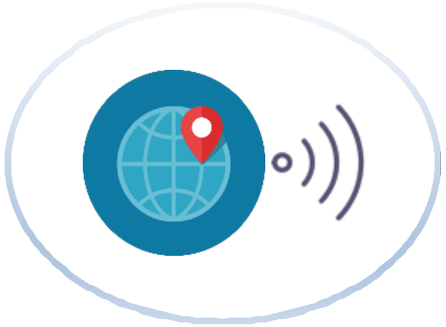
A class of events that can occur

Social events

Data changes

Device readings

User input



Location updates

Actions

A *Code that runs in response to an event (that is, an event handler)*

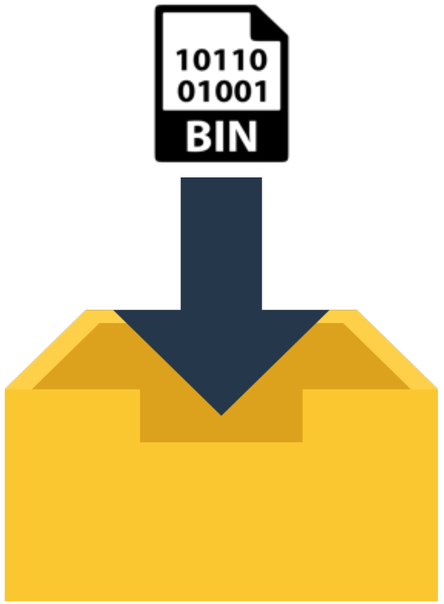
Actions

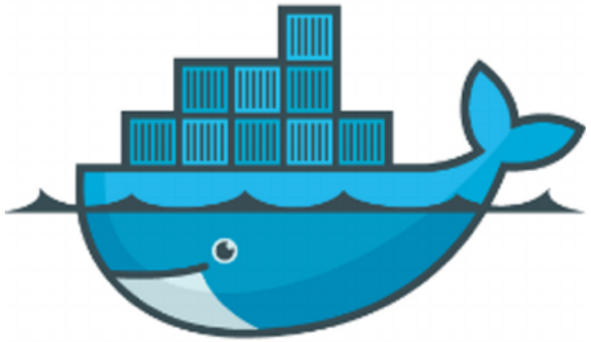
Can be written in a variety of languages, such as JavaScript, Python, Java, PHP, and Swift

```
function main(params) {
    return { message: 'Hello, ' + params.name + ' from ' + params.place };
};
```

Actions

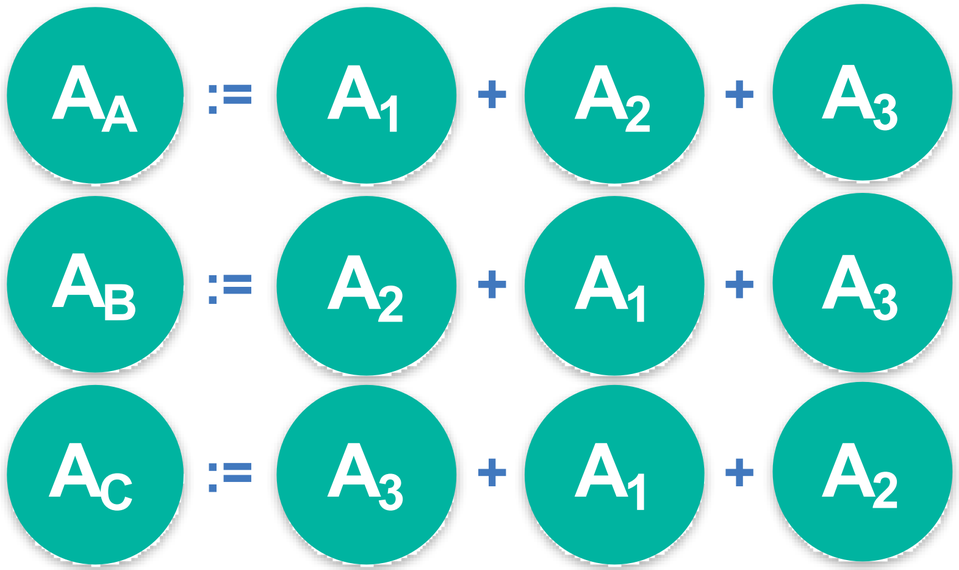
A Or any other language by packaging with Docker





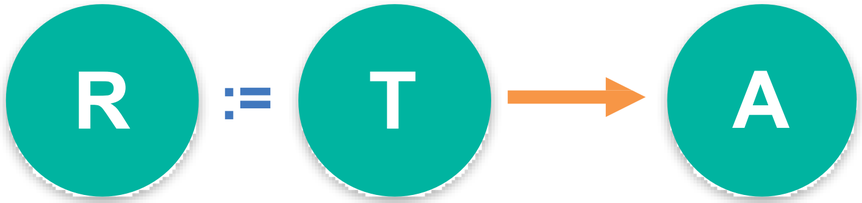
Actions

- Can be composed to create sequences that increase flexibility and foster reuse



Rules

R *An association of a trigger to an action in a many to many mapping.*



Packages

P *A shared collection of triggers and actions*

IBM

IBM Cloudant®
- A read
- A write
- T changes

IBM Watson
- A translate

The Weather Company
- A forecast

Open Source

kafka
- A post
- T topic

Third Party

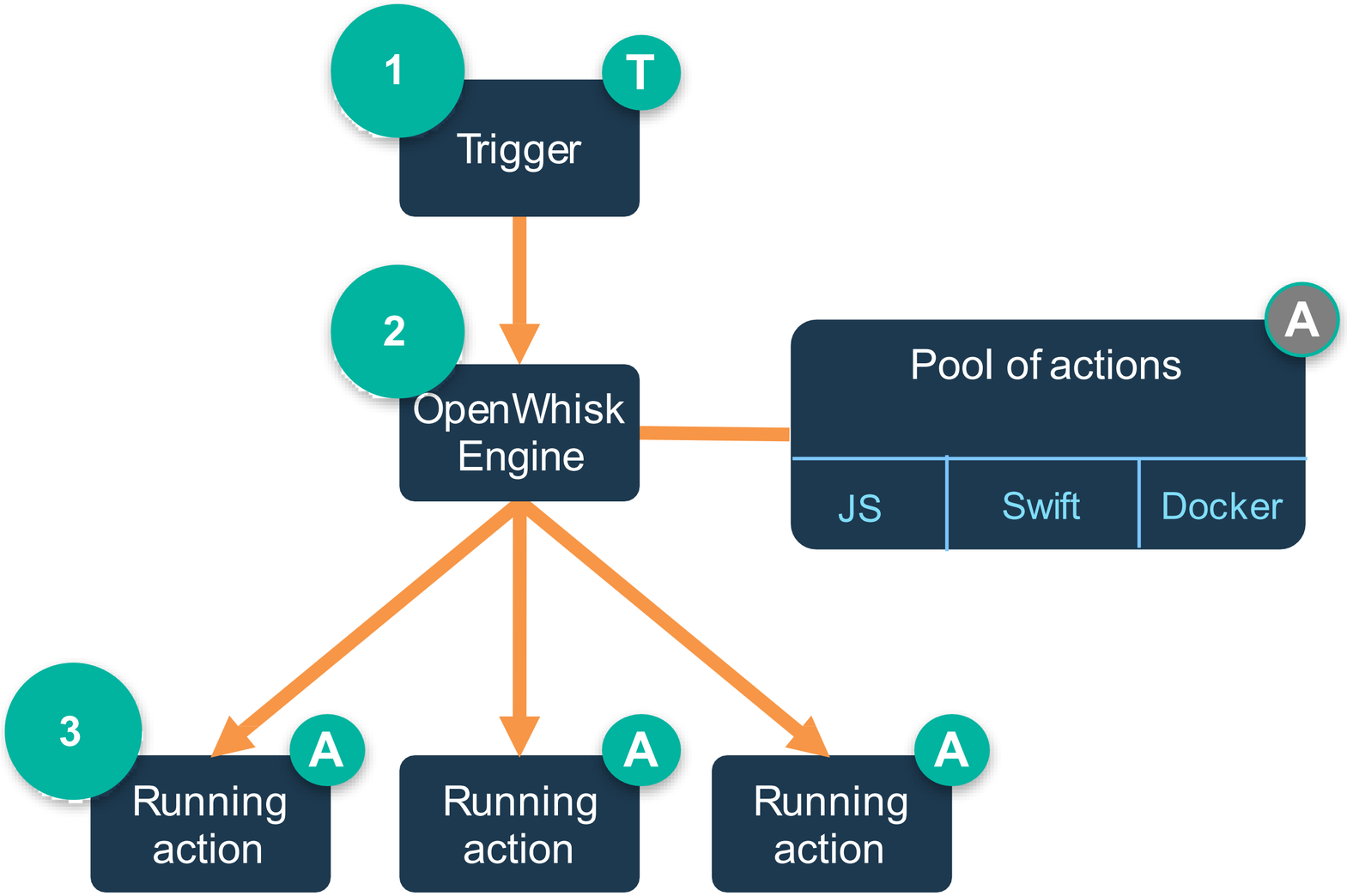
Git
- T commit

Yours

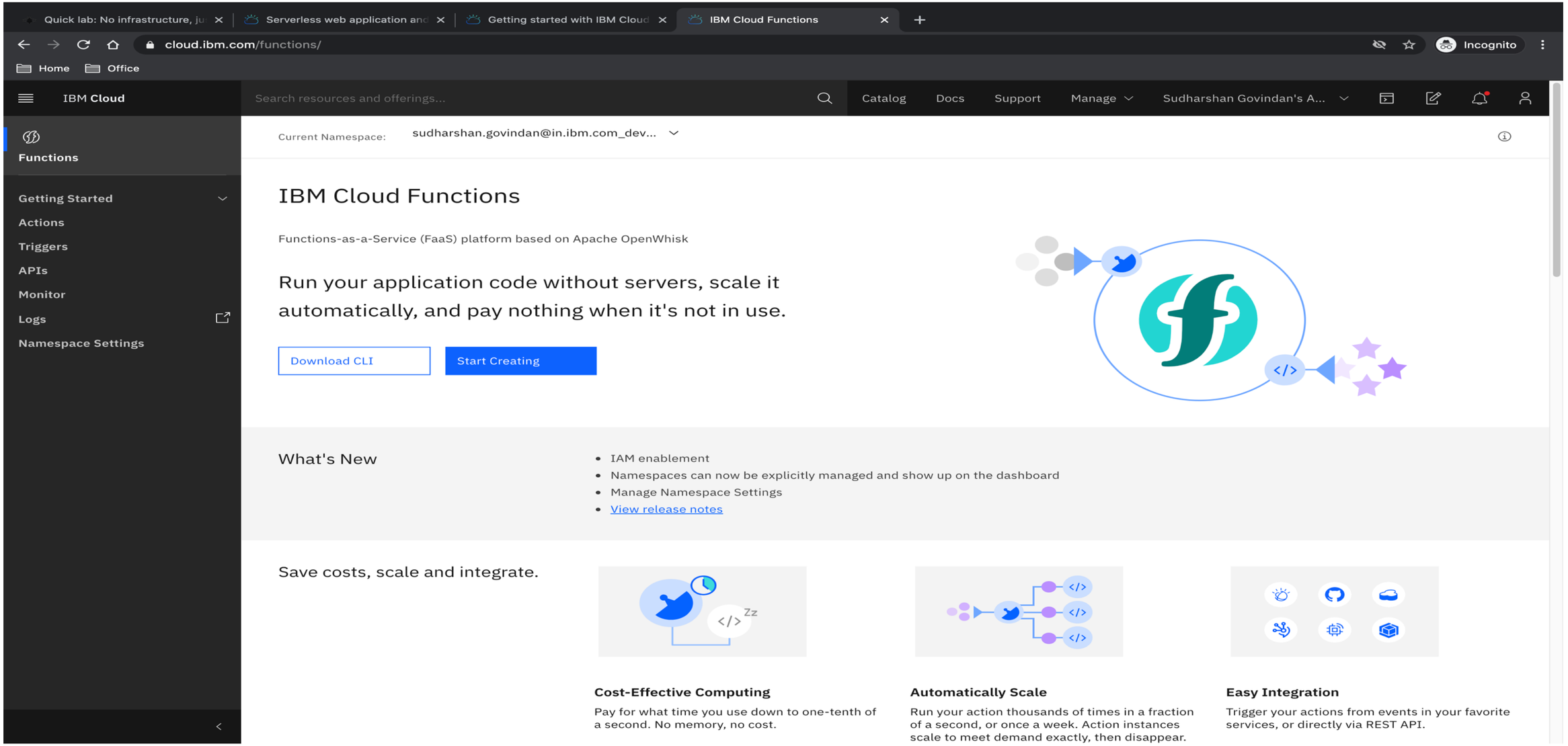

- A myAction
- T myFeed

Apache OpenWhisk in action

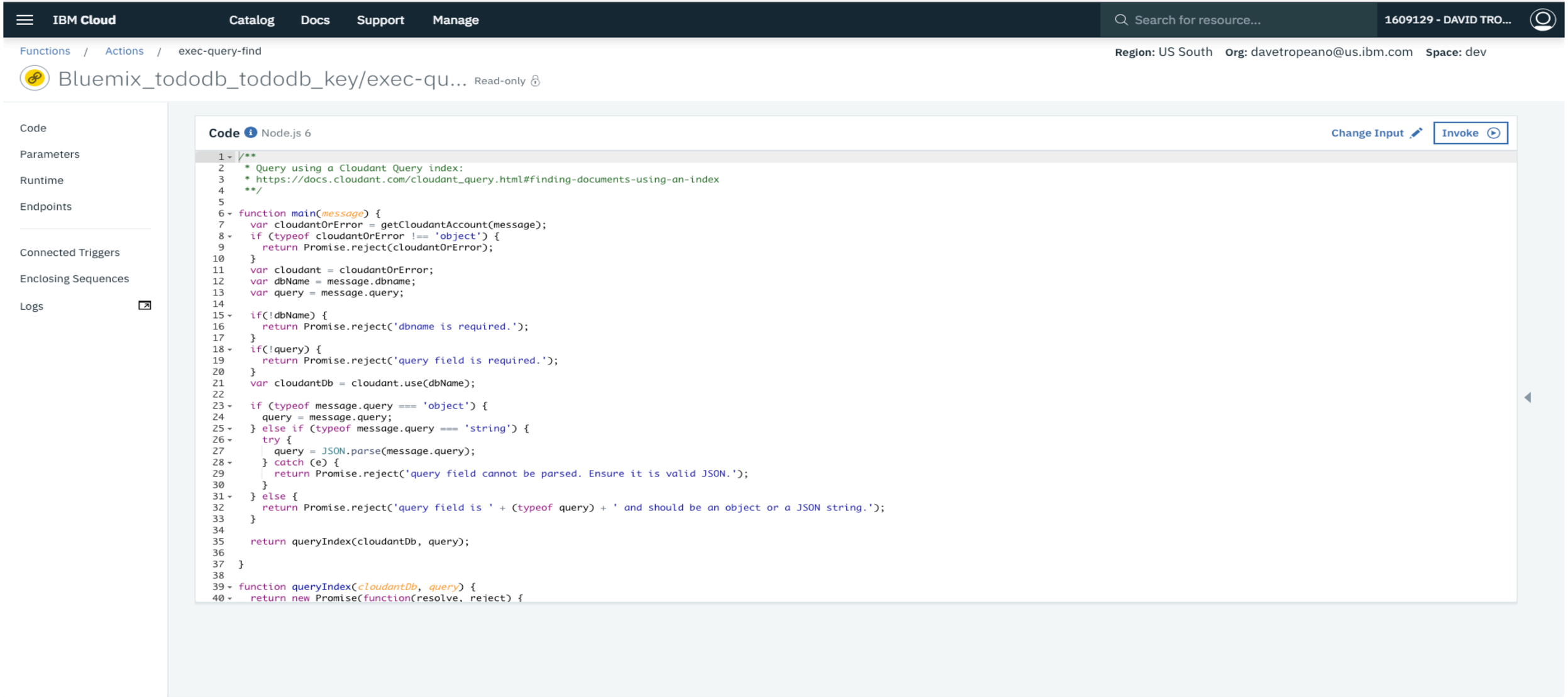
OpenWhisk awaits events, fetches mapped code, runs it in a container



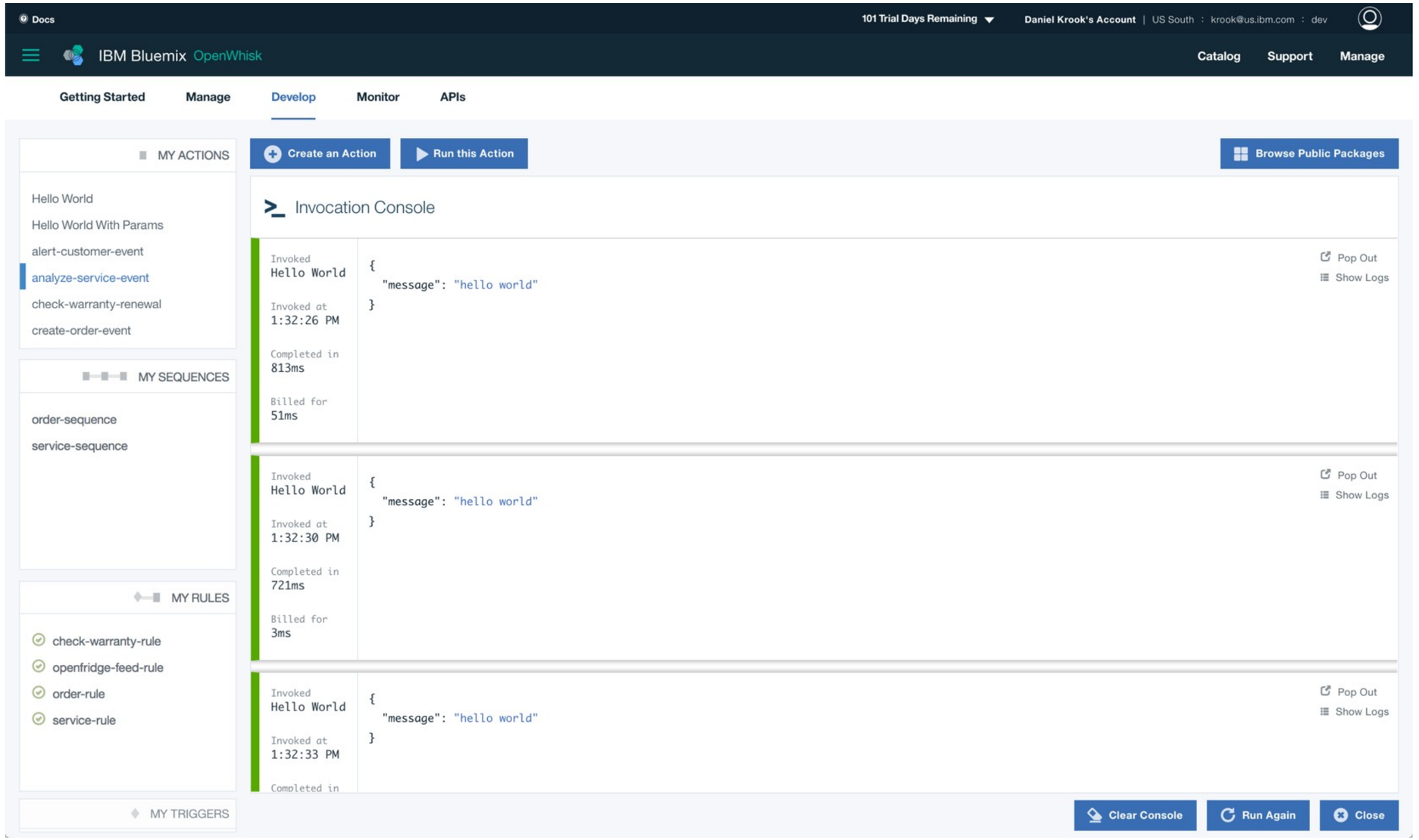
Use Apache OpenWhisk via IBM Cloud Functions: https://cloud.ibm.com/functions/



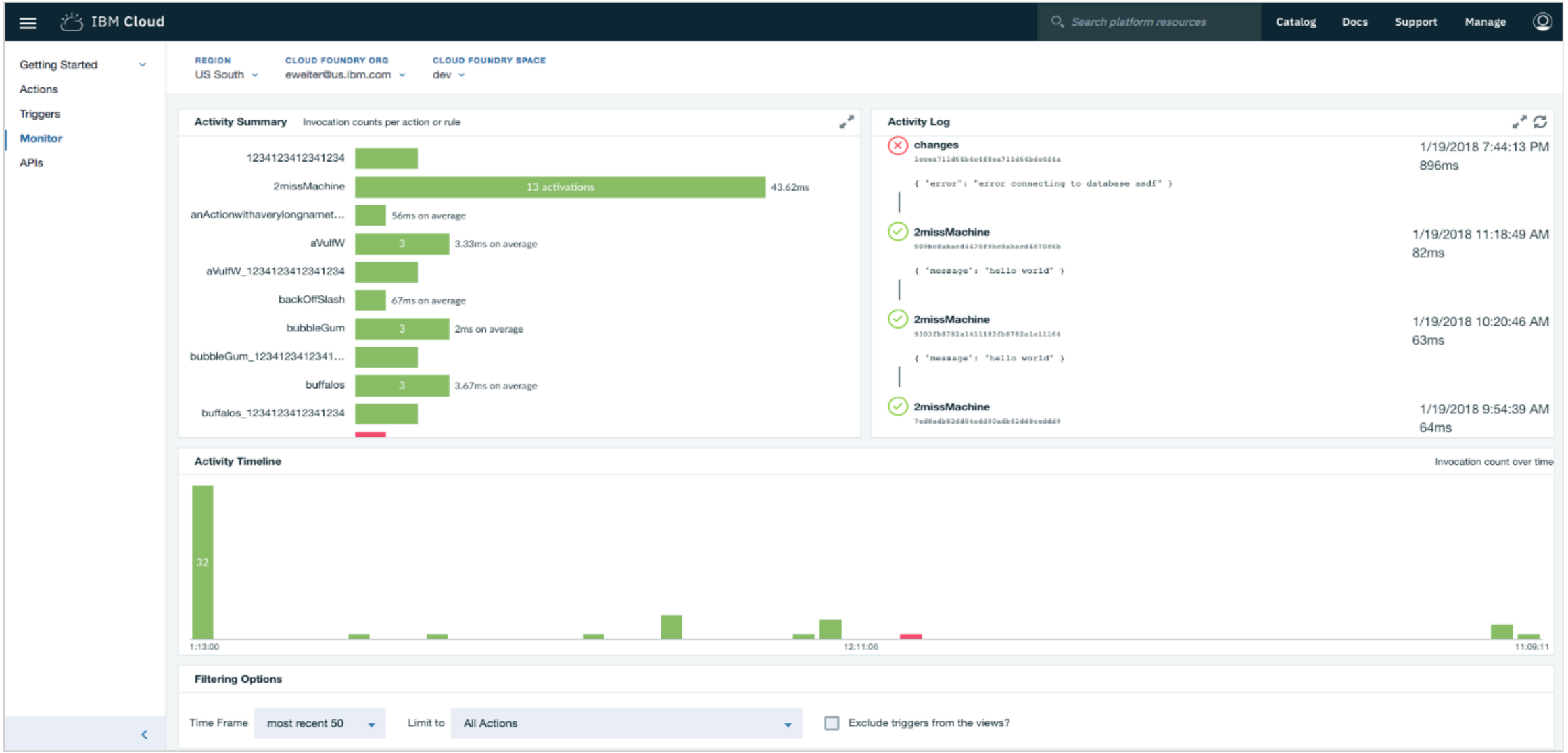
Code Editor


IBM Cloud
Catalog
Docs
Support
Manage
Search for resource...
1609129 - DAVID TRO...
Functions / Actions / exec-query-find
Region: US South Org: davetropeano@us.ibm.com Space: dev
Bluemix_tododb_tododb_key/exec-qu... Read-only
Code
Parameters
Runtime
Endpoints
Connected Triggers
Enclosing Sequences
Logs
Code Node.js 6
Change Input
Invoke
1 /**
2 * Query using a Cloudant Query index:
3 * https://docs.cloudant.com/cloudant_query.html#finding-documents-using-an-index
4 **/
5
6 function main(message) {
7 var cloudantOrError = getCloudantAccount(message);
8 if (typeof cloudantOrError !== 'object') {
9 return Promise.reject(cloudantOrError);
10 }
11 var cloudant = cloudantOrError;
12 var dbName = message.dbname;
13 var query = message.query;
14
15 if(!dbName) {
16 return Promise.reject('dbname is required.');
17 }
18 if(!query) {
19 return Promise.reject('query field is required.');
20 }
21 var cloudantDb = cloudant.use(dbName);
22
23 if (typeof message.query === 'object') {
24 query = message.query;
25 } else if (typeof message.query === 'string') {
26 try {
27 query = JSON.parse(message.query);
28 } catch (e) {
29 return Promise.reject('query field cannot be parsed. Ensure it is valid JSON.');
30 }
31 } else {
32 return Promise.reject('query field is ' + (typeof query) + ' and should be an object or a JSON string.');
33 }
34
35 return queryIndex(cloudantDb, query);
36
37 }
38
39 function queryIndex(cloudantDb, query) {
40 return new Promise(function(resolve, reject) {

IBM Cloud Functions provides management, tooling, and monitoring

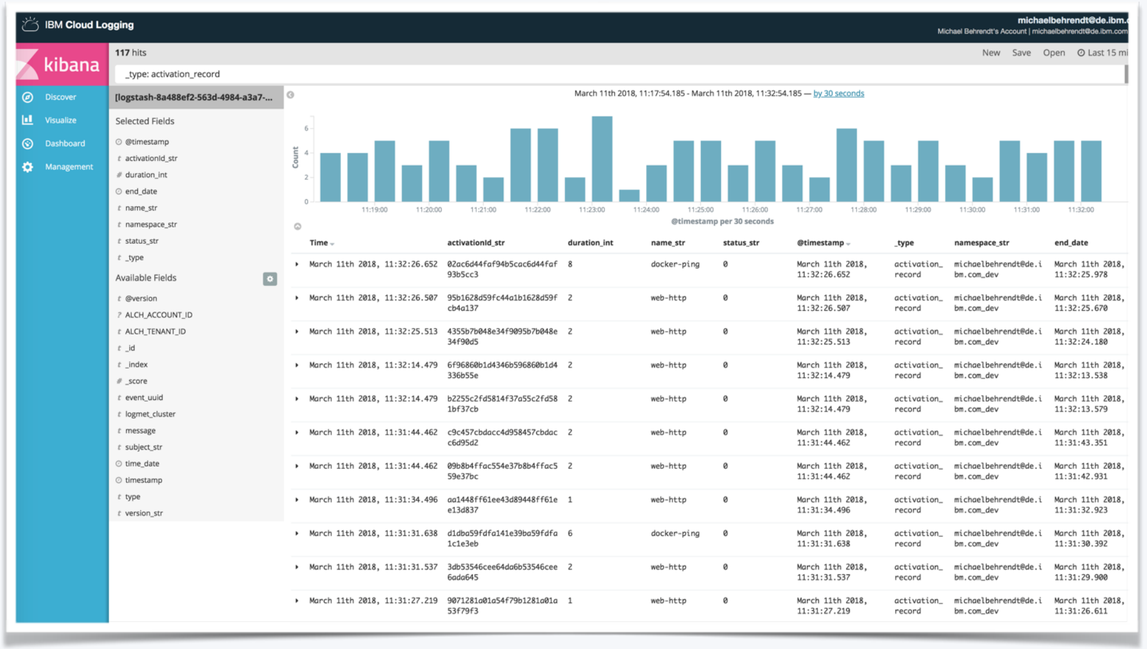


Action / Trigger Monitoring

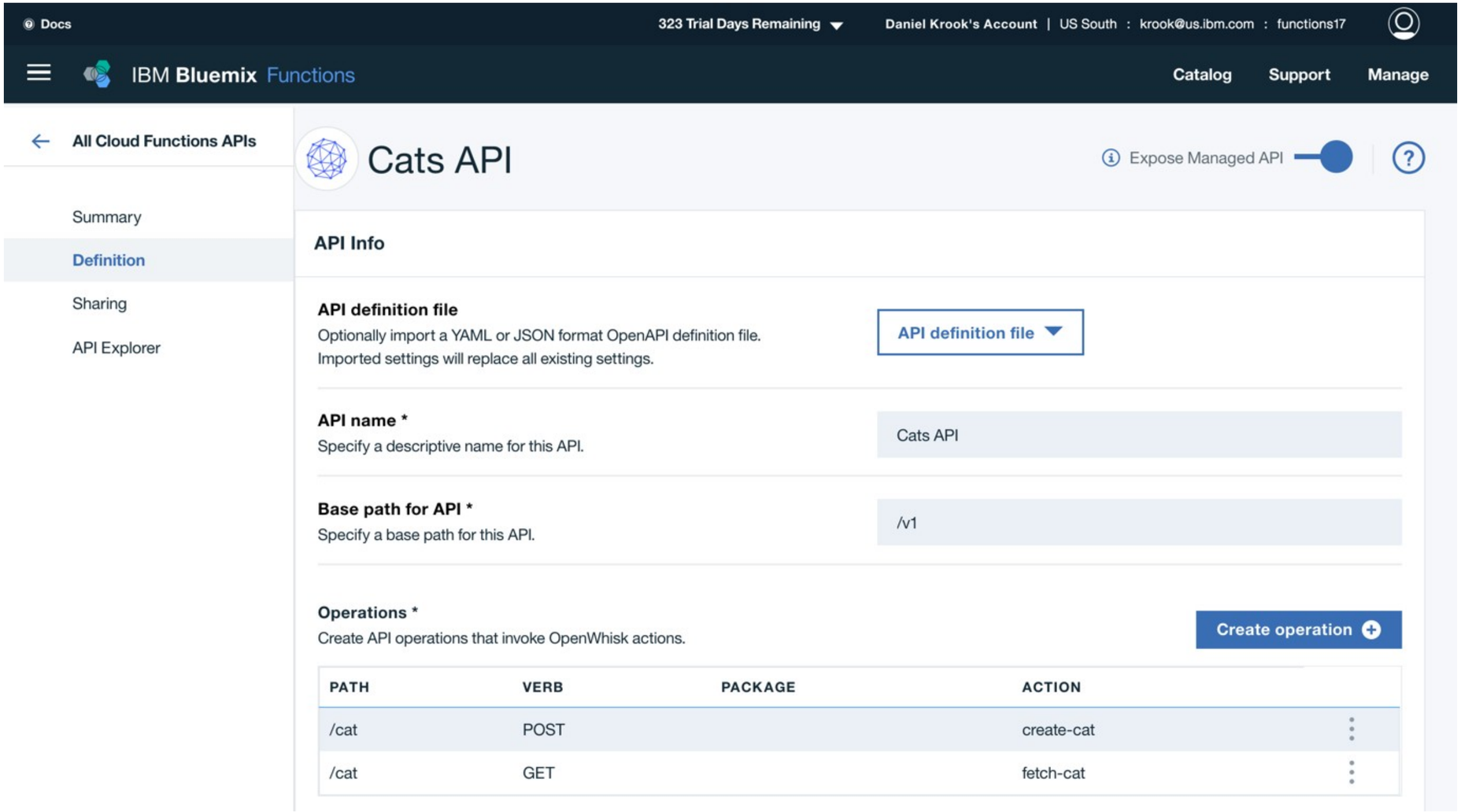


Integration with IBM Logging Service

- All logs and activation records automatically available via IBM Logging Service
- Provides rich Kibana-based experience for searching logs in any dimension
- Critical for problem determination at scale
- Includes visualization capabilities which are critical for quickly detecting trends and anomalies



IBM Cloud Functions also provides included API gateway integration



Connecting to on prem-resources

Common **requirements**:

- Receive events from on-premise resources (e.g. Kafka)
- Writing data into on-premise data stores from IBM Cloud Functions
- Call on-prem APIs

Solution:

- Leverage **IBM Secure Gateway for IBM Cloud Functions** to communicate with your on-prem data center

Compliance standards

Certified for…

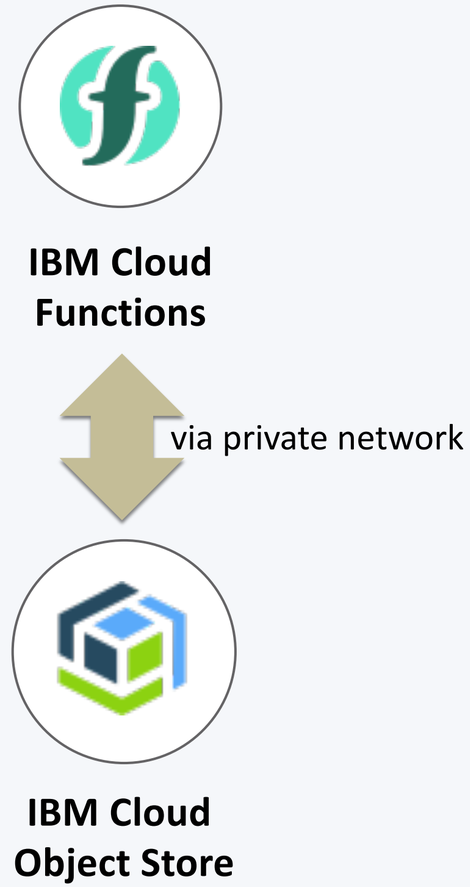
- **ISO 27001**
  - specifies a management system that is intended to bring information security under management control and gives specific requirements
- **ISO 27017**
  - gives guidelines for information security controls applicable to the provision and use of cloud services
- **ISO 27018**
  - provides guidance aimed at ensuring that cloud service providers offer suitable information security controls to protect the privacy of their customers' clients by securing PII
- **GDPR**
- **HIPAA**
- **SOC2**

Sources: https://www.wikipedia.org/ & https://www.iso27001security.com/html/27018.html

COS private endpoint

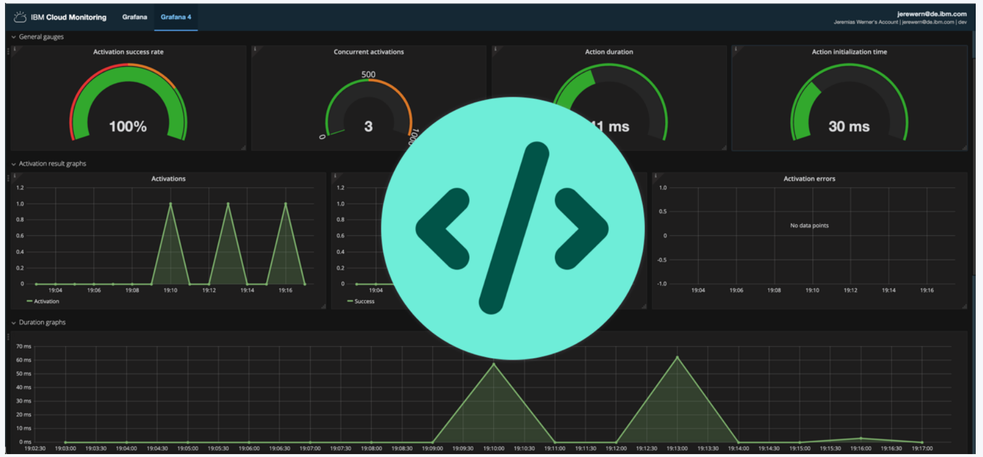
Connect via the private endpoints which:

- **allows higher throughput** and
- **do not incur charges for in/outgoing bandwidth**



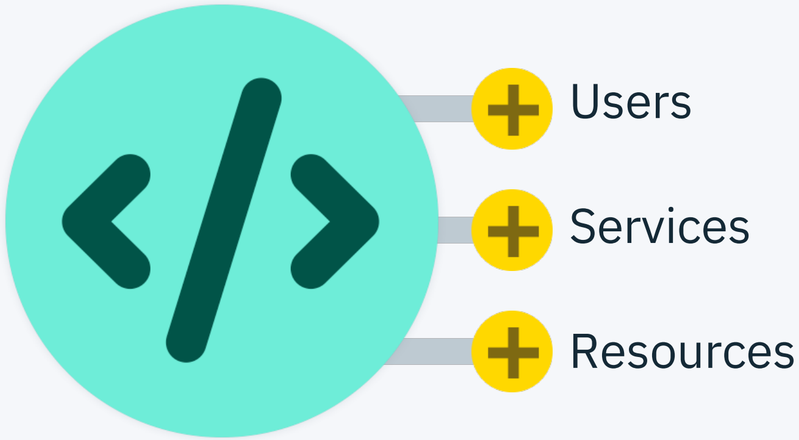
Integration with Monitoring Service

Empower your DevOps team for **insight** into how your functions are performing. Quickly **identify trends**, detect and **diagnose problems.**



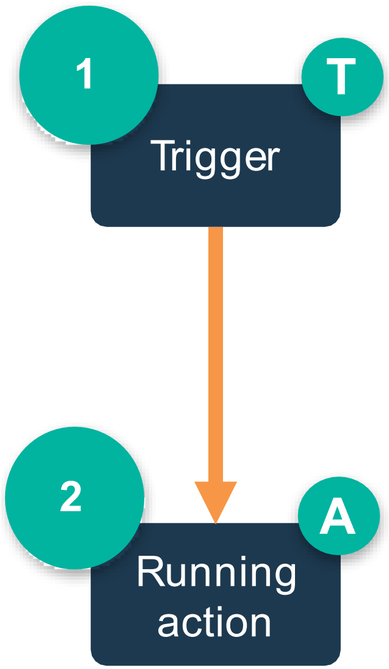
IAM support

Authenticate users and **control access to resources** consistently across IBM Cloud



Use case 1: Your first trigger, action, and rule

```
function main(params) {
  var date = new Date();
  console.log("Invoked at: " + date.toLocaleString());
  return { message: "Invoked at: " + date.toLocaleString() };
}
```



1. Cron syntax alarm

2. Log the current time

```
$ ibmcloud fn activation poll
```

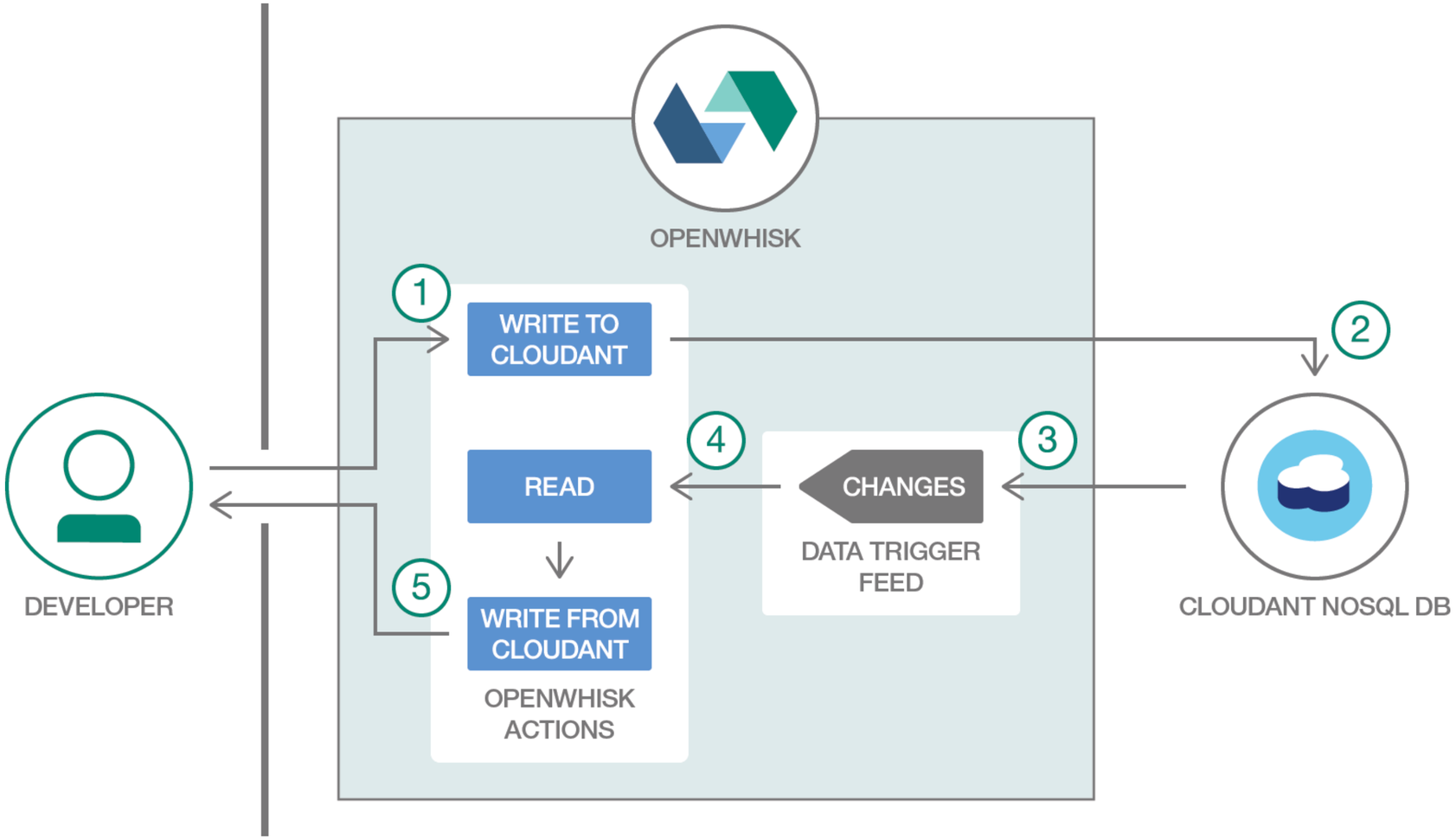
```
$ ibmcloud fn action create handler handler.js
```

```
$ ibmcloud fn action invoke --blocking handler
```

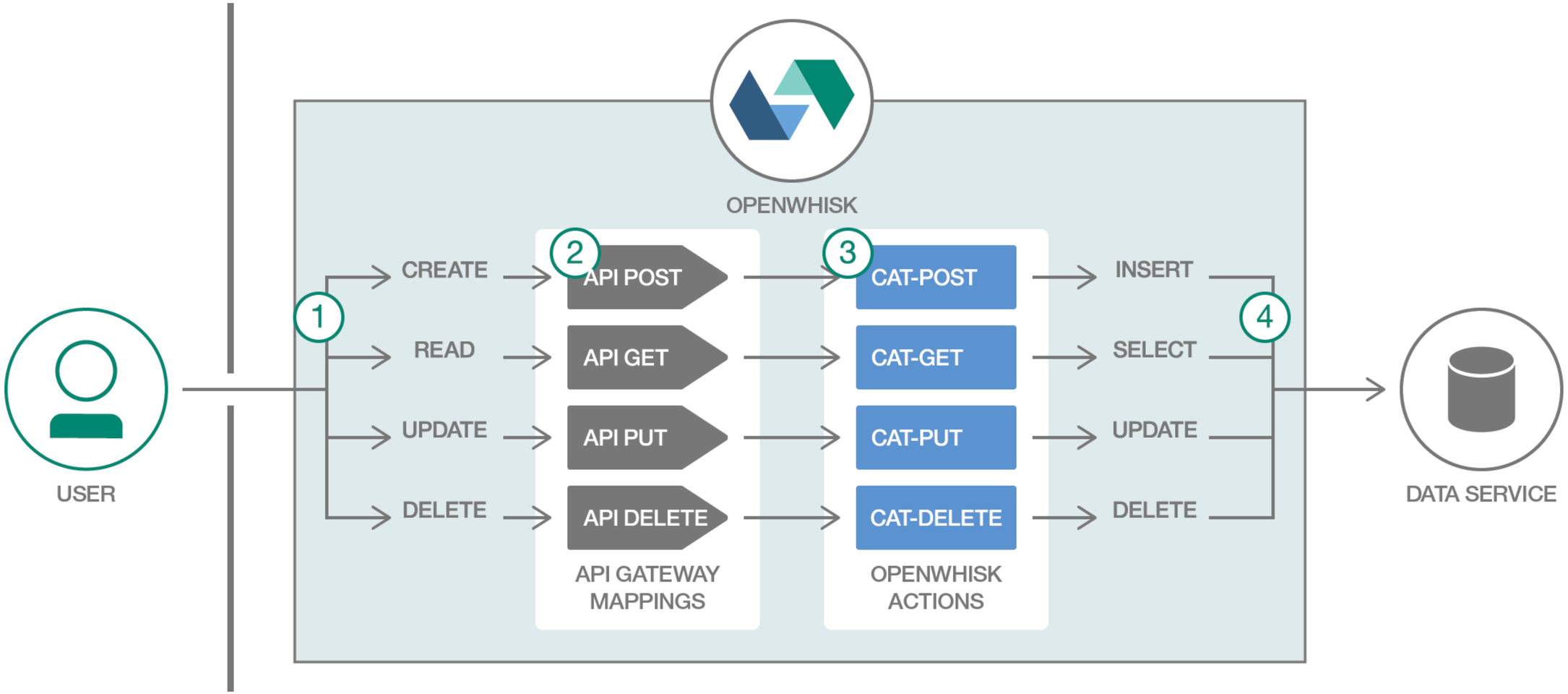
```
$ ibmcloud fn trigger create every-20-second \
    --feed /whisk.system/alarms/alarm \
    --param cron "*/20 * * * * *" \
    --param maxTriggers 15
```

```
$ ibmcloud fn rule create \
  invoke-periodically \
  every-20-seconds \
  handler
```

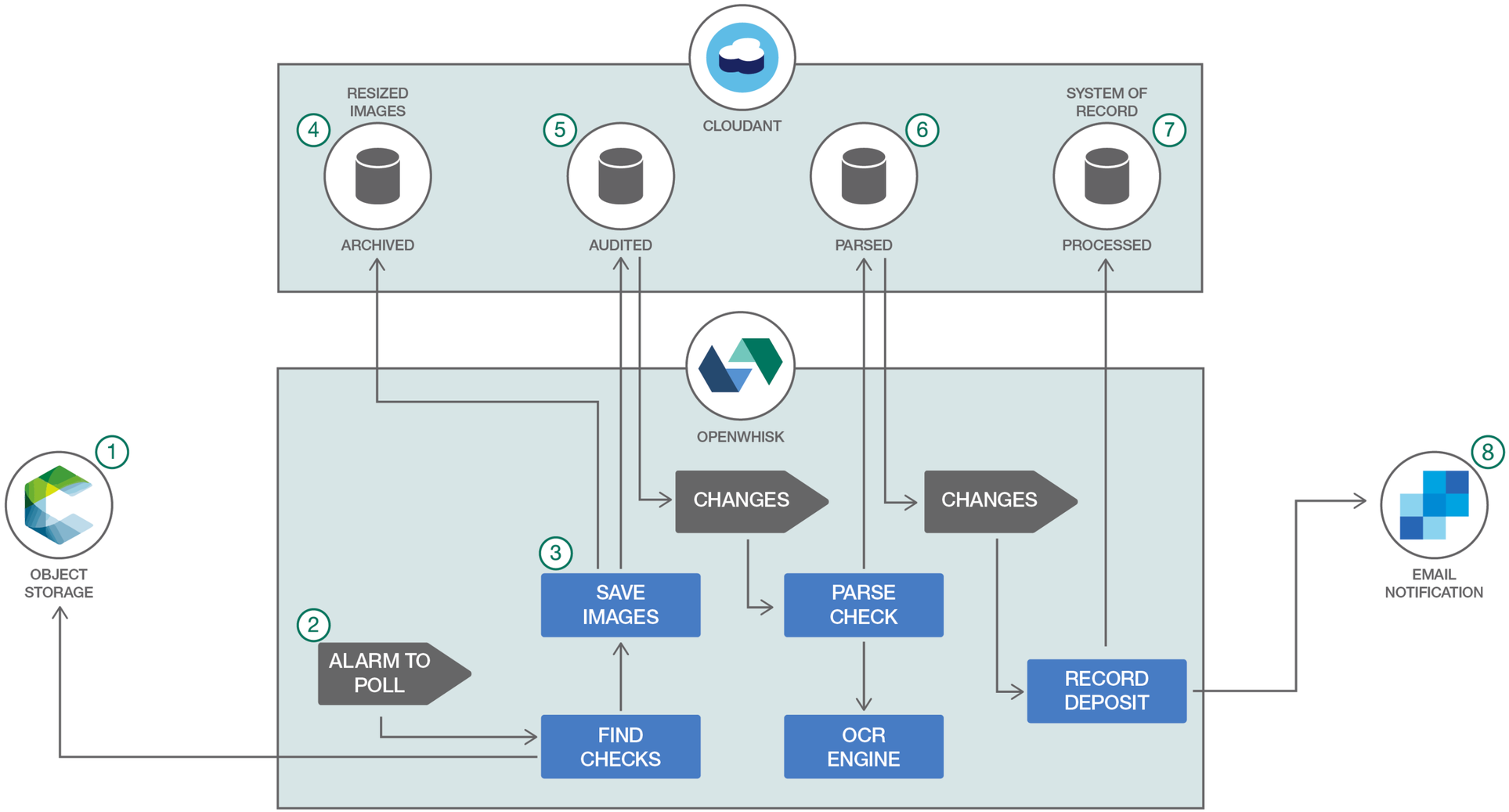
Use case 2: Database change triggered action



Use case 3: HTTP API request triggered action



Other simple apps, working solutions, more complex uses



Get started with Cloud Functions, or explore the open source project

Managed OpenWhisk with
IBM Cloud Functions
cloud.ibm.com/functions

Delivered as
Open source via Apache
openwhisk.org


github.com/openwhisk


slack.openwhisk.org


twitter.com/openwhisk


medium.com/openwhisk

IBM Cloud Functions

Thank You!