Serverless Computing with IBM Cloud Functions and Apache OpenWhisk

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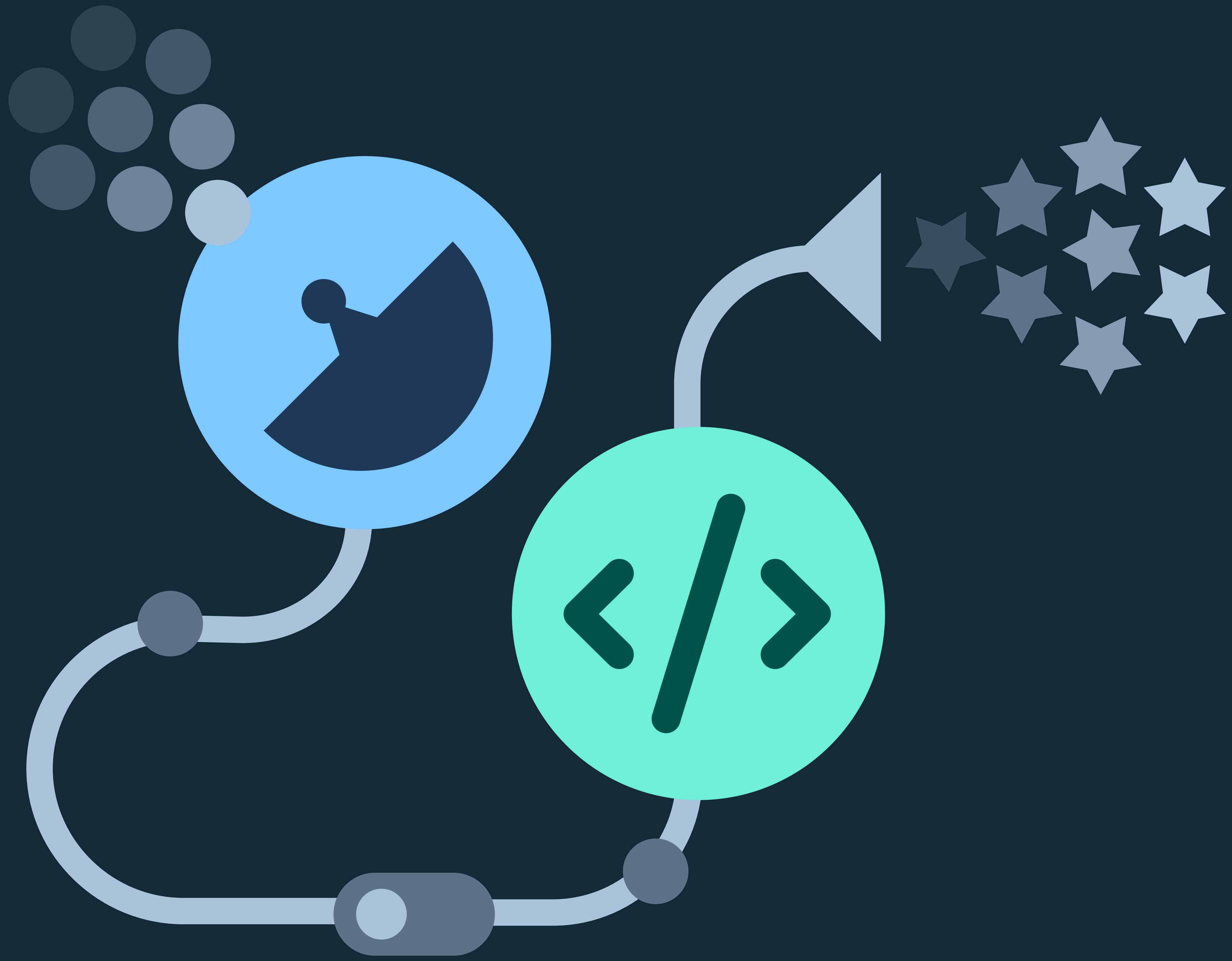
@AndreasNauerz



SummerSoc
Service Oriented Computing

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Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user’s job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.

Agenda

1. What is serverless?
2. What are the advantages of serverless and why should I care?
3. What is IBM Cloud Functions?
4. How does IBM Cloud Functions work behind the scenes?
5. Live Demo I
6. IBM Cloud Functions ecosystem & integrations
7. What is IBM Cloud Functions good for (scenarios/use-cases)?
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10. Roadmap & Strategy
11. Live Demo III
12. Getting started material & time for questions

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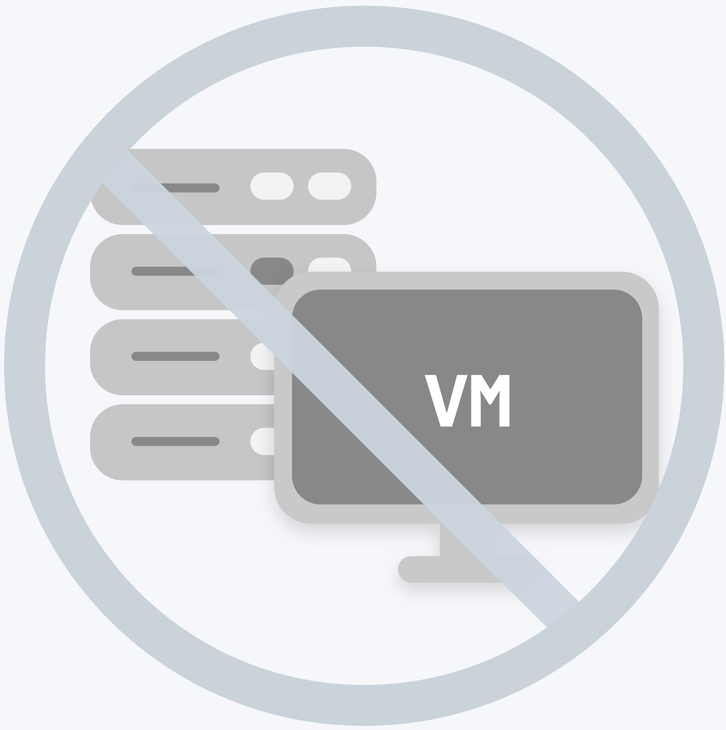
What is serverless?

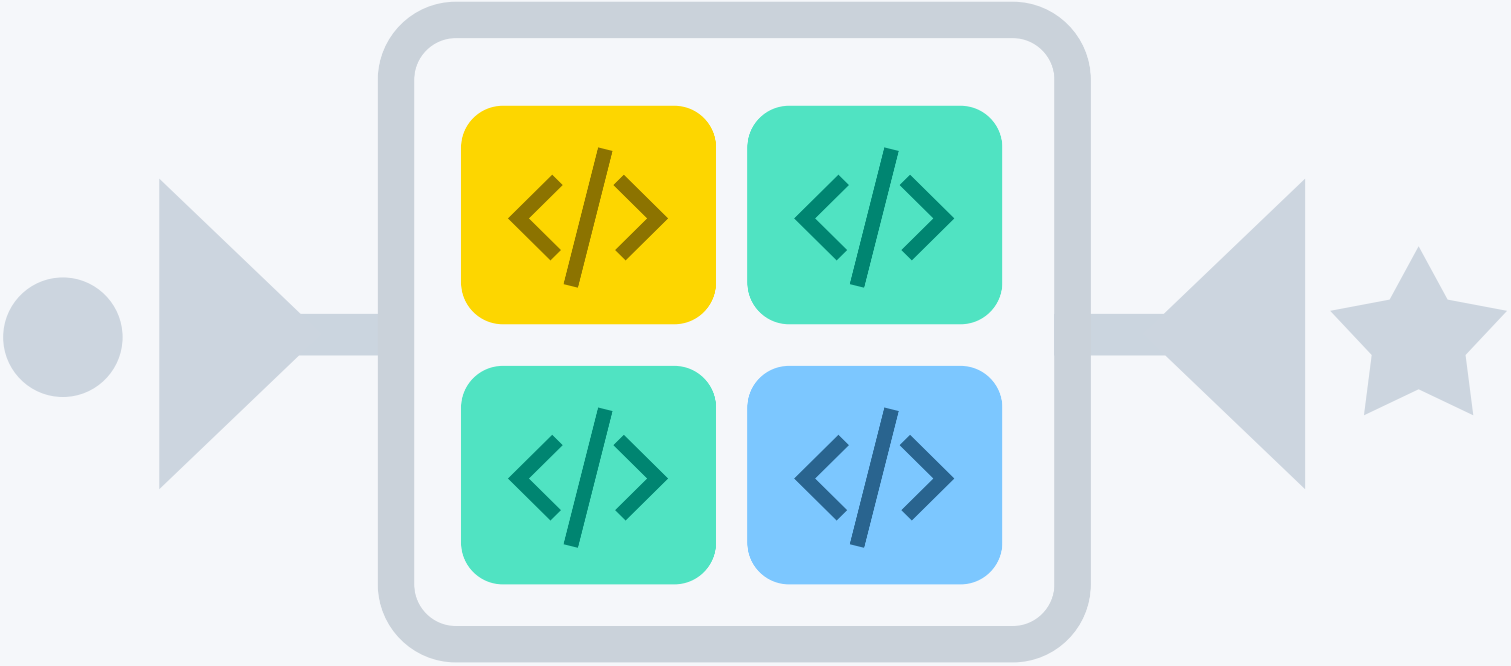
Runs code **only** on-demand on a per-request basis

No management and operation of **infrastructures**

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



No servers

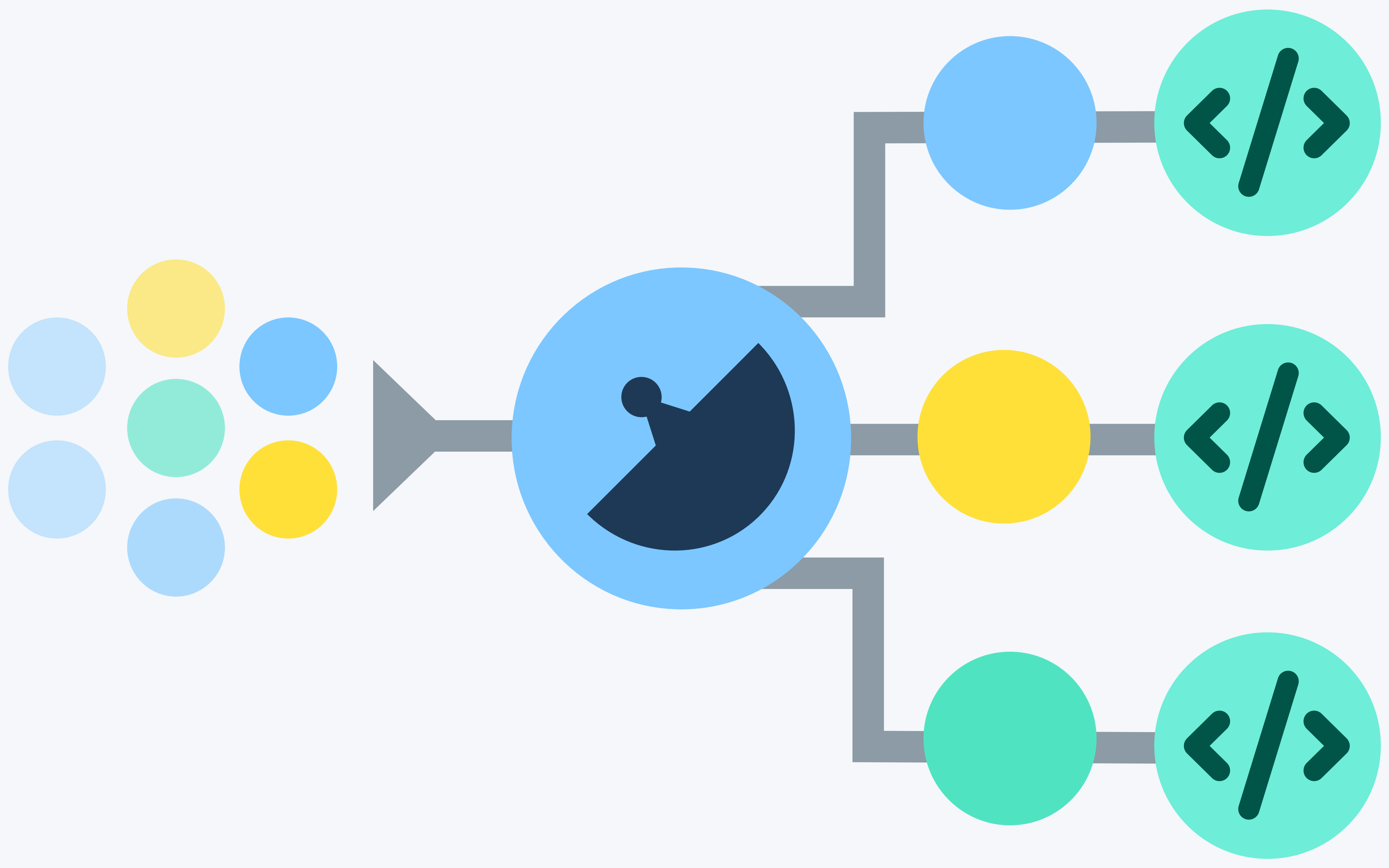


Just code

What is serverless?

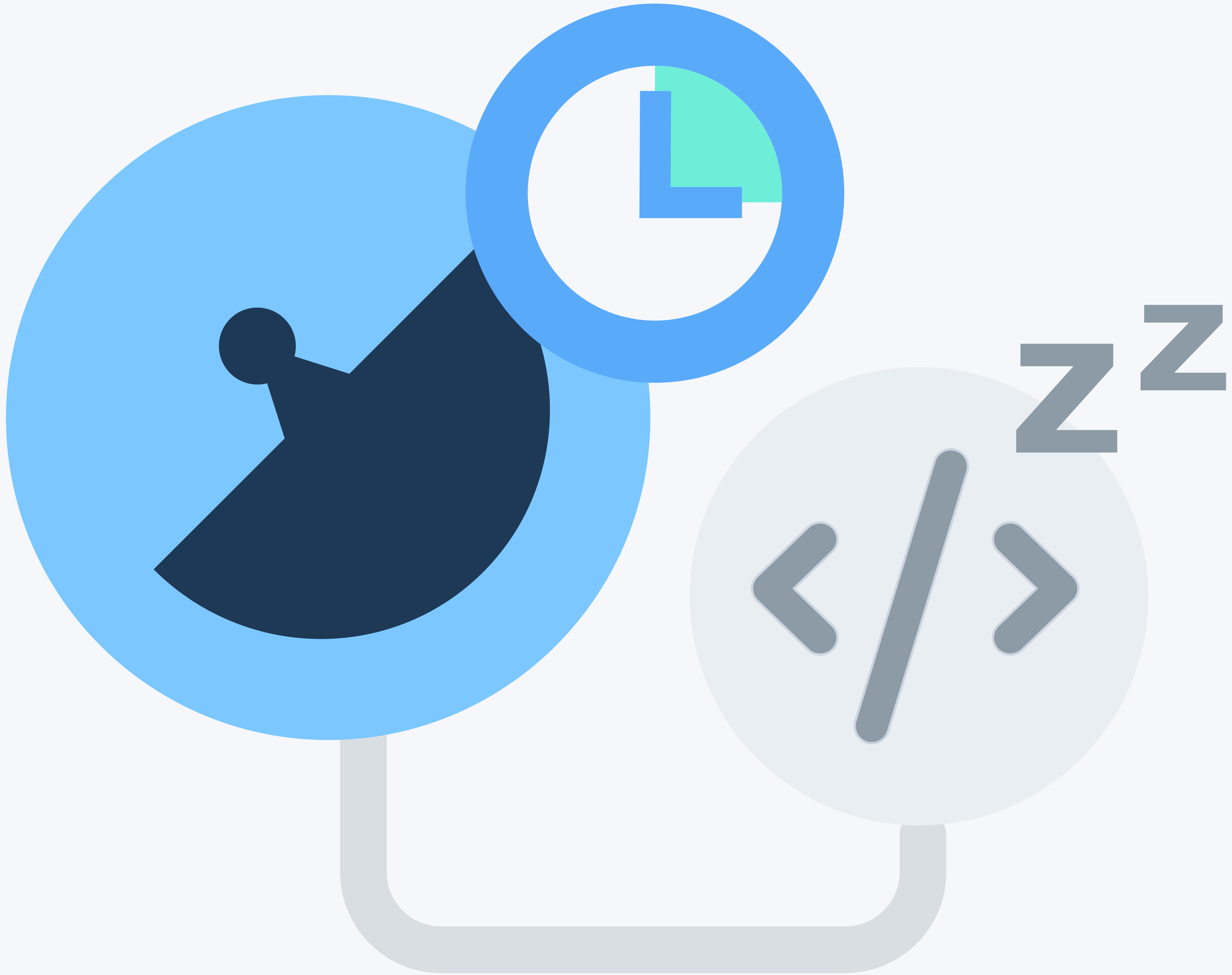
Runs code **only** on-demand on a per-request basis

Transparently scales with the number of requests being served

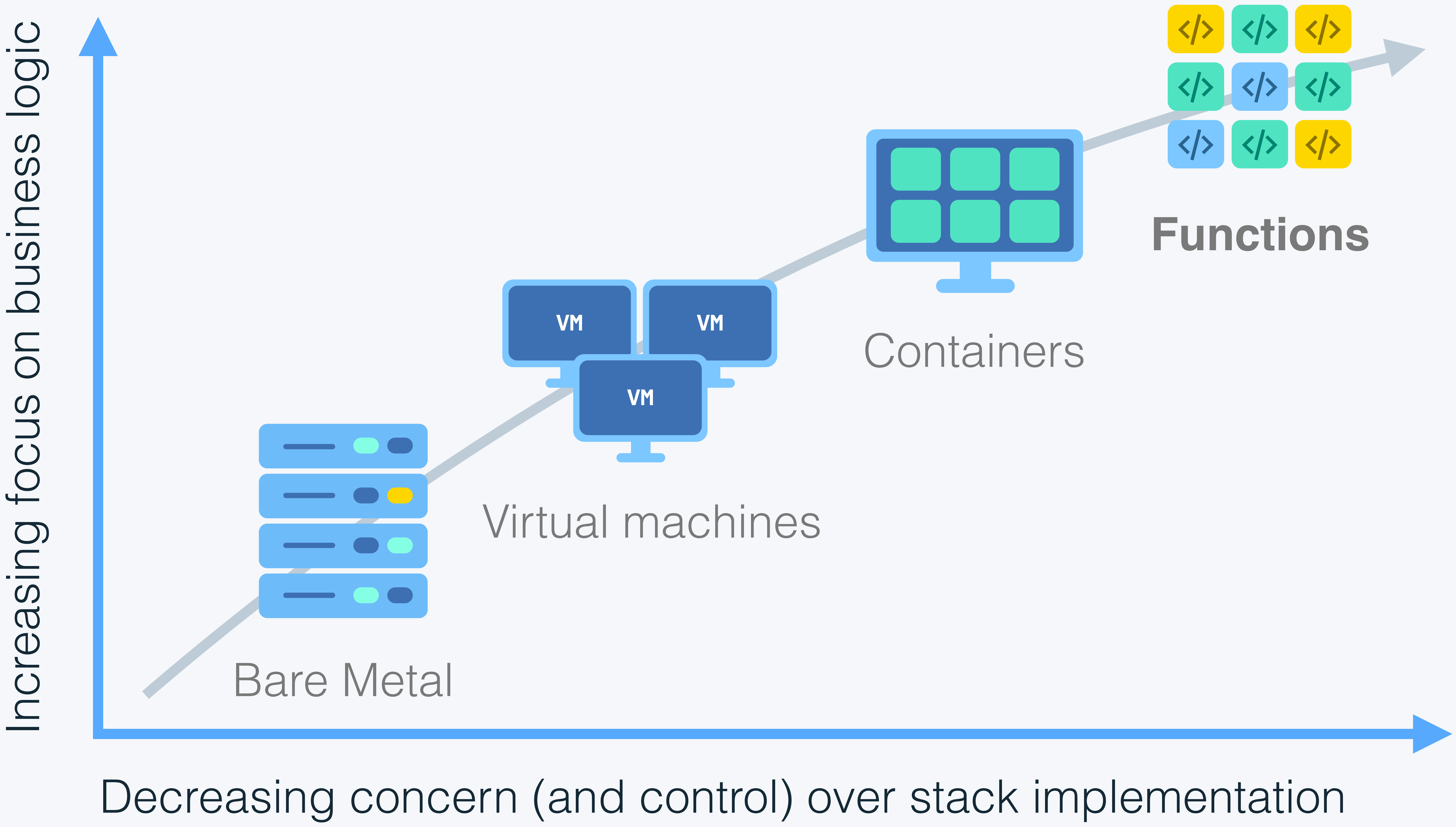


Runs code **only** on-demand on a per-request basis

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



What is serverless?


Increasing focus on business logic
Bare Metal
VM
VM
VM
Virtual machines
Containers
</>
Functions
Decreasing concern (and control) over stack implementation

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Traditional model

Worry about scaling

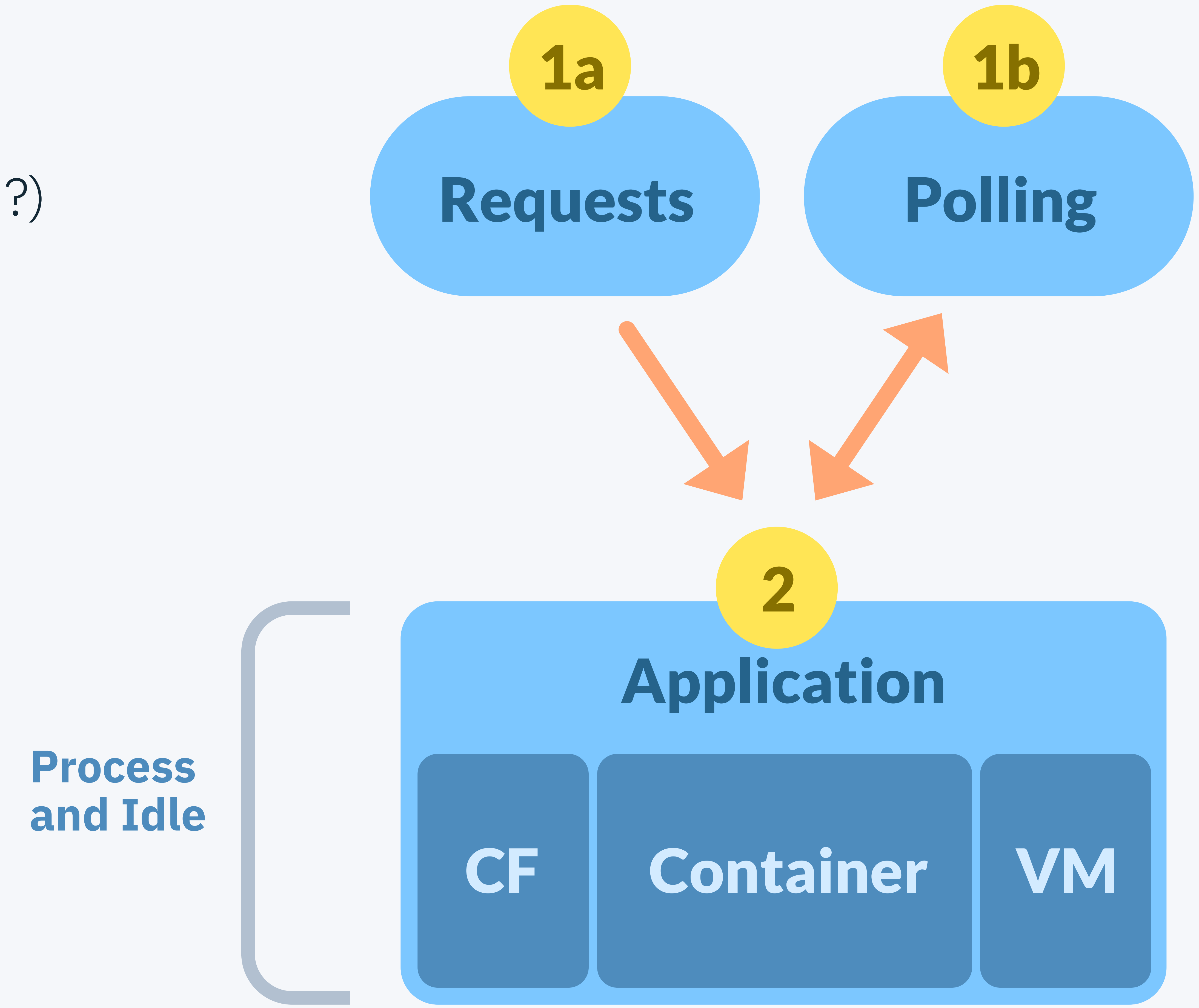
- When to scale? (mem-, cpu-, response time-, etc. driven?)
- How fast can you scale?

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

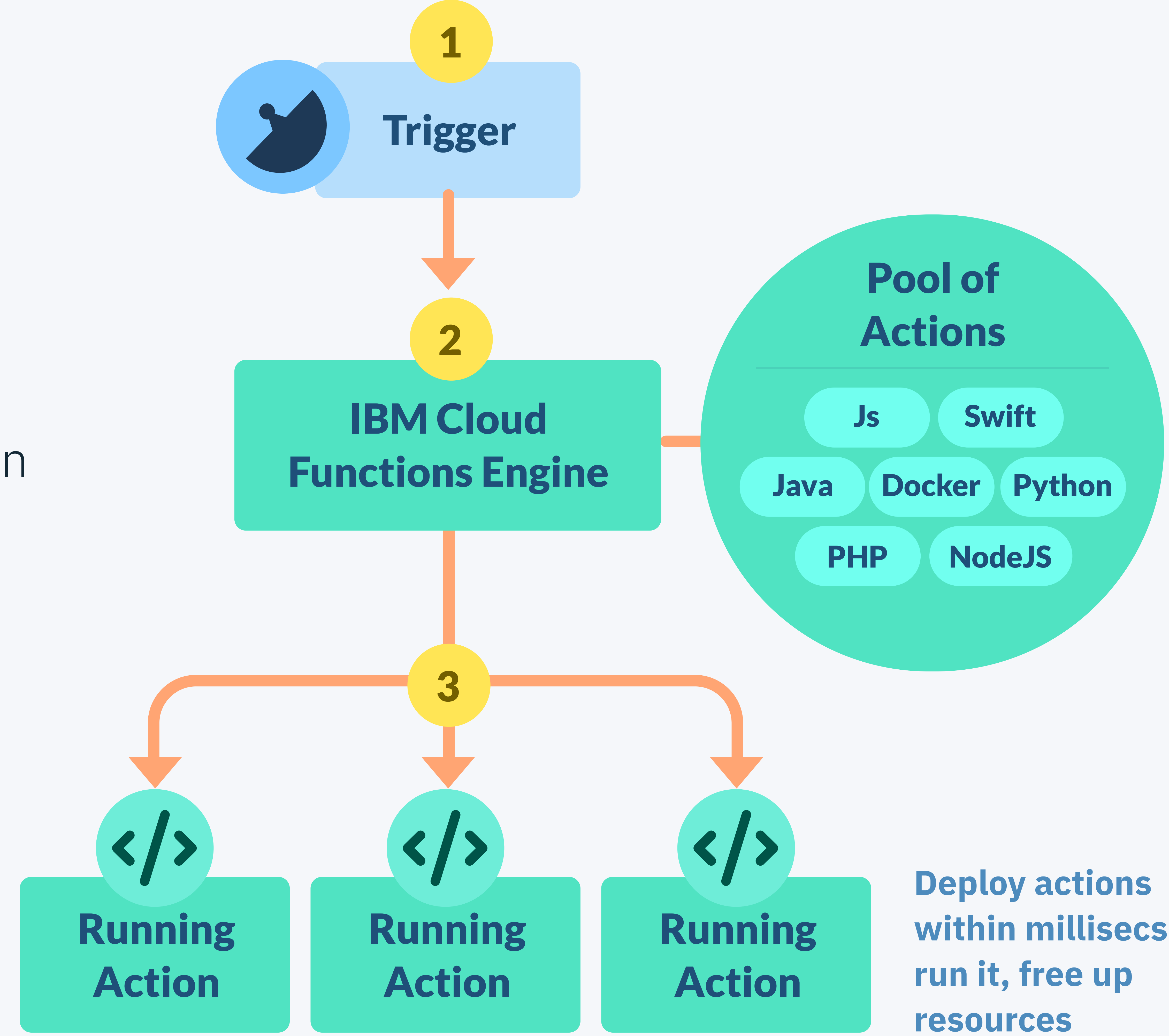
No cost overhead for resiliency

- 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



Deploy actions within millisecs, run it, free up resources

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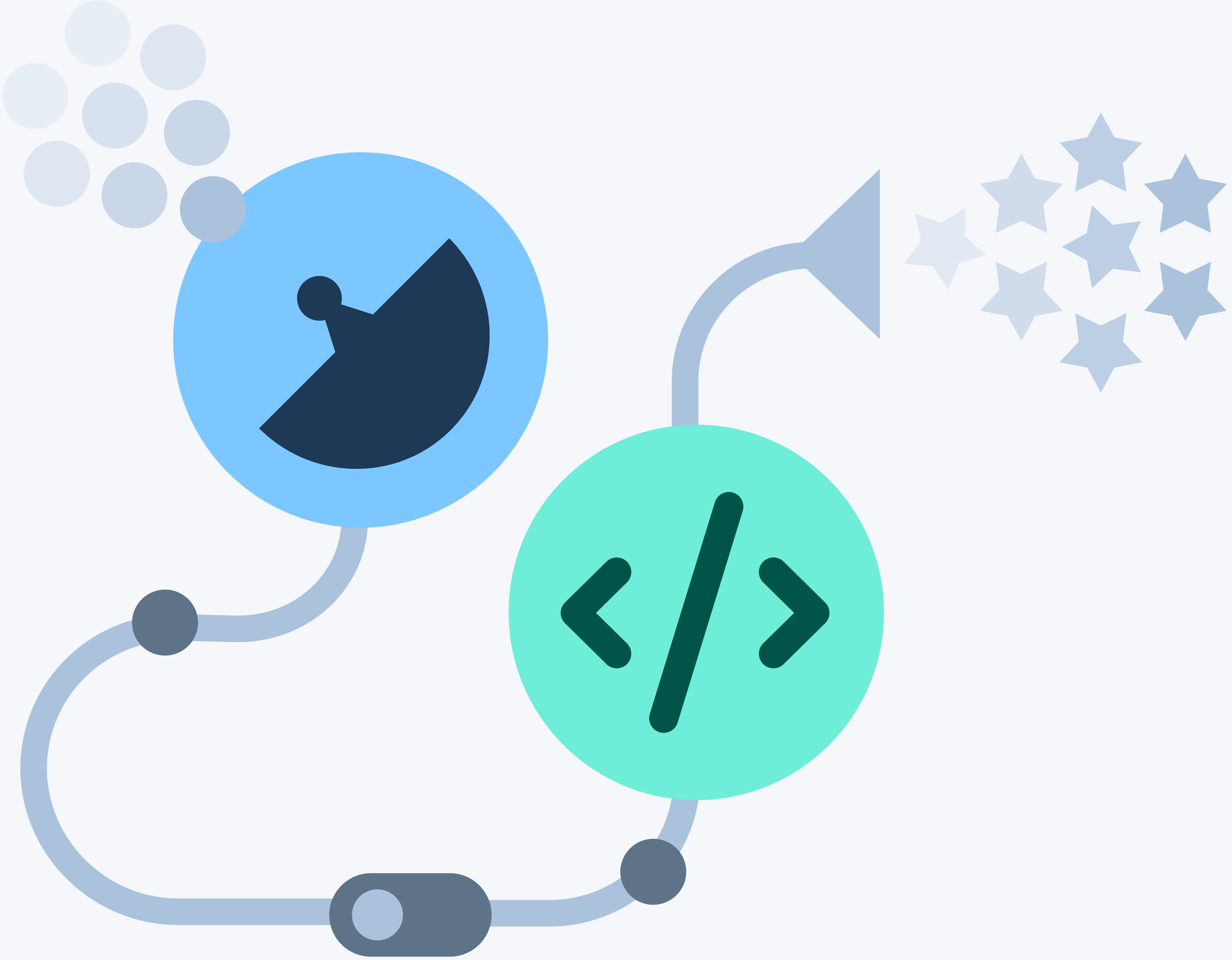
What is IBM Cloud Functions?

FaaS platform to execute code in a serverless fashion

Available as **managed service** on **IBM Cloud**

bluemix.net/openwhisk



What is IBM Cloud Functions?

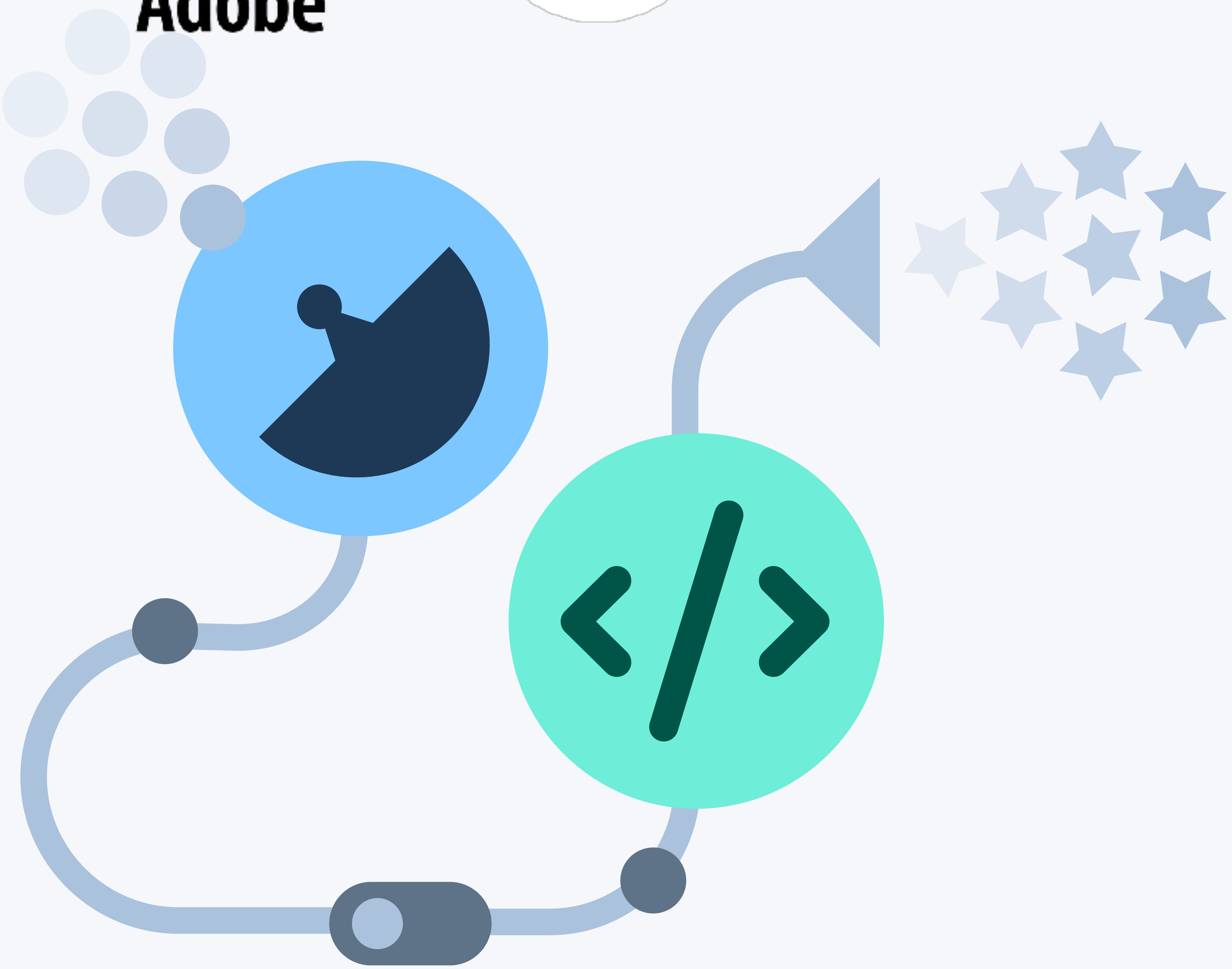
FaaS platform to execute code in a serverless fashion

Software also available as **open-source via Apache:** openwhisk.org

Ready to be downloaded, installed, and **managed by you and on your hardware**

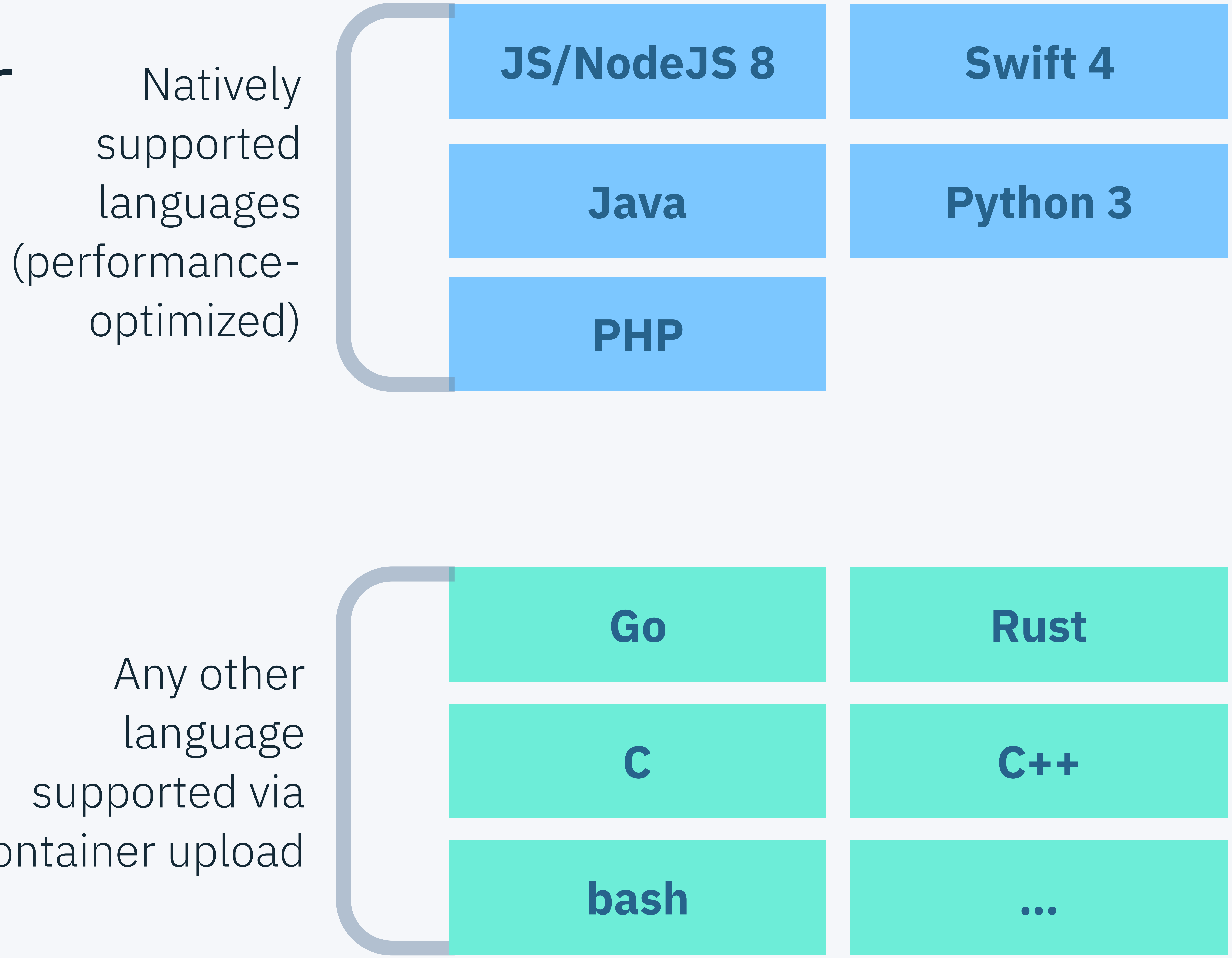
Adobe

redhat



What is IBM Cloud Functions?

Any language or binary is supported



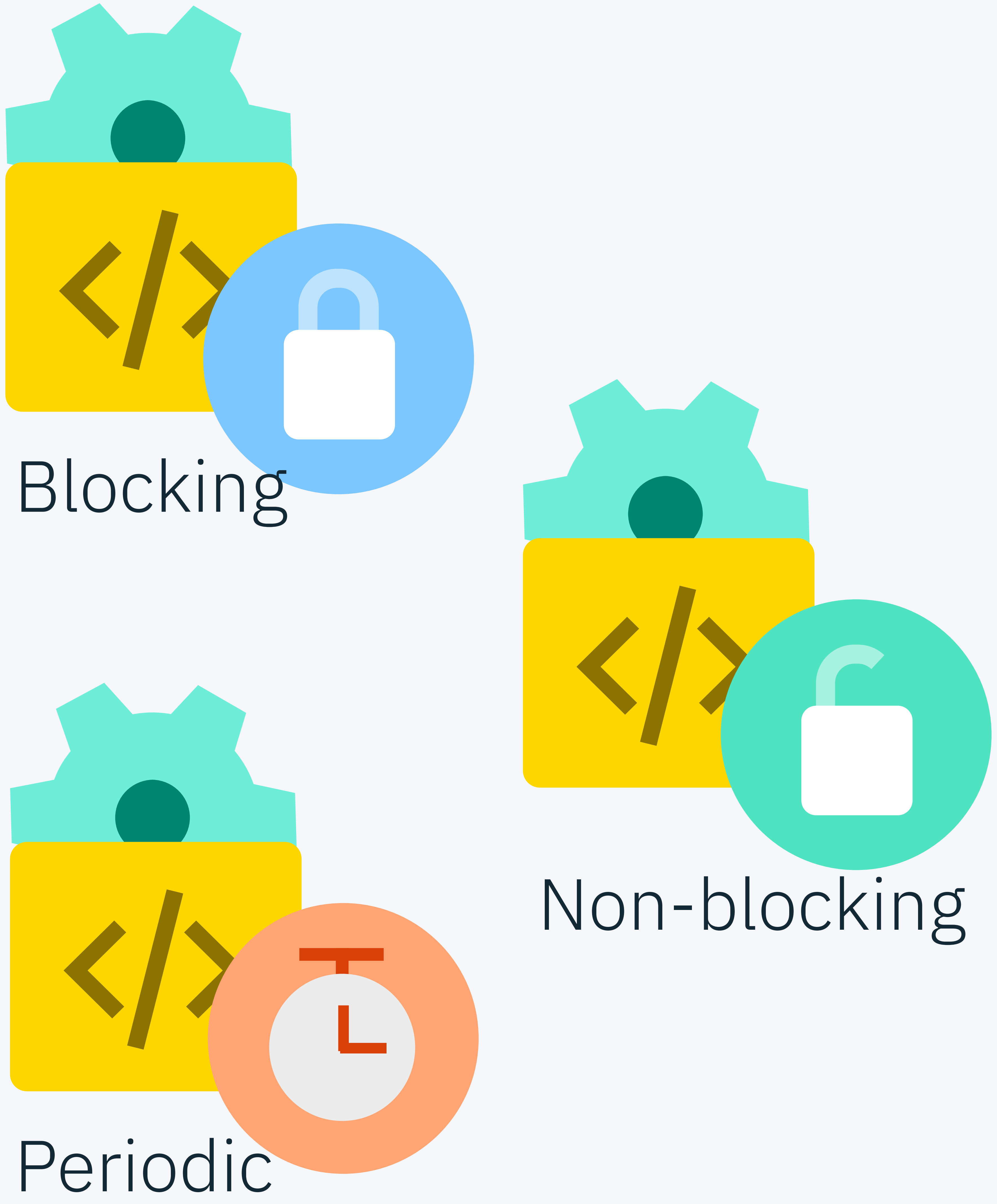
Natively supported languages (performance-optimized)

- JS/NodeJS 8
- Swift 4
- Java
- Python 3
- PHP

Any other language supported via container upload

- Go
- Rust
- C
- C++
- bash
- ...

Support for different invocation models

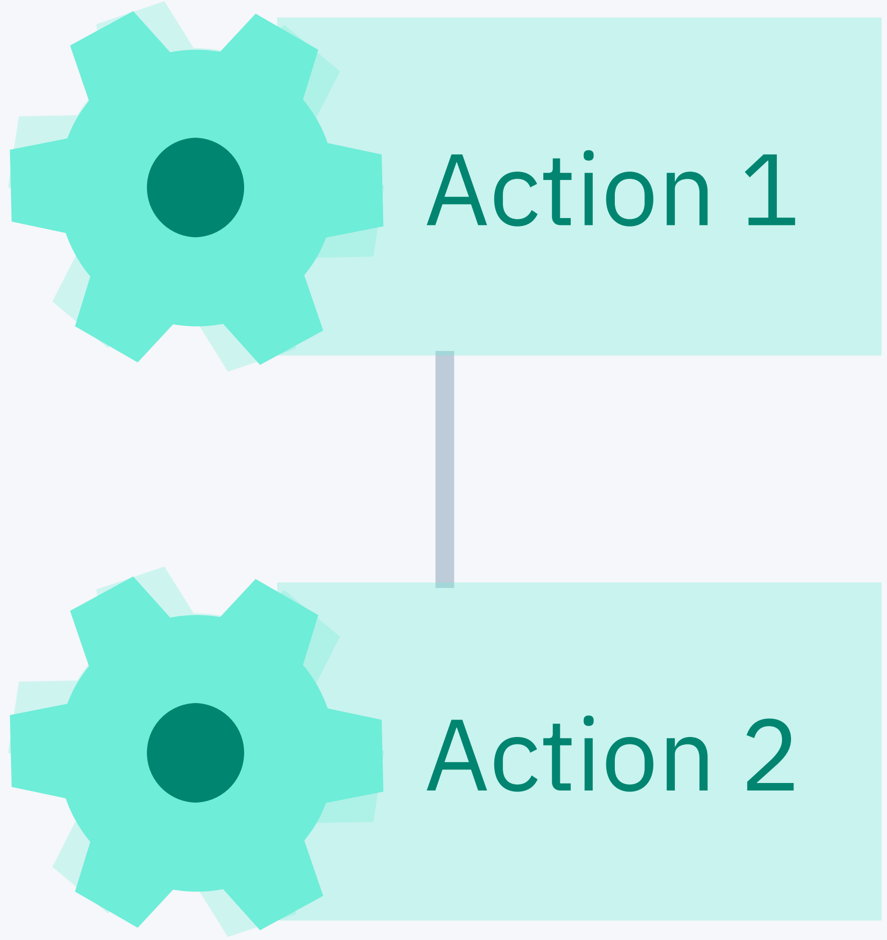


Blocking

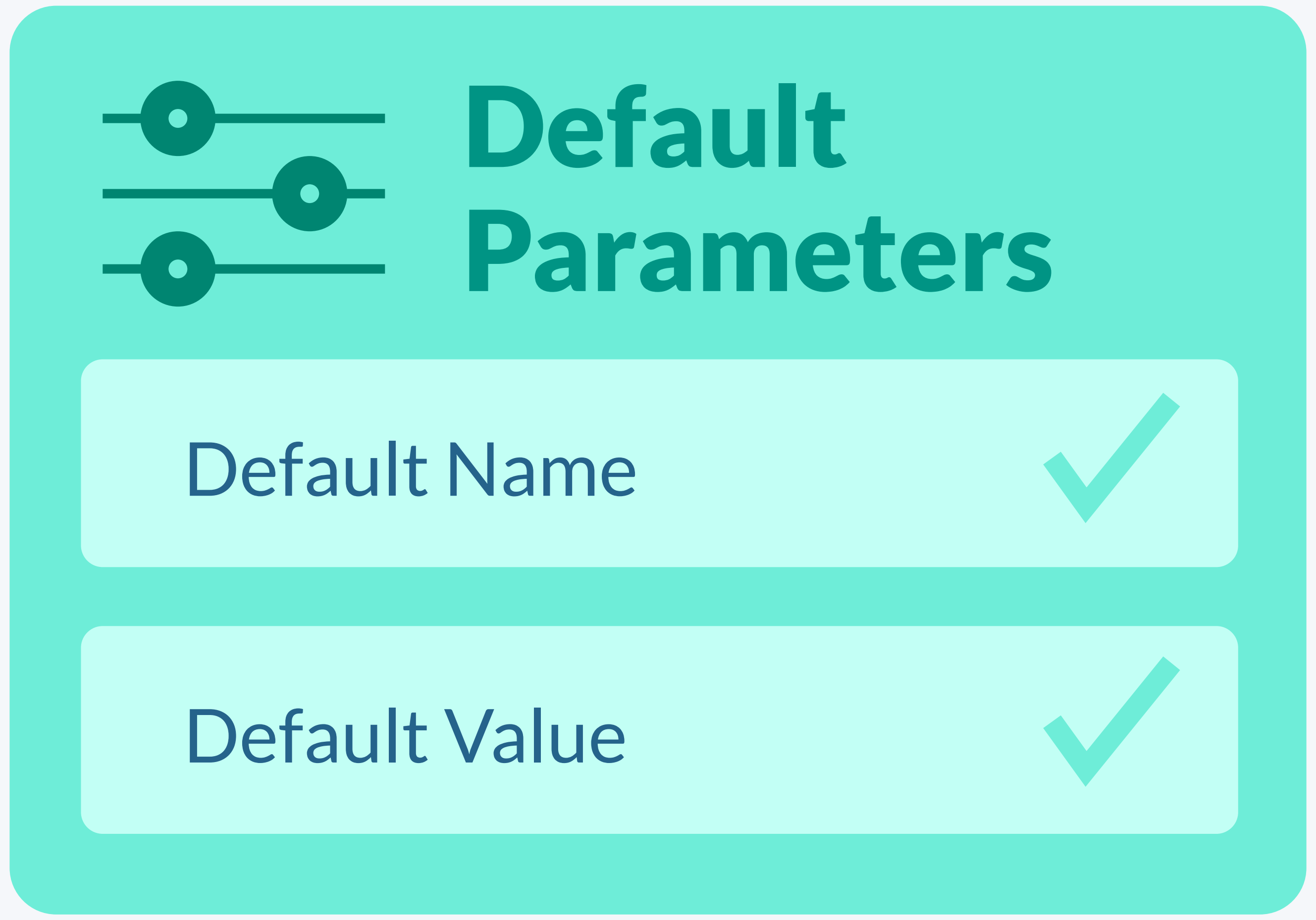
Non-blocking

Periodic

Supports higher-level programming constructs



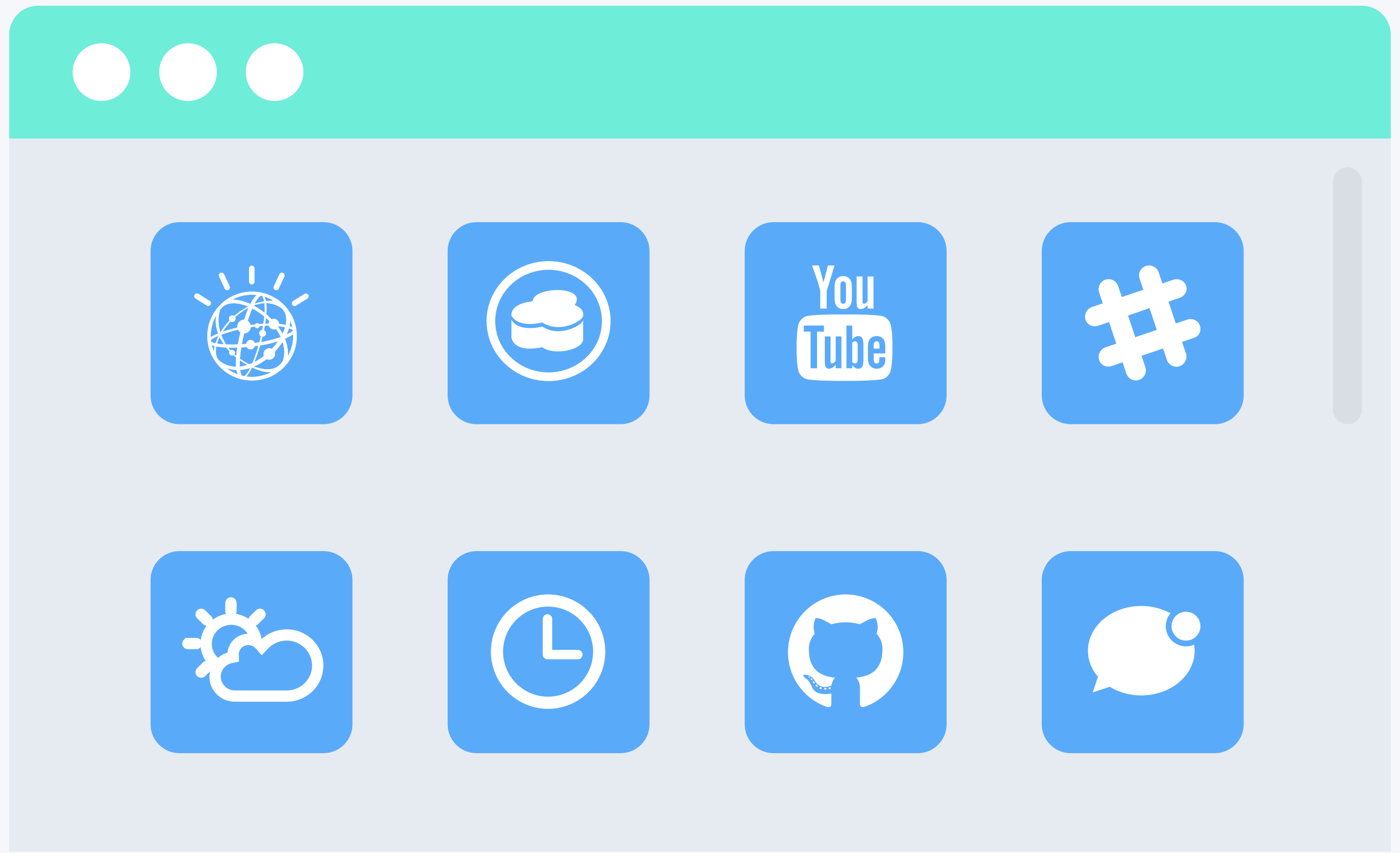
Chaining/ Sequencing



Parameter Binding

What is IBM Cloud Functions?

Event Provider



Open event emitter
(consumer ecosystem)

Open interface
for event emitters

What is IBM Cloud Functions?

Event Provider

- Periodic
- Cloudant
- Message Hub
- API Gateway
- Mobile Push
- Github
- AppConnect
- Watson Conversation

Granular pricing

Pay only for the exact time your actions run

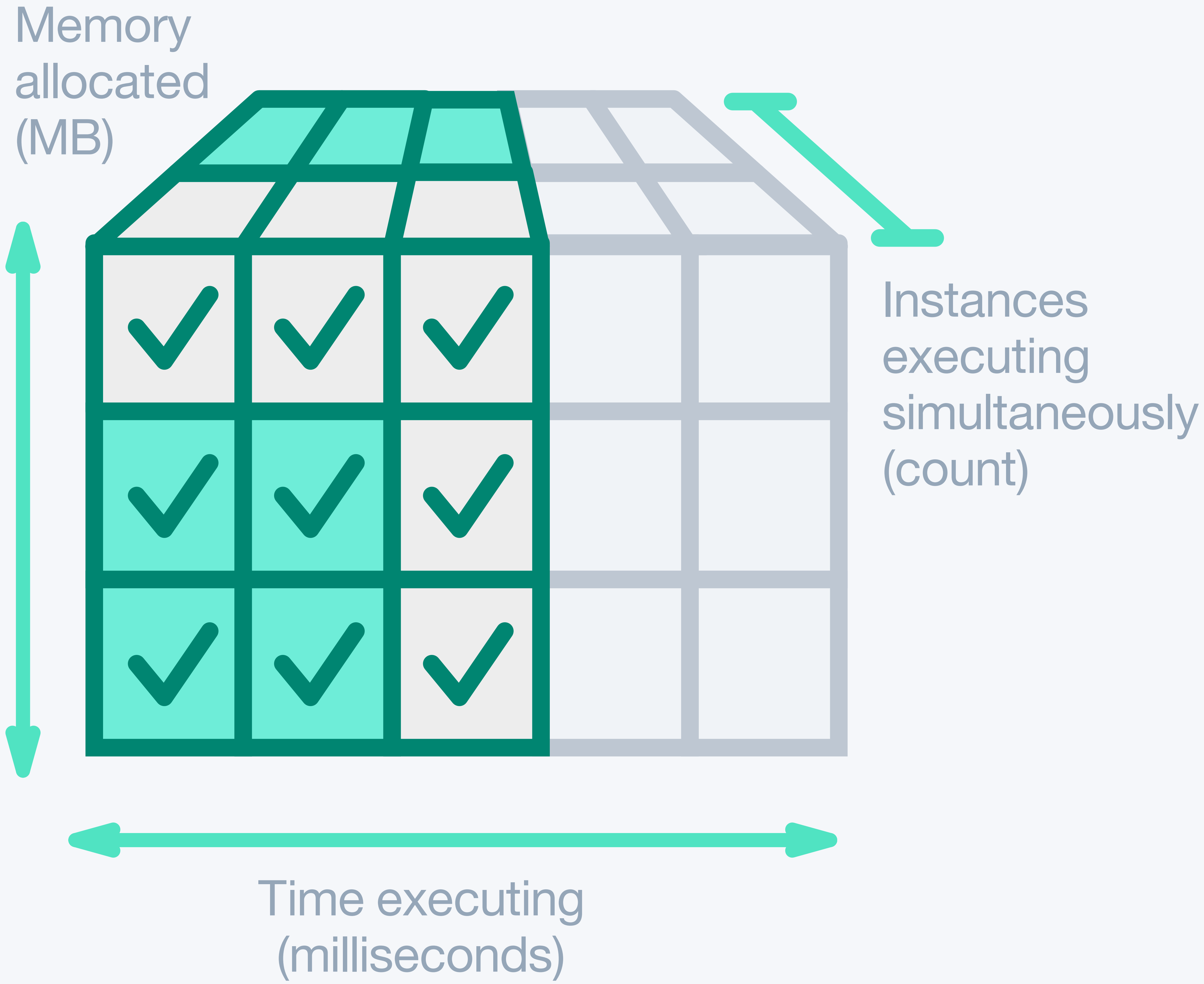
When an action is not invoked, it’s not in memory, so you don’t pay anything

Pricing model

Time an action was running
* memory allocated to action

$0.000017 per GBs

Free tier: 400000 GBs


Memory allocated (MB)
Instances executing simultaneously (count)
Time executing (milliseconds)

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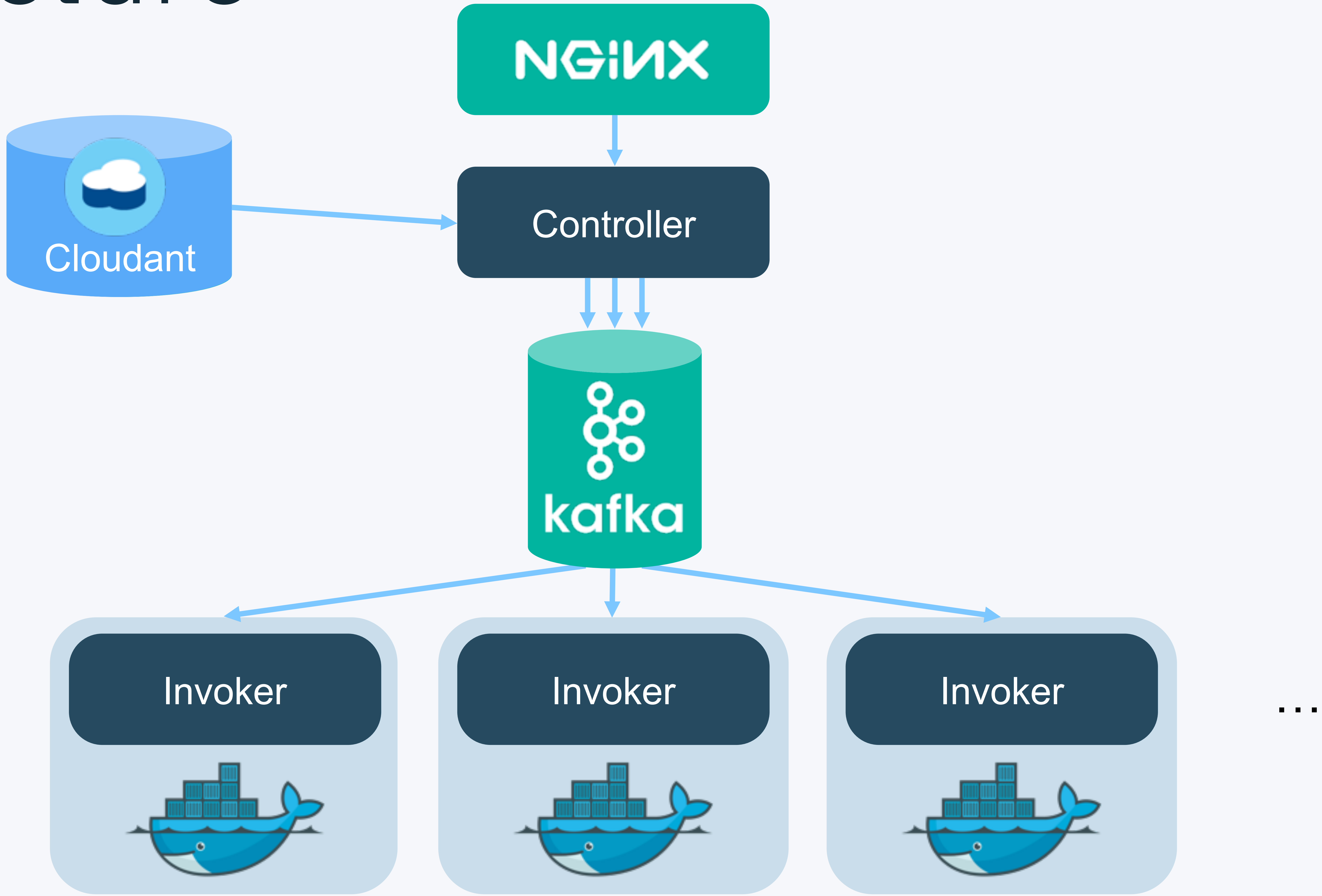
Architecture



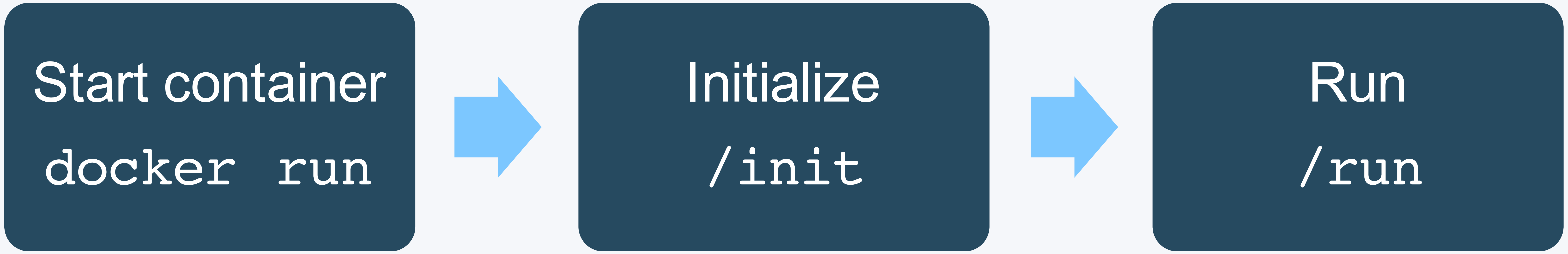
Docker-based, but...

Basically, IBM Cloud Functions is based on Docker...
but we added some smartness to meet our performance goals...

How does IBM Cloud Functions work behind the scenes?

`wsk action invoke` ≈ `docker run`

How does IBM Cloud Functions work behind the scenes?



Start container

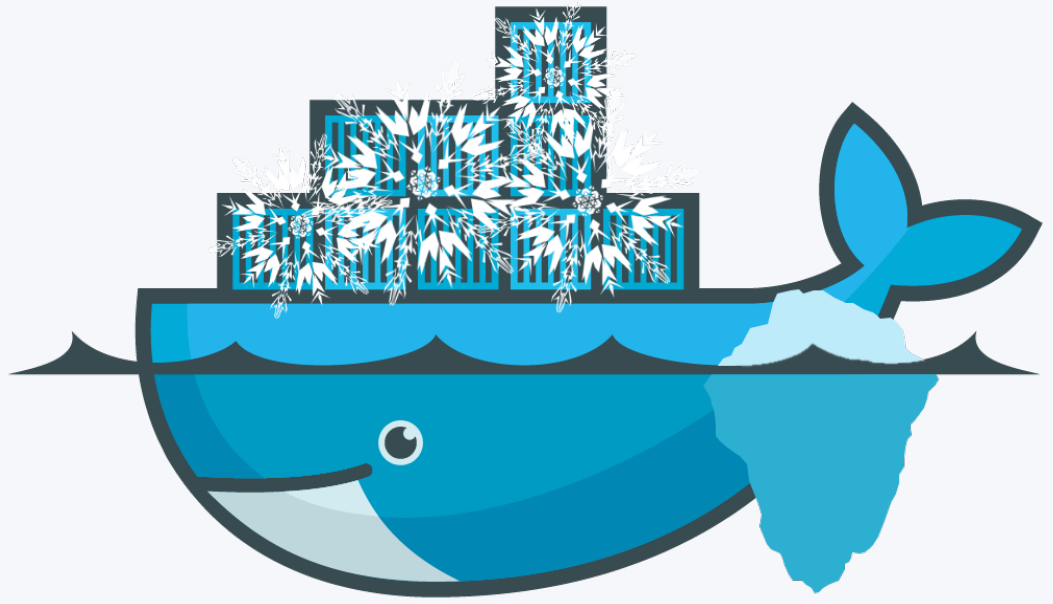
`docker run`

Initialize

`/init`

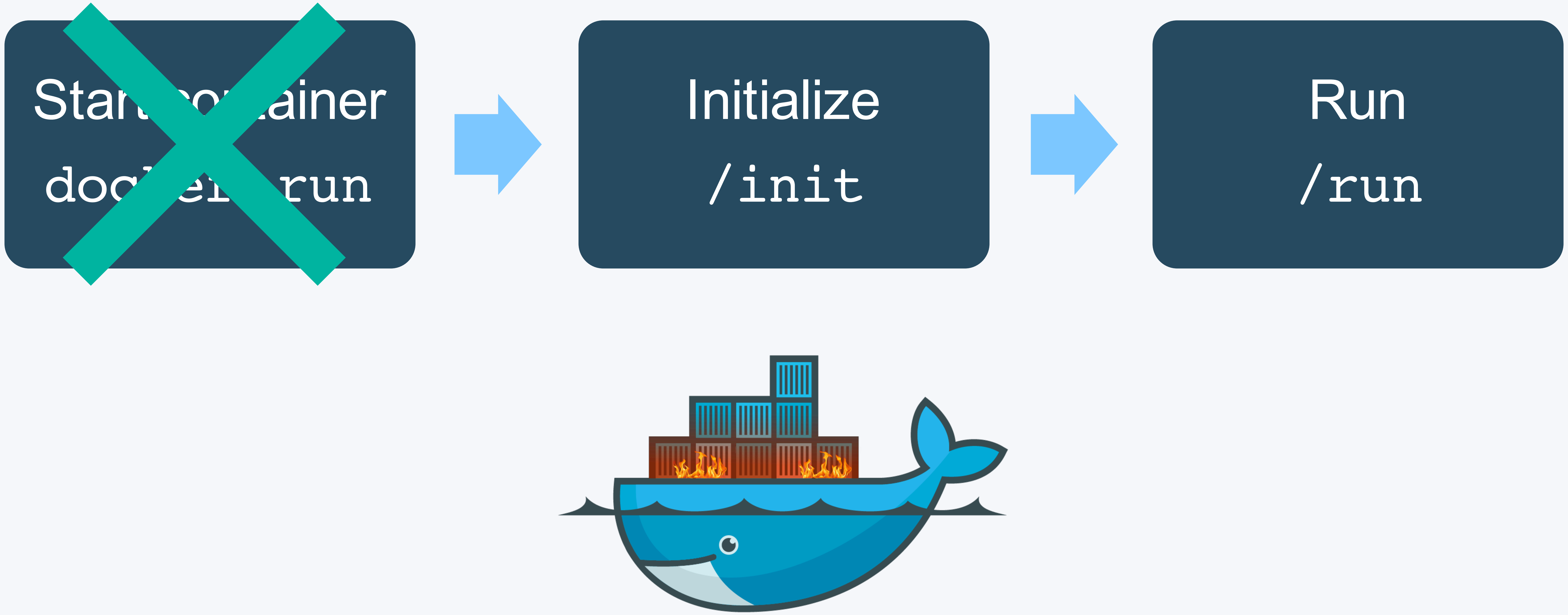
Run

`/run`



cold container

How does IBM Cloud Functions work behind the scenes?



~~Start container~~

~~`docker run`~~

Initialize

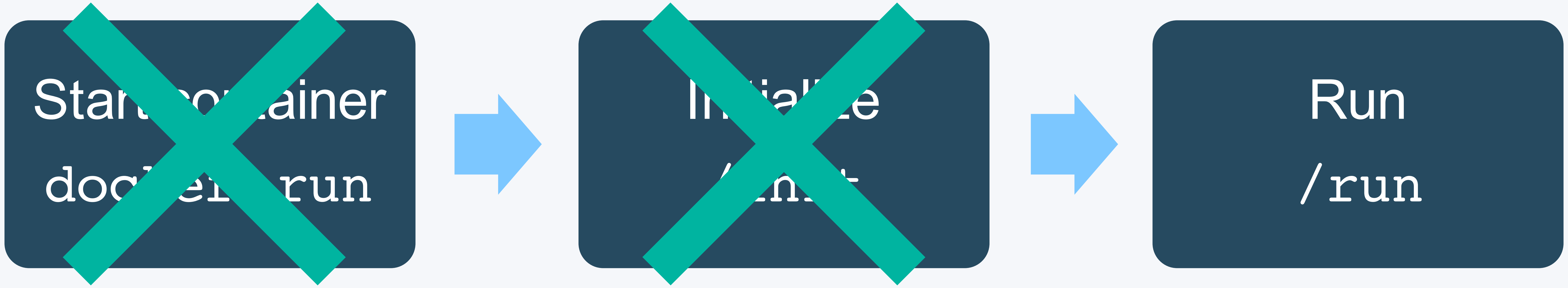
`/init`

Run

`/run`

pre-warmed container

How does IBM Cloud Functions work behind the scenes?



~~Start container~~

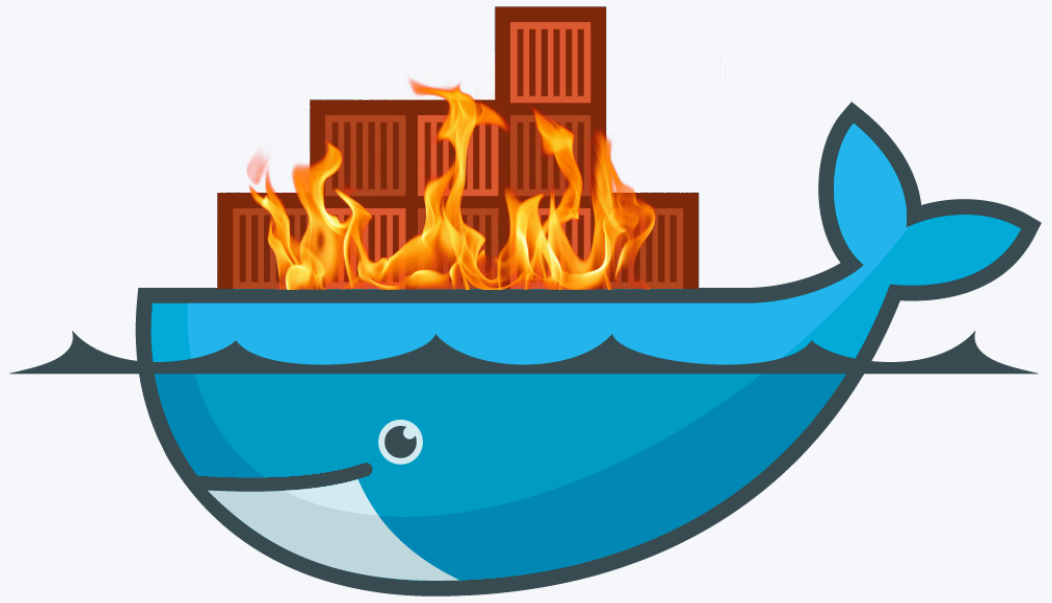
~~`docker run`~~

~~Initialize~~

~~`/init`~~

Run

`/run`



warm container

Performance is king

cold container

pre-warmed container

warm container

faster

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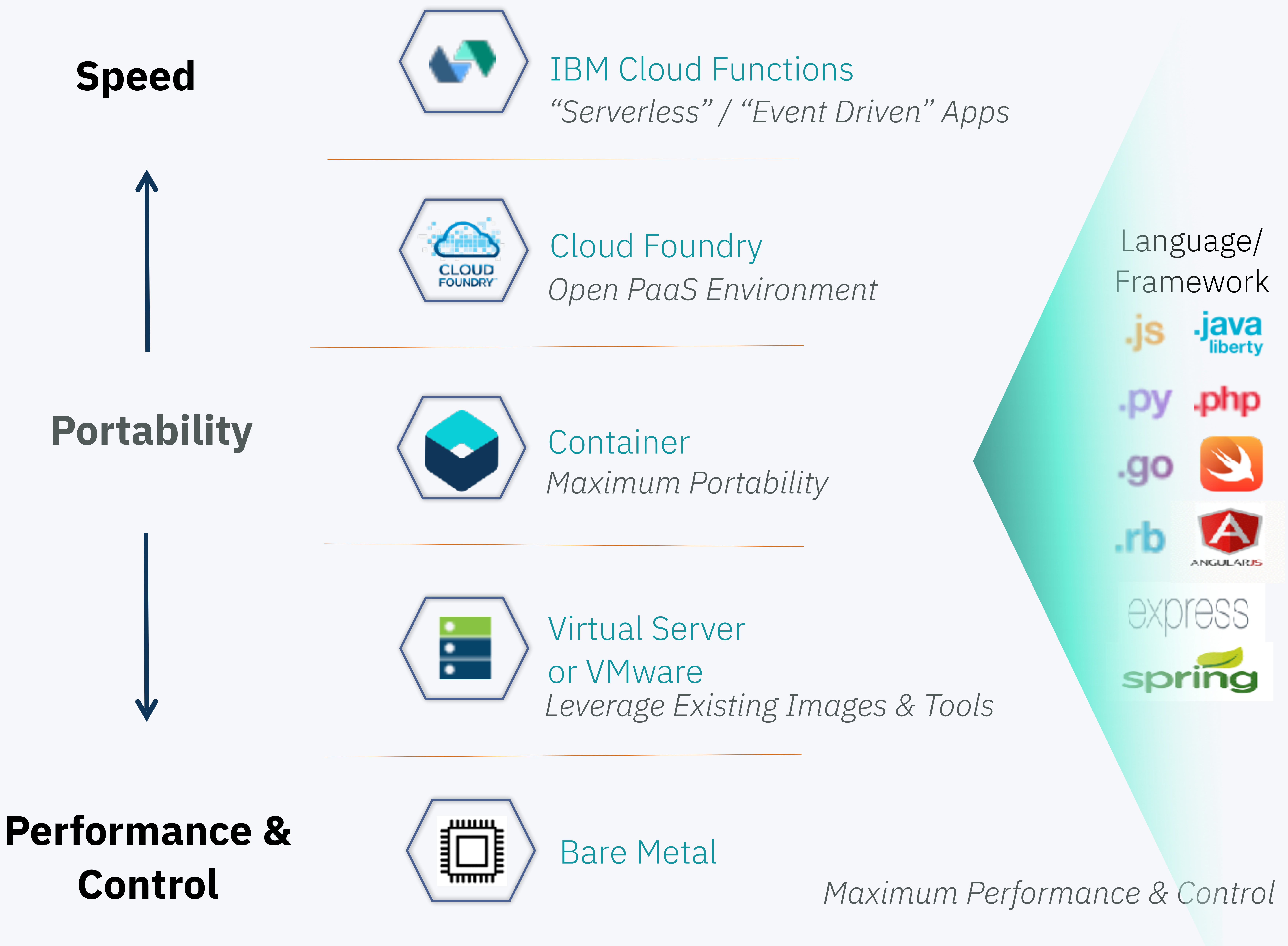
IBM Cloud Functions ecosystem & integrations



Speed

Portability

Performance & Control

IBM Cloud Functions
"Serverless" / "Event Driven" Apps

Cloud Foundry
Open PaaS Environment

Container
Maximum Portability

Virtual Server or VMware
Leverage Existing Images & Tools

Bare Metal

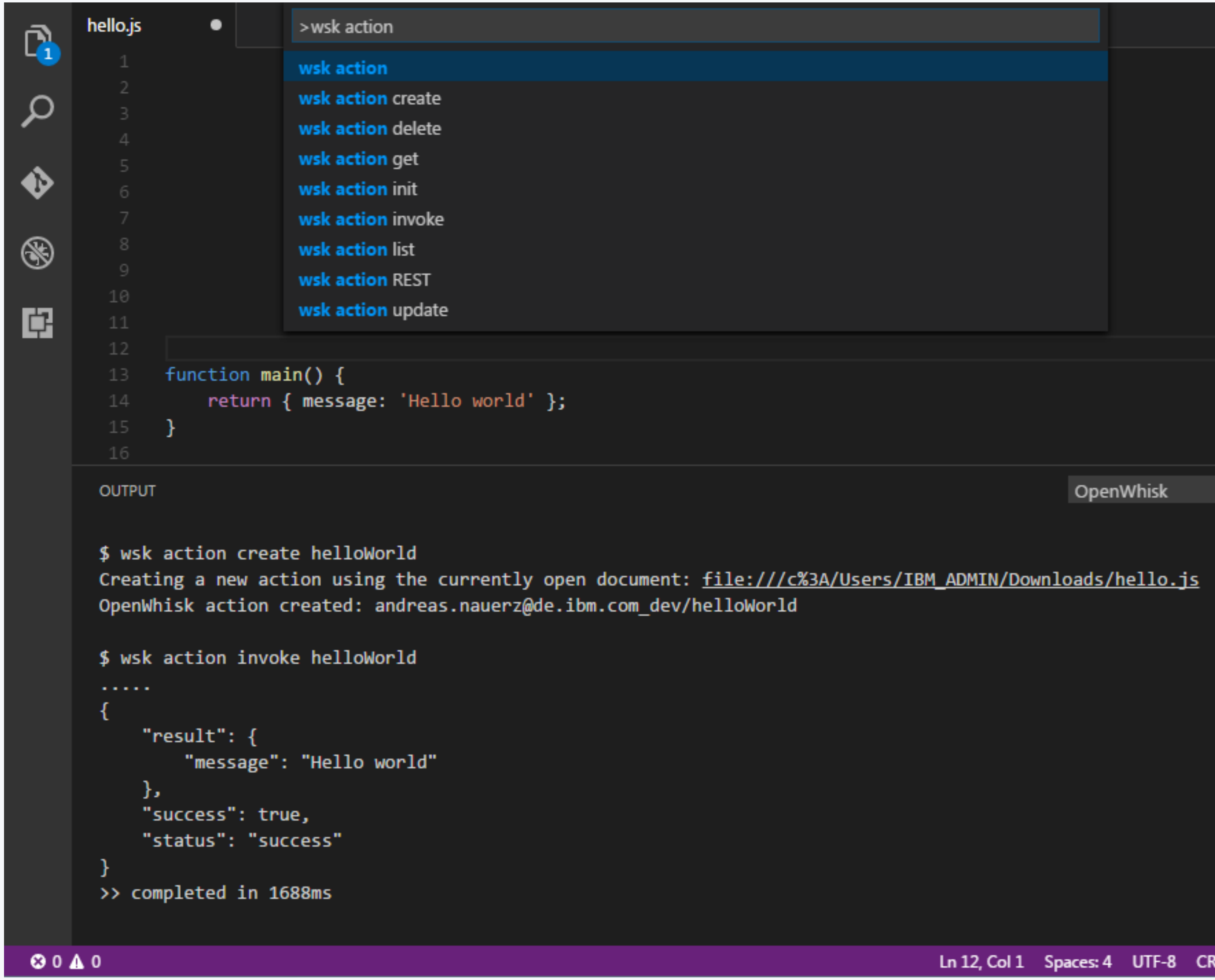
Maximum Performance & Control

Language/ Framework

Serverless Framework

Allows to package all puzzle pieces of a server less application into a single project and deploy it in a vendor-agnostic way.

Community efforts to integrate with open tools



```
function main() {
    return { message: 'Hello world' };
}
```

```
$ wsk action create helloWorld
Creating a new action using the currently open document: file:///c%3A/Users/IBM_ADMIN/Downloads/hello.js
OpenWhisk action created: andreas.nauerz@de.ibm.com_dev/helloWorld

$ wsk action invoke helloWorld
.....
{
    "result": {
        "message": "Hello world"
    },
    "success": true,
    "status": "success"
}
>> completed in 1688ms
```

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What is IBM Cloud Functions good for?

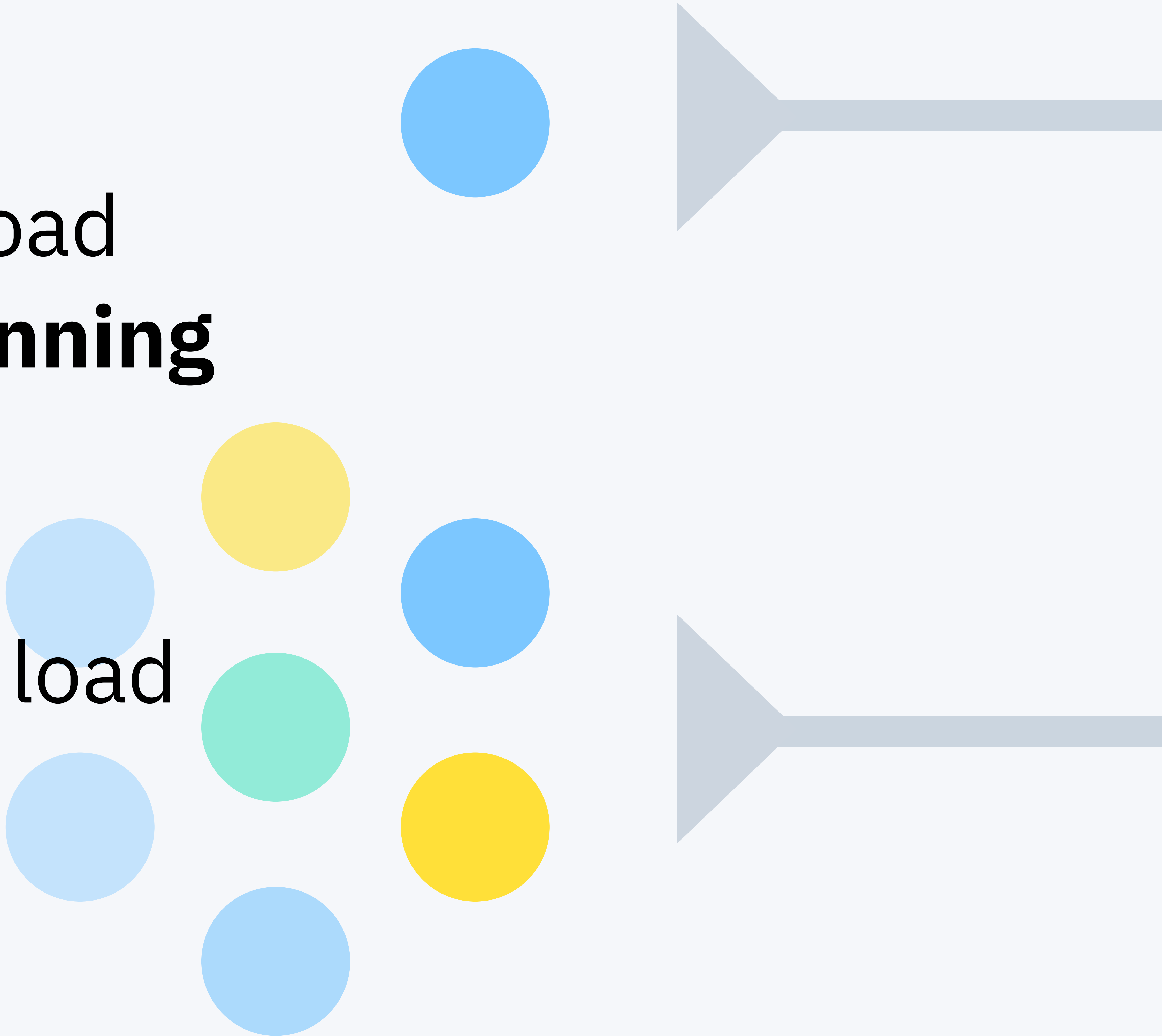
Customers

fileshadow™
cloud file assurance
KONE
GreenQ
Making Garbage Trucks Smarter
Wakefern
FOOD CORP.®
Santander
SiteSpirit
WEATHER GODS
code*
*zinger
articoolo
croosing
Taking Browsing Forward
The Weather Company
NeuroApplied
AgilSense
A S
Panorays
BIGVU
POCKET TV STUDIO

Volatile workload

Volatile and/or **event-driven** workload that can be split in smaller **short-running** pieces.

Suited for sporadic as well as heavy load scenarios.



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

Message Hub

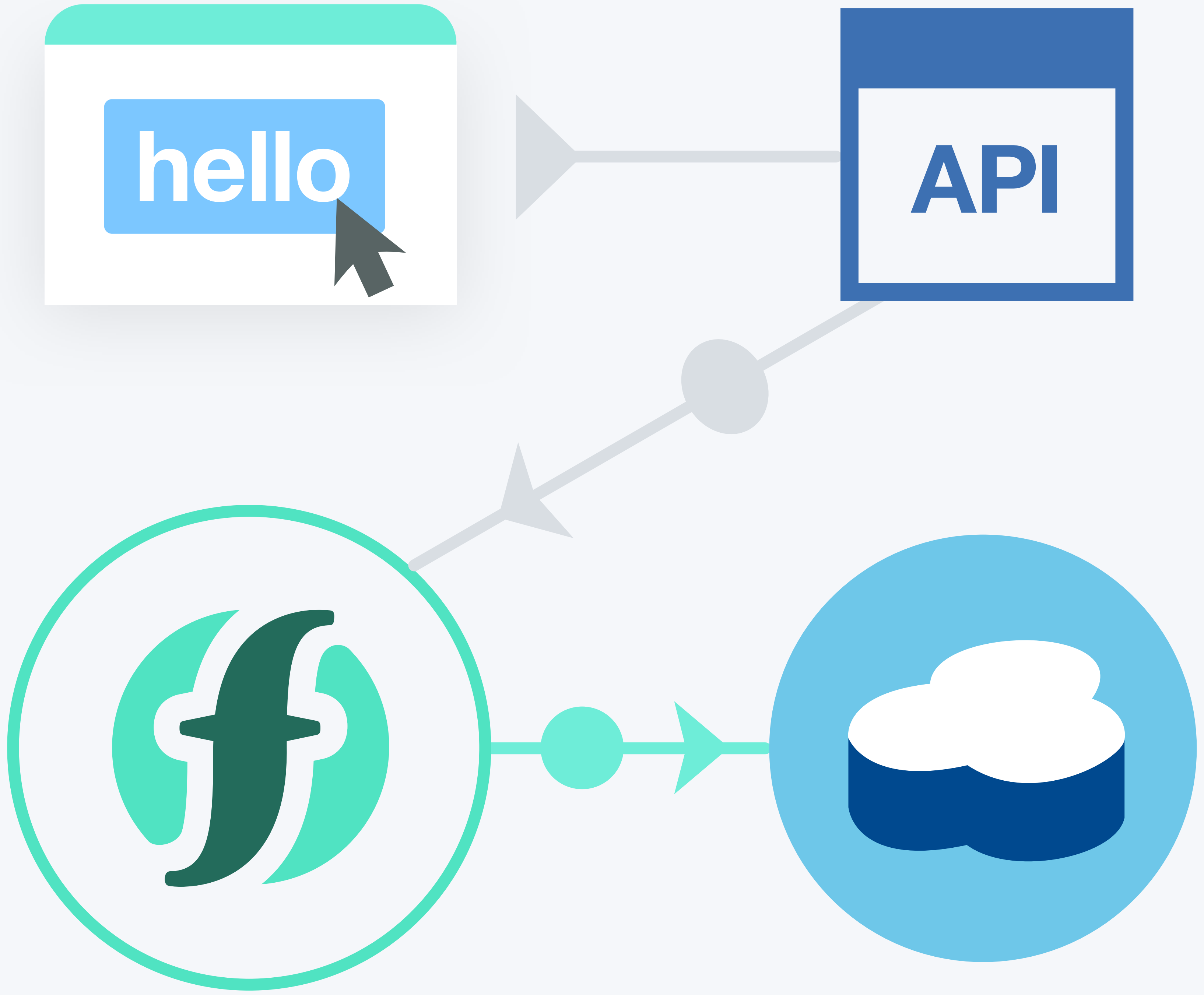
API Gateway

Watson services

SQL service

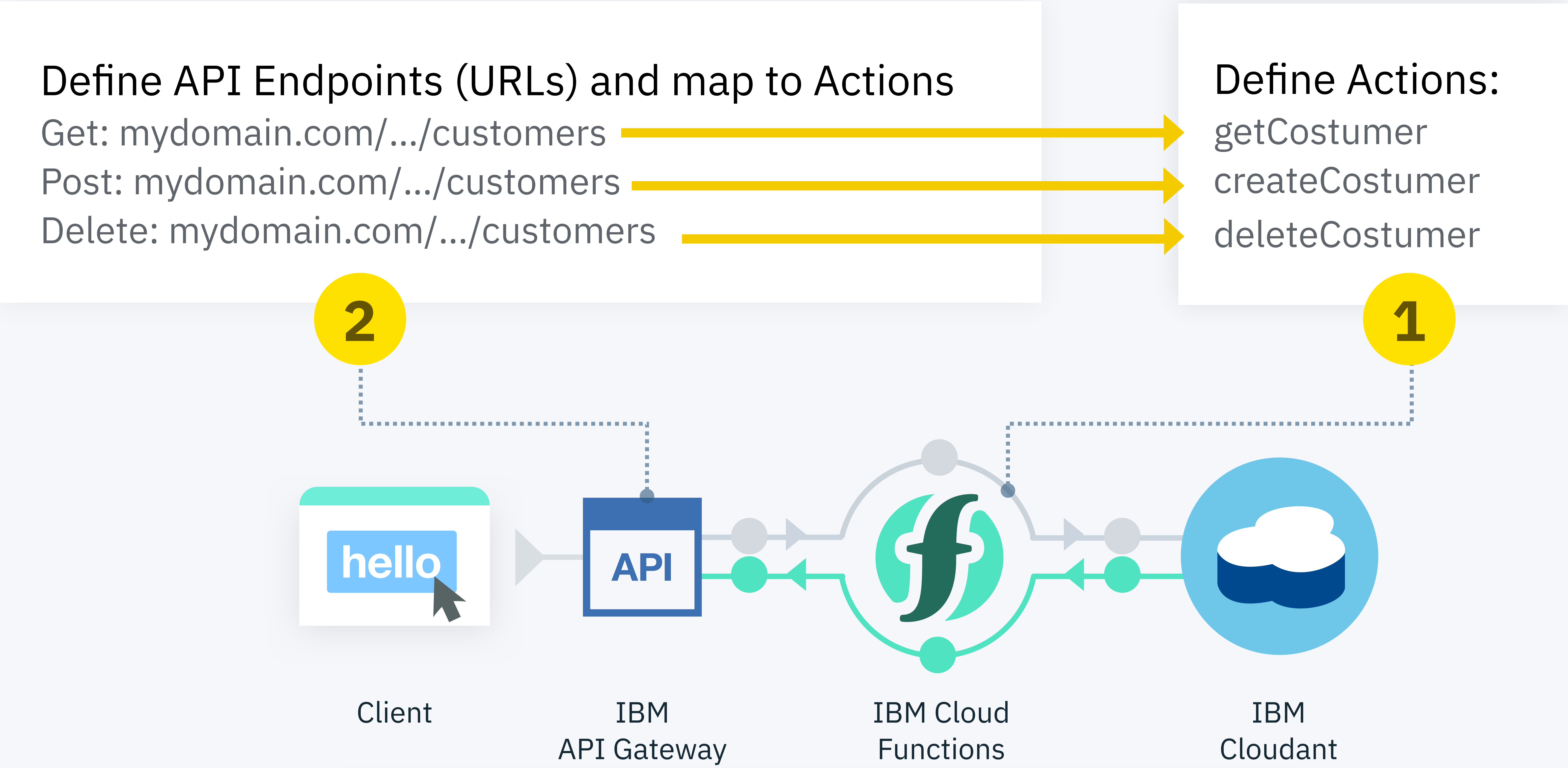
Common use-cases

- Serverless API Backends / Microservices
- Mobile backends
- Parallel data (& compute) processing
  - Data-at-rest processing & ETL pipelines
  - Data processing enriched with cognitive capabilities
  - Event Stream Processing
- IoT
- Conversational applications
- Massively parallel compute / “Map” operations
- Scheduled tasks



Microservices/ API Backends

Allows to map API endpoints to IBM Cloud Functions actions



Define API Endpoints (URLs) and map to Actions

Get: mydomain.com/.../customers

Post: mydomain.com/.../customers

Delete: mydomain.com/.../customers

Define Actions:

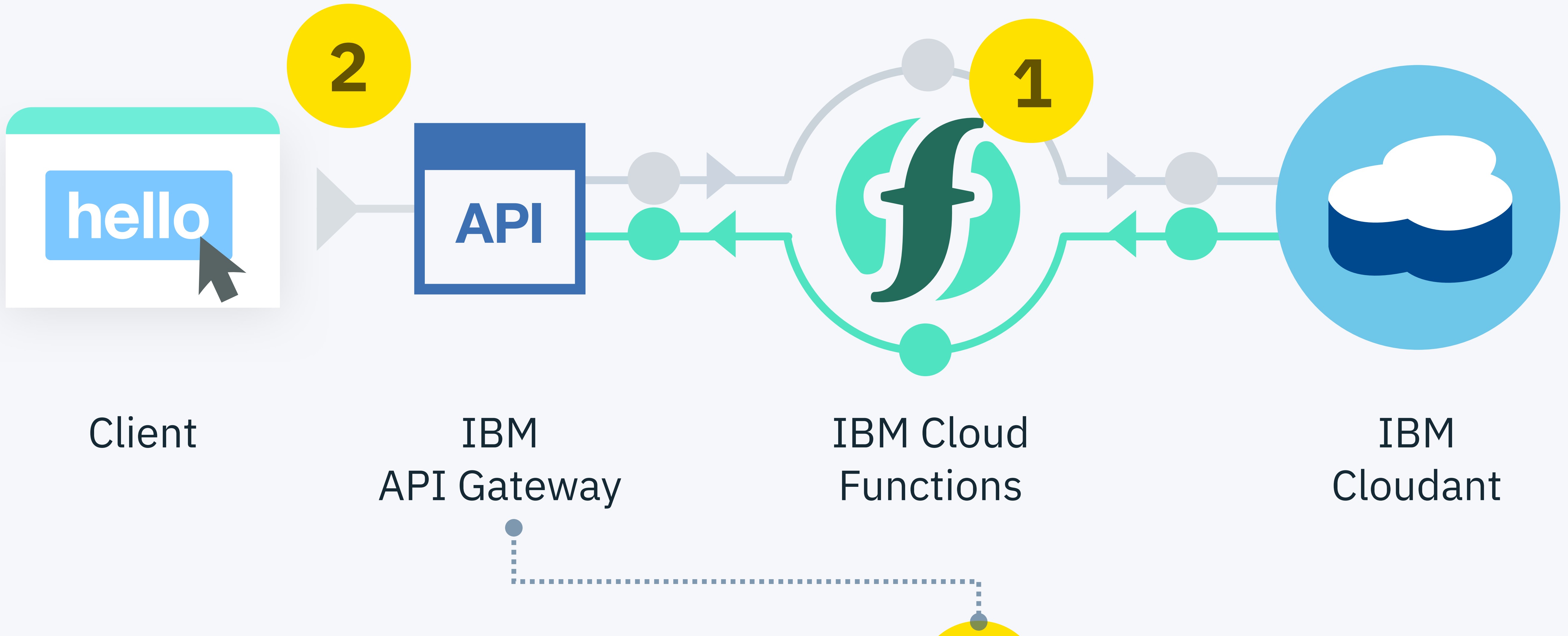
getCostumer

createCostumer

deleteCostumer

API GW available for free, without limits.

What is IBM Cloud Functions good for?

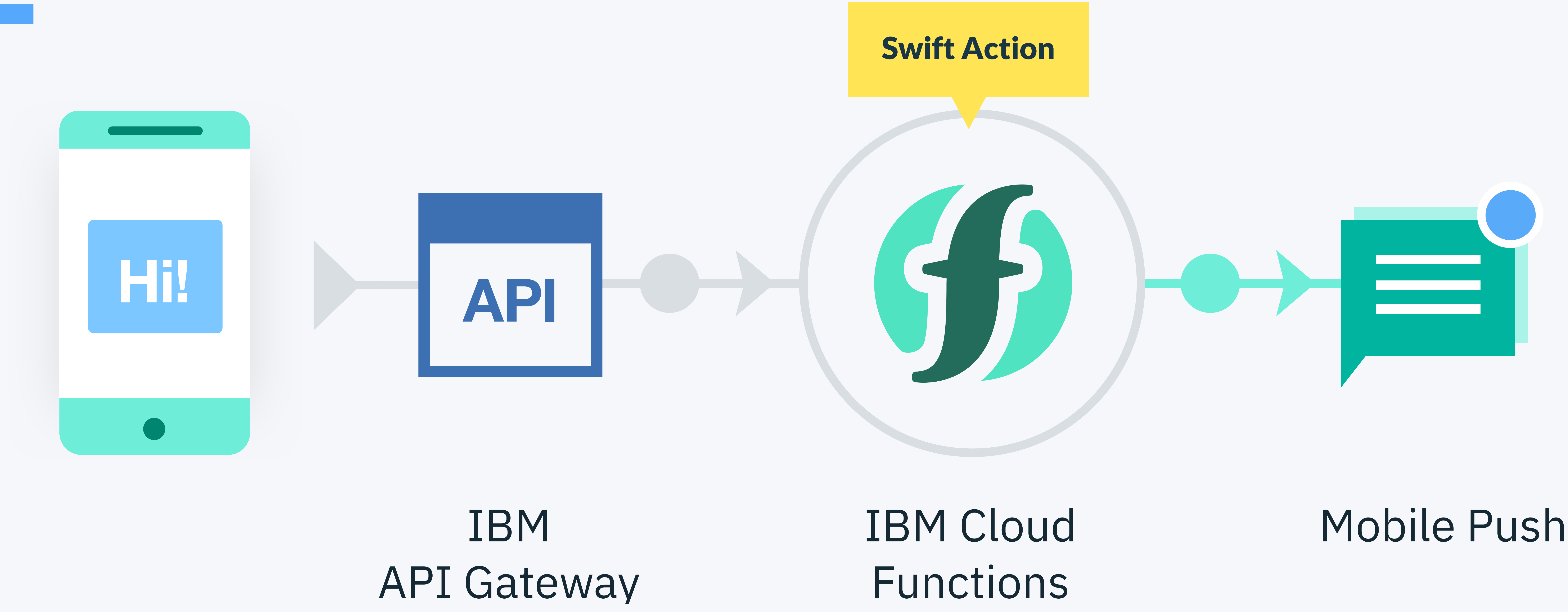


Easy to add and edit:

Security (API key, API secret, OAuth validation, CORS)
Rate-Limiting
Map actions to API endpoints (OpenAPI Doc creation)
Easy socialization (sharing, API key creation)
Analytics (API calls, errors, response time)
Test your API (API Explorer)
Upload Swagger/OpenAPI Doc

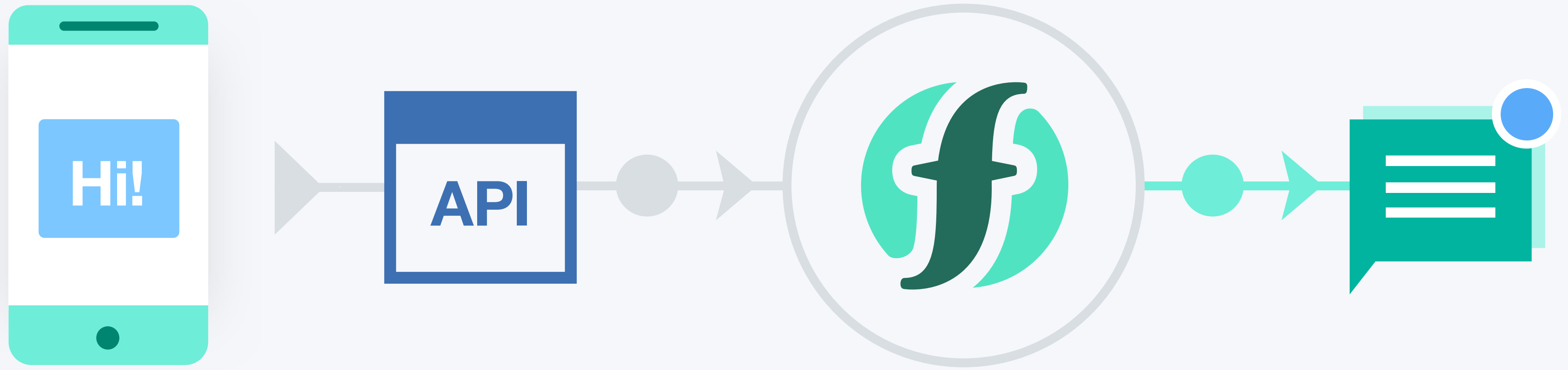
Mobile backend

Outsource compute-intensive tasks to a powerful & scalable serverless platform and implement your actions even without changing the programming language.



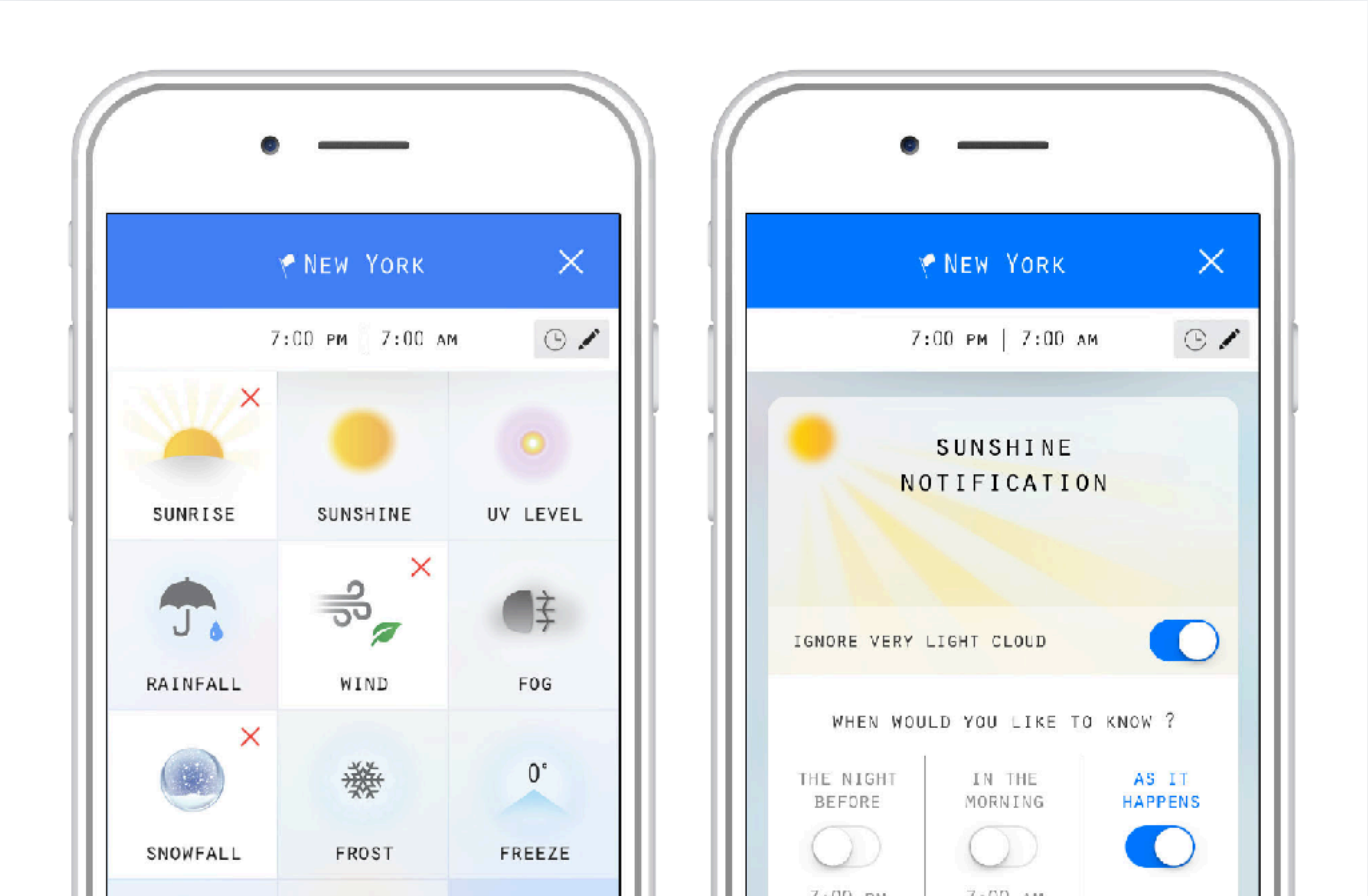
What is IBM Cloud Functions good for?

Mobile backend



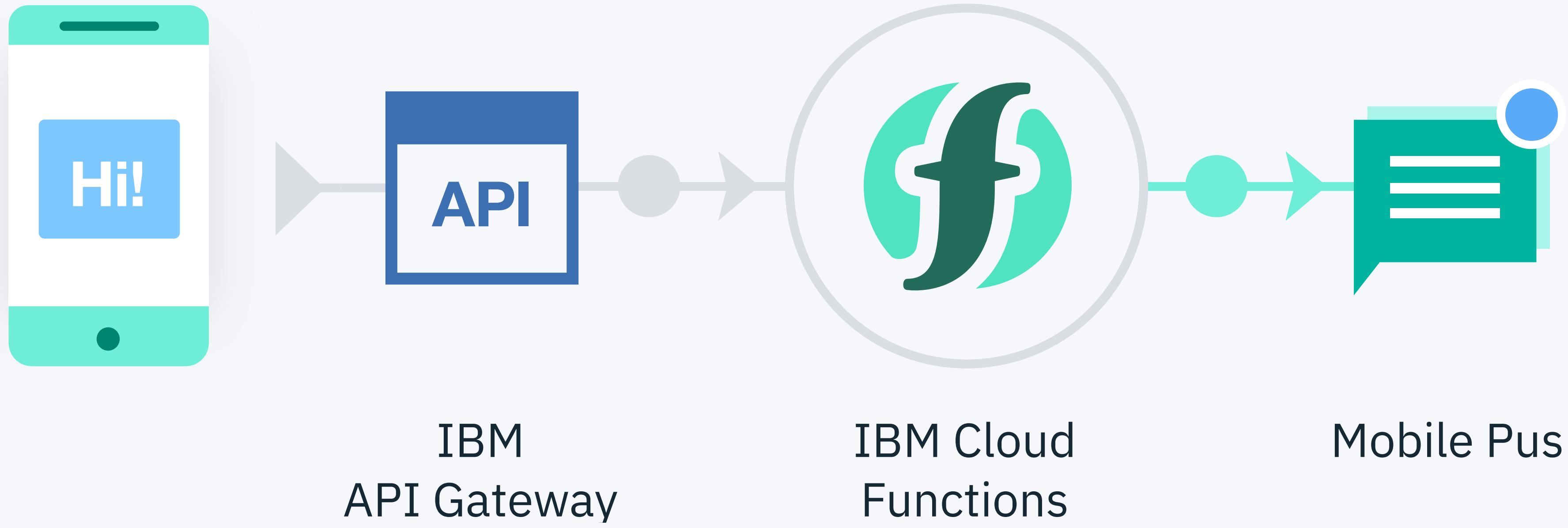
The Weather Gods

https://itunes.apple.com/us/app/weather-gods/id1041512978?mt=8



What is IBM Cloud Functions good for?

Mobile backend



DOV-E

https://www.dov-e.com/

Mobile Payment Transactions

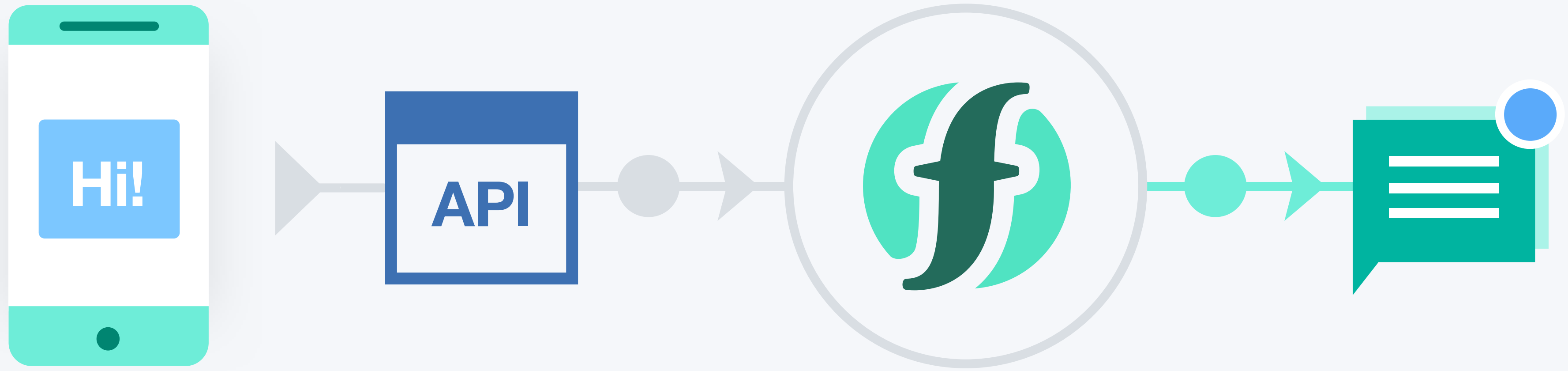
DOV-E enabled Application Buyer
DOV-E enabled Application Merchant

Mobile Promotions

DOV-E enabled Application
Ultrasonic sound Source

What is IBM Cloud Functions good for?

Mobile backend

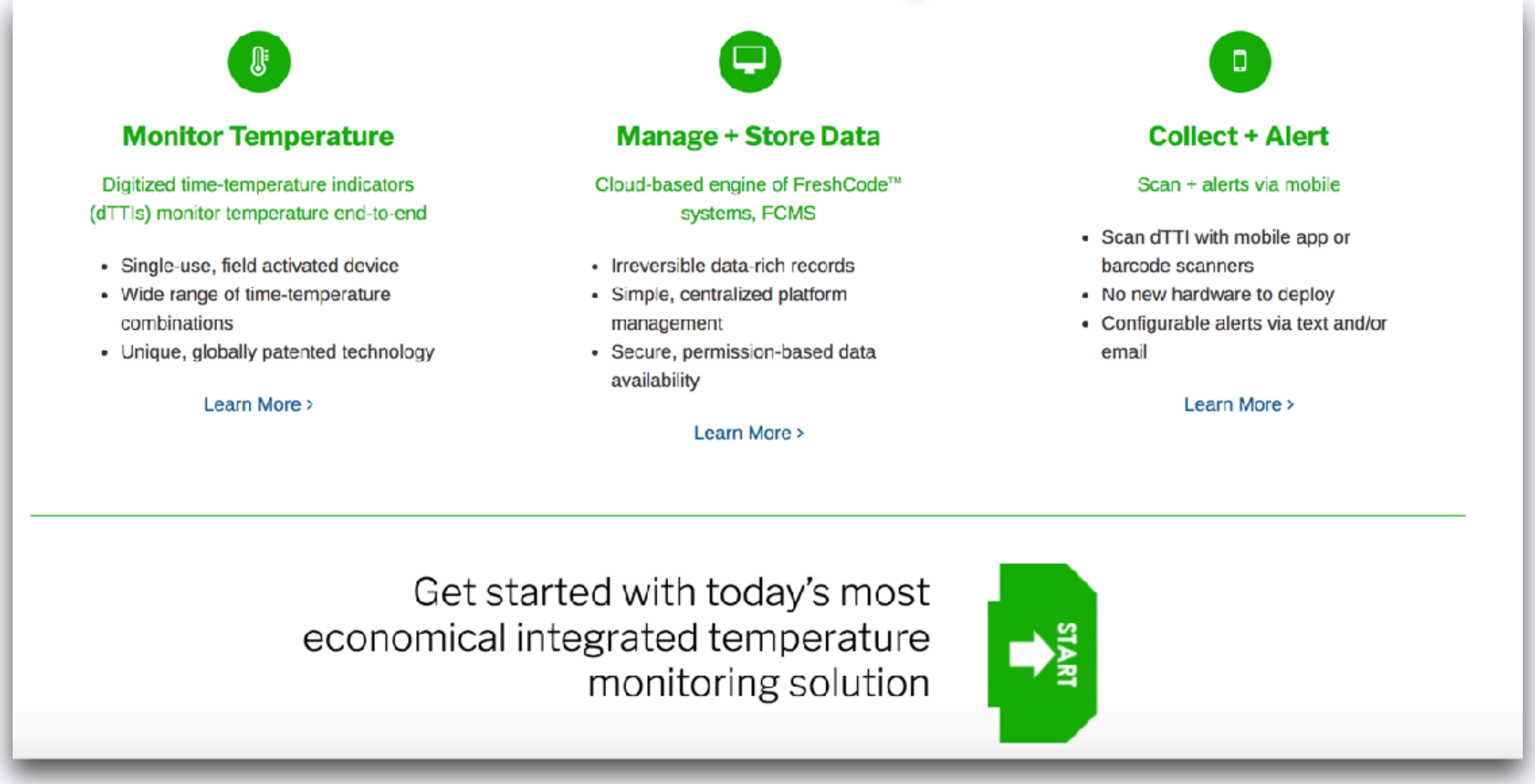


IBM API Gateway

IBM Cloud Functions

Mobile Push

Varcode
https://www.varcode.com/



Monitor Temperature

Digitized time-temperature indicators (dTTIs) monitor temperature end-to-end

- Single-use, field activated device
- Wide range of time-temperature combinations
- Unique, globally patented technology

Learn More ›

Manage + Store Data

Cloud-based engine of FreshCode™ systems, FCMS

- Irreversible data-rich records
- Simple, centralized platform management
- Secure, permission-based data availability

Learn More ›

Collect + Alert

Scan + alerts via mobile

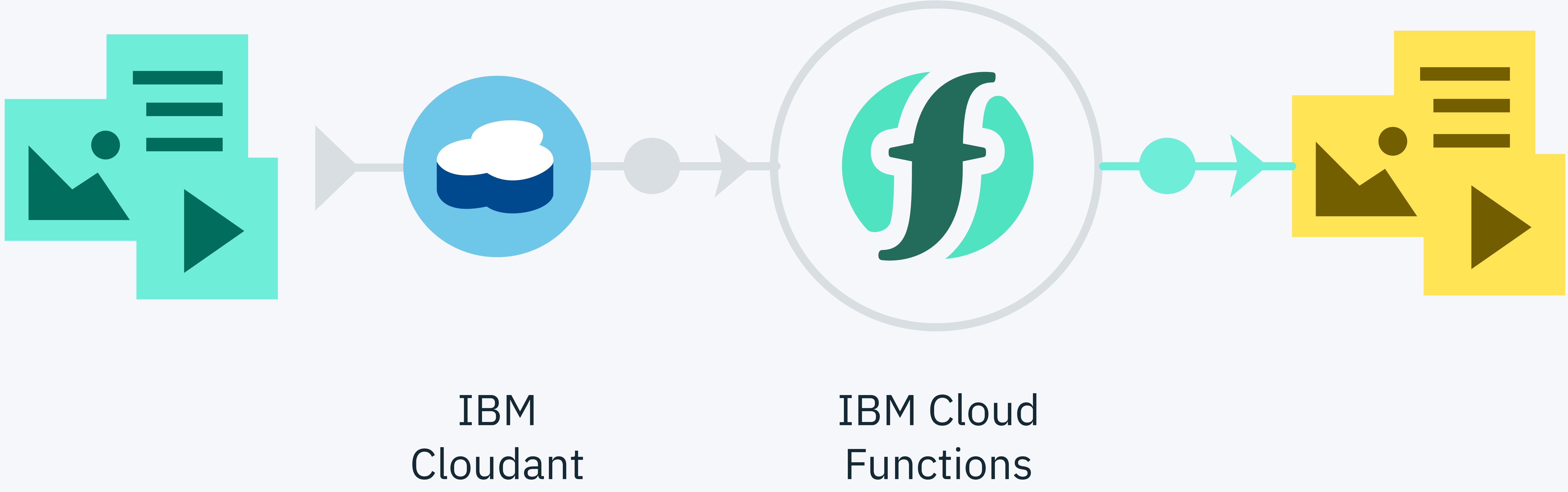
- Scan dTTI with mobile app or barcode scanners
- No new hardware to deploy
- Configurable alerts via text and/or email

Learn More ›

Get started with today's most economical integrated temperature monitoring solution

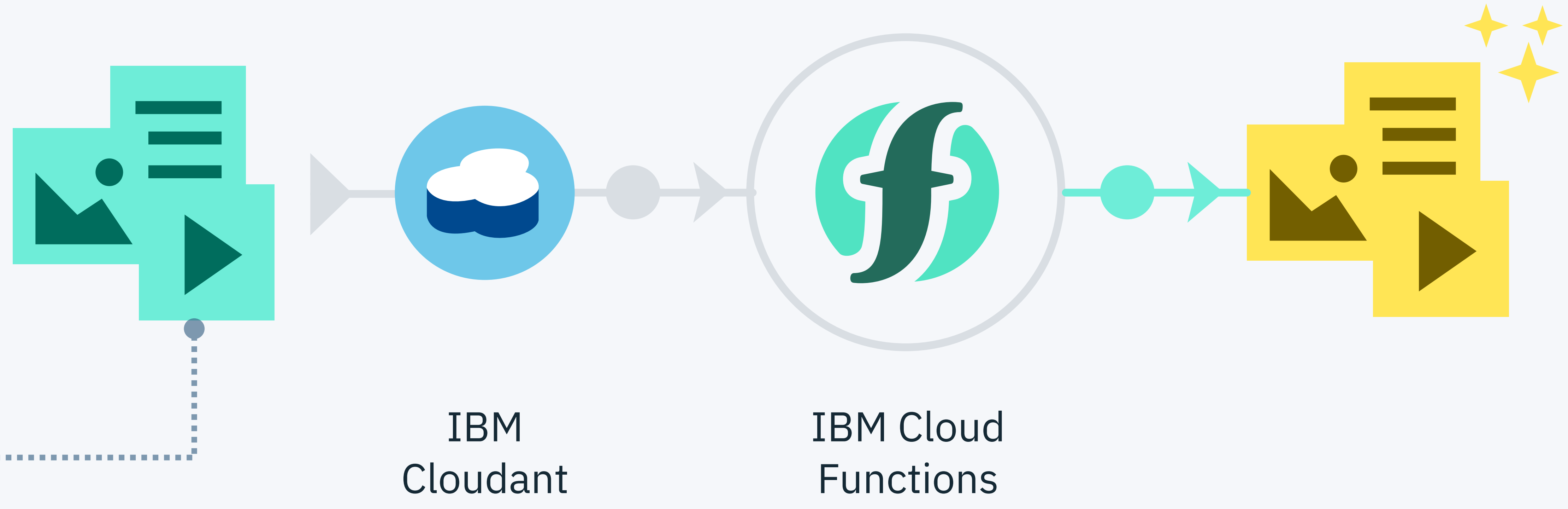
START

Data-at-rest processing & ETL pipelines



What is IBM Cloud Functions good for?

Data processing

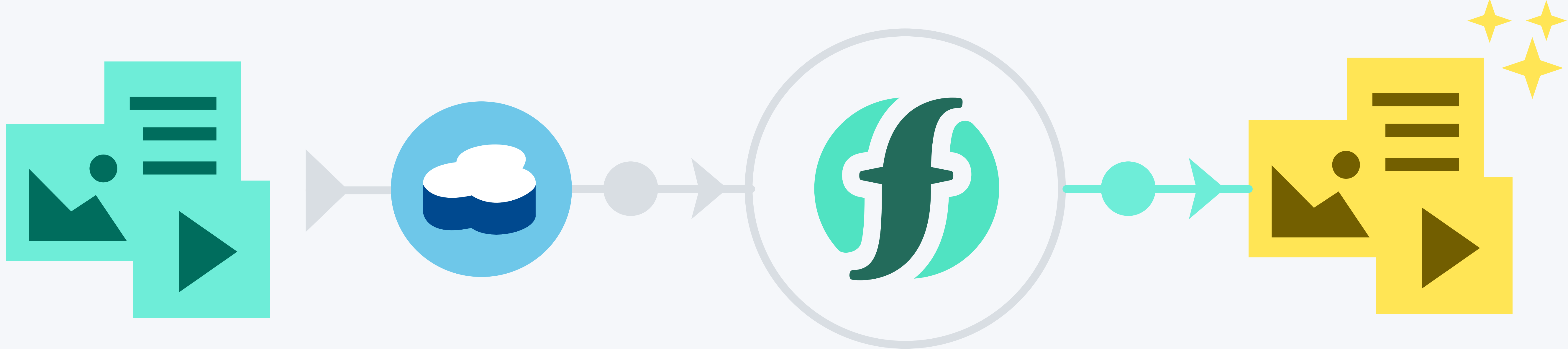


Ideally suited for working with structured data, text, audio, image and video data:

- Data enrichment, transformation, validation, cleansing
- PDF processing
- Audio normalization
- Image rotation, sharpening, noise reduction or
- Thumbnail generation
- Image OCR’ing
- Applying ML toolkits
- Video transcoding

What is IBM Cloud Functions good for?

Data processing



IBM Cloudant

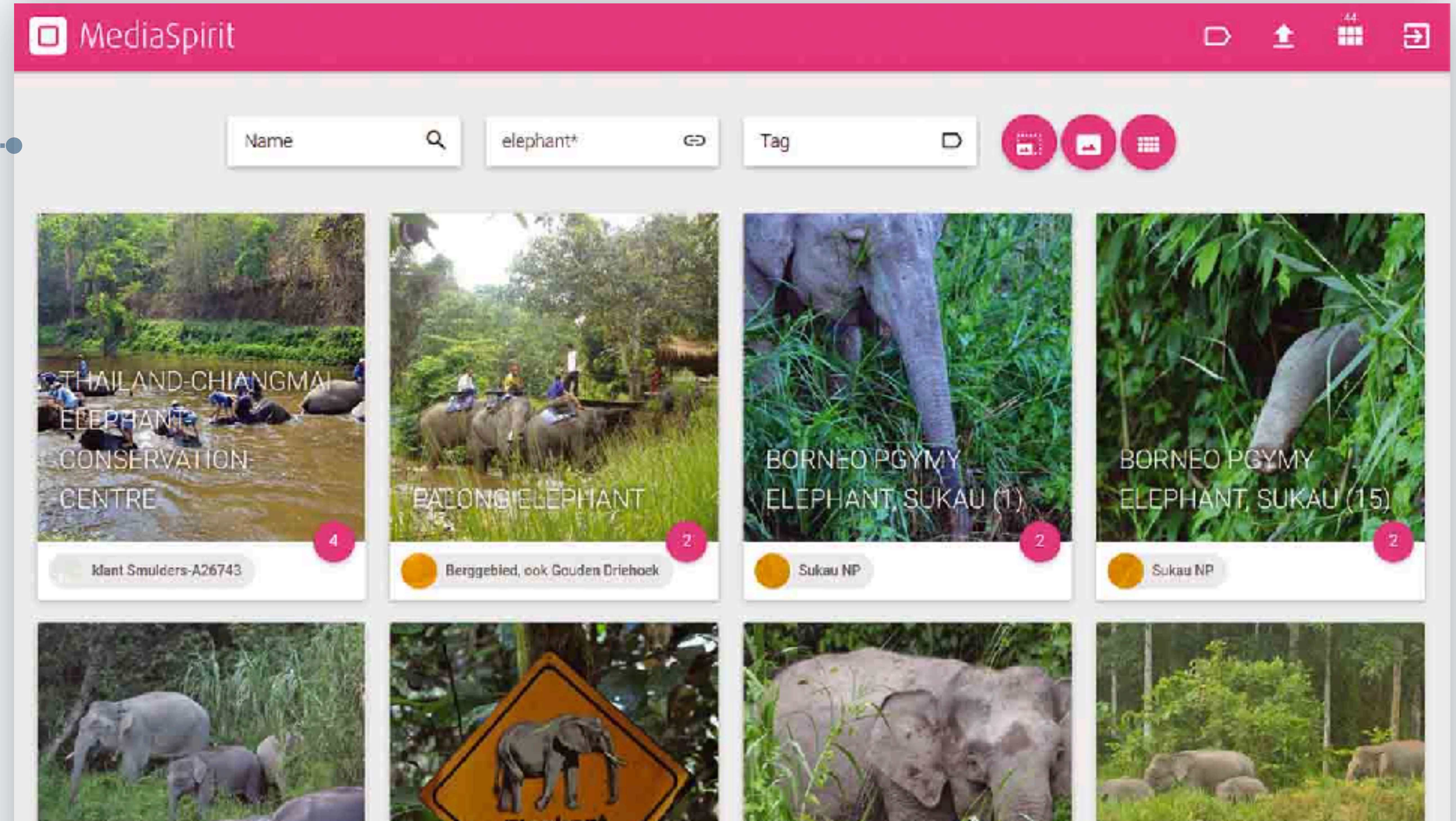
IBM Cloud Functions

SiteSpirit

http://ecc.ibm.com/case-study/us-en/ECCF-CDC12387USEN

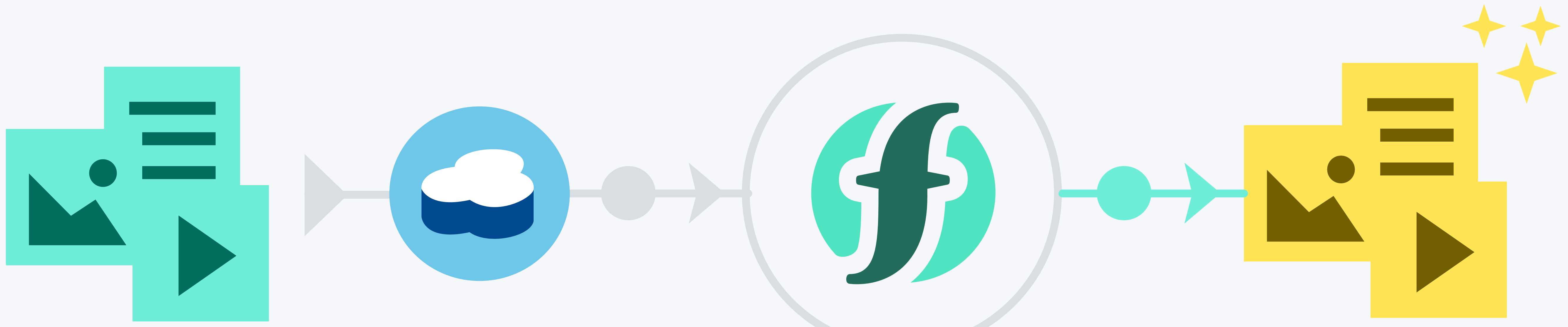
10x faster

90% less cost


MediaSpirit
Name
elephant*
Tag
THAILAND-CHIANGMAI ELEPHANT CONSERVATION CENTRE
4
Klant Smulders-A26743
PATONG ELEPHANT
2
Berggebied, ook Gouden Driehoek
BORNEO PGYMY ELEPHANT, SUKAU (1)
2
Sukau NP
BORNEO PGYMY ELEPHANT, SUKAU (15)
2
Sukau NP

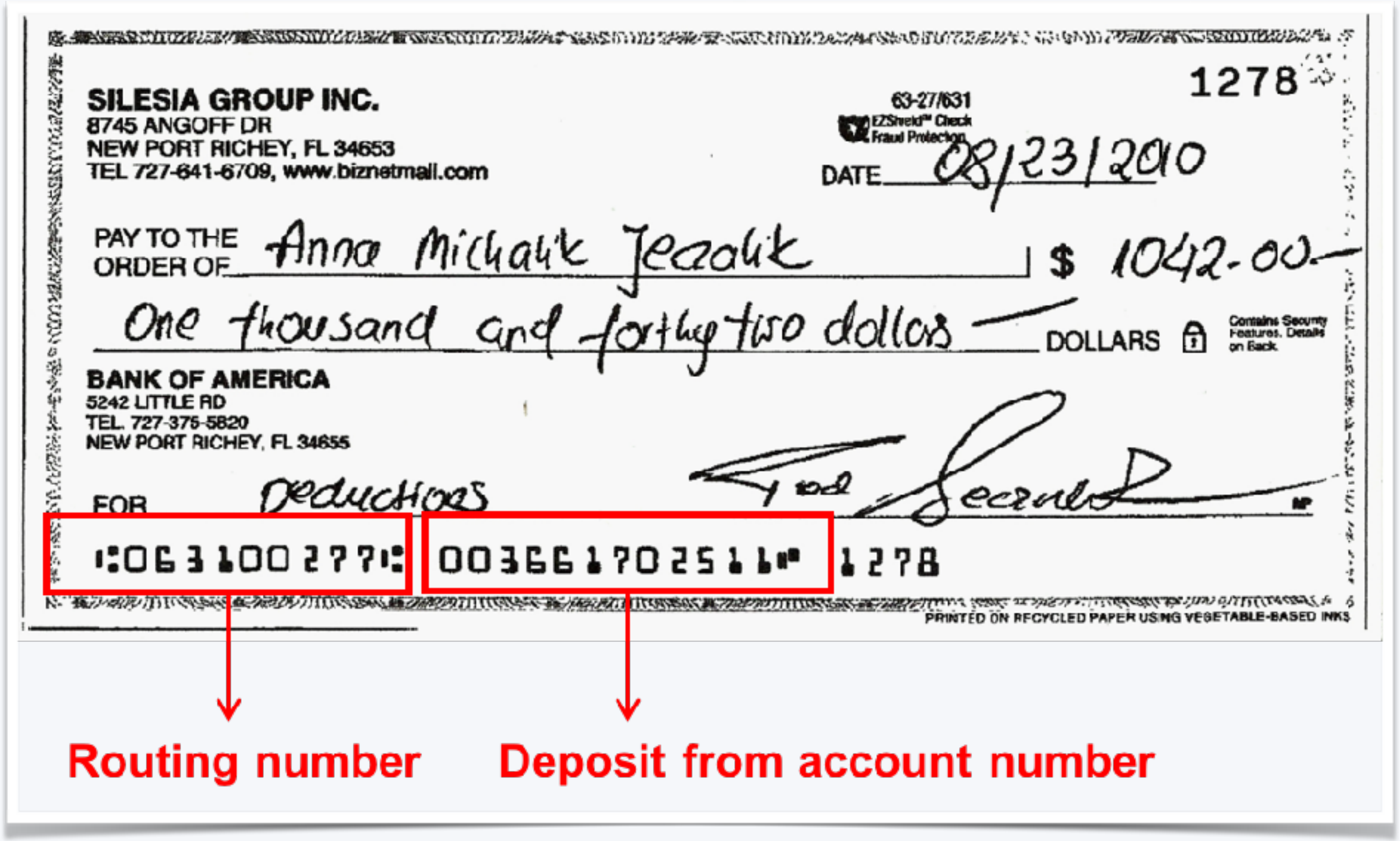
What is IBM Cloud Functions good for?

Data processing



Santander

Less cost
<$2 for all paper checks processed within 1 year



SILESIA GROUP INC.
8745 ANGOFF DR
NEW PORT RICHEY, FL 34653
TEL 727-641-6709, www.biznetmail.com

1278

63-27/631
EZShield™ Check Fraud Protection

DATE 08/23/2010

PAY TO THE ORDER OF Anna Michalik Jezalik $ 1042.00

One thousand and forthy two dollars DOLLARS

Contains Security Features. Details on Back.

BANK OF AMERICA
5242 LITTLE RD
TEL. 727-375-5820
NEW PORT RICHEY, FL 34655

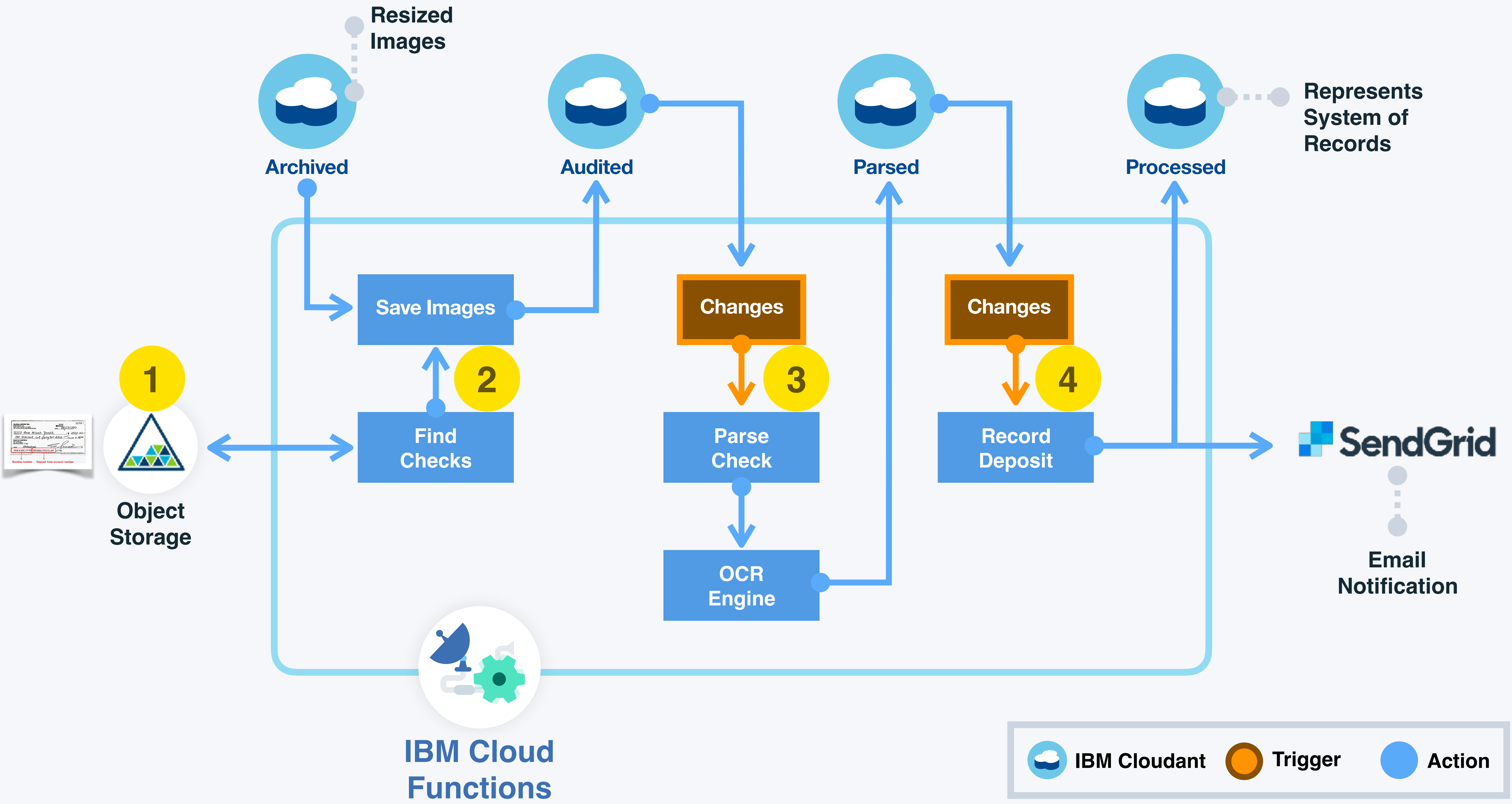
FOR Deductions

⑆063100277⑆ 003661702511⑈ 1278

PRINTED ON RECYCLED PAPER USING VEGETABLE-BASED INKS

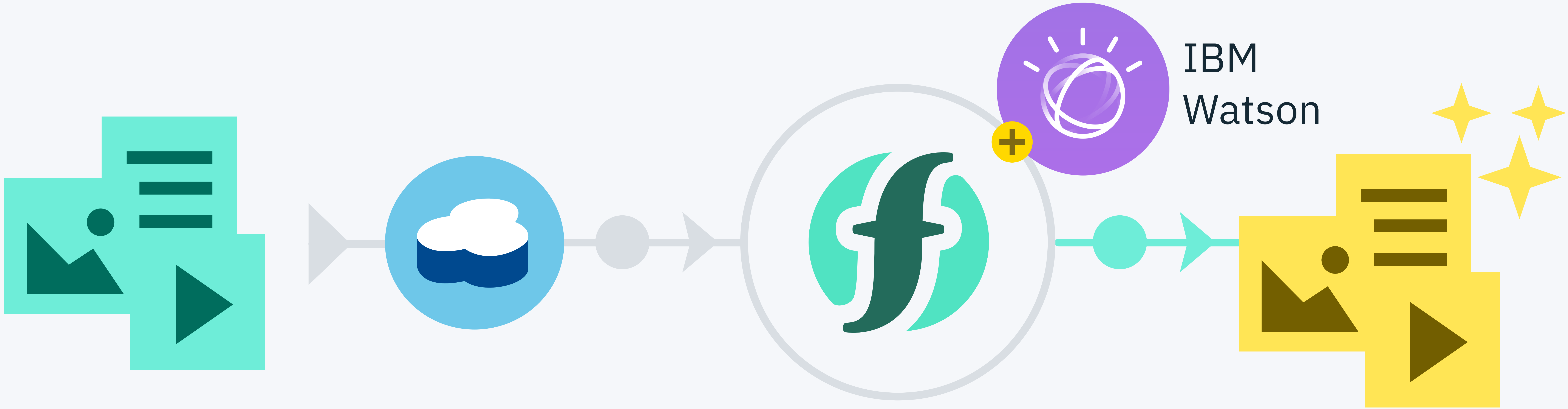
Routing number **Deposit from account number**

What is IBM Cloud Functions good for?



What is IBM Cloud Functions good for?

Cognitive



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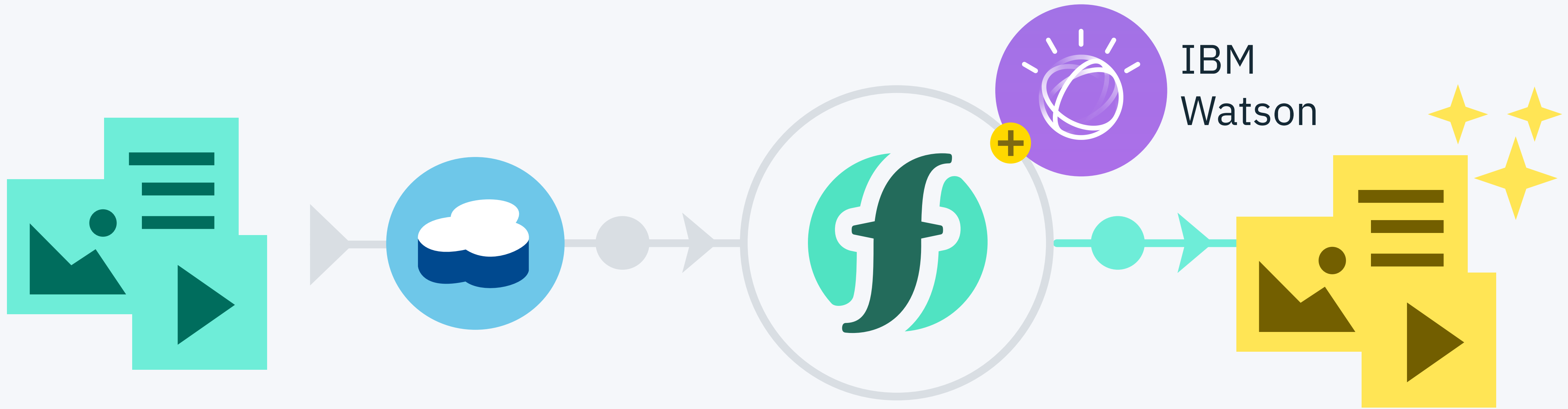
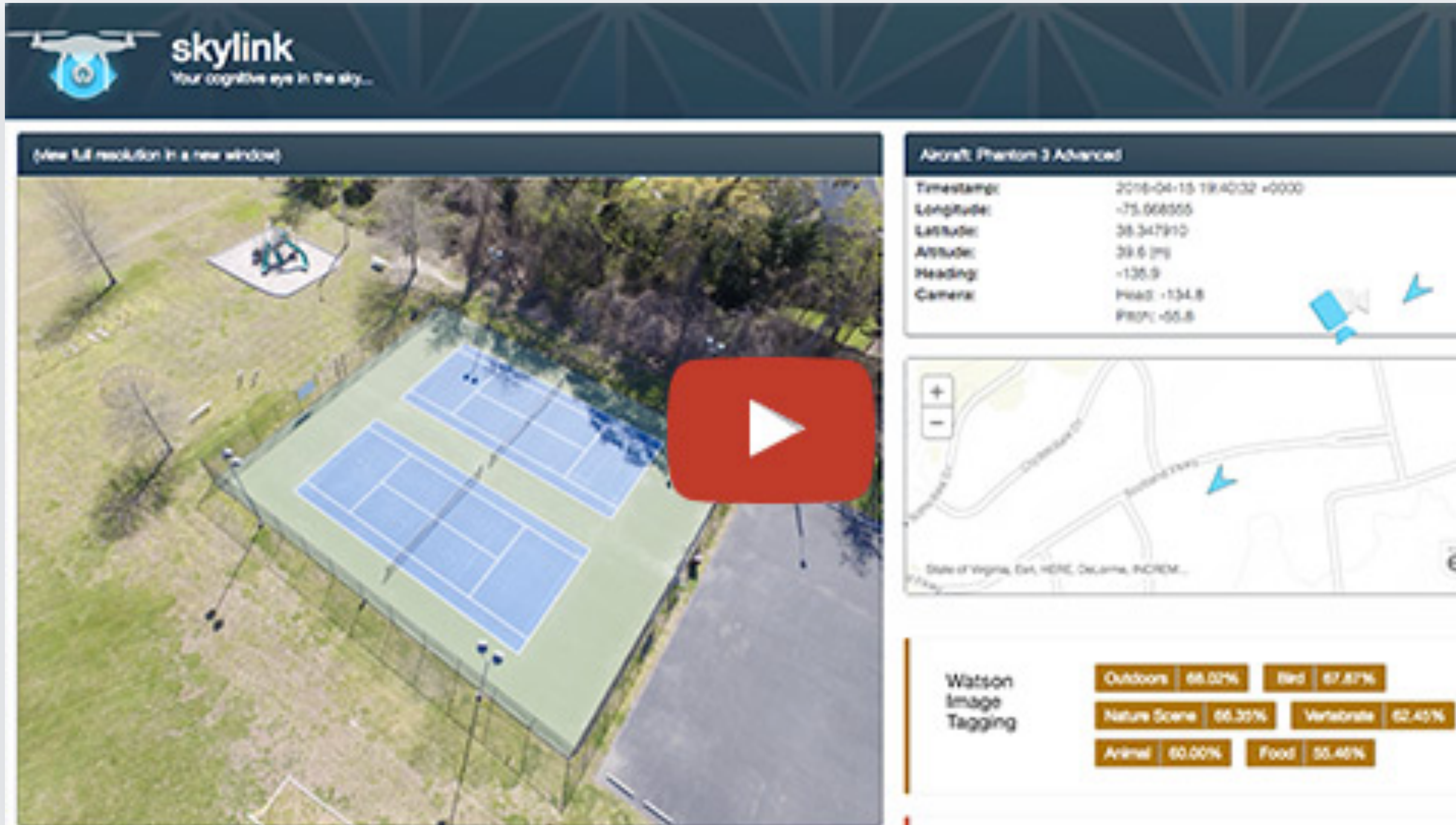


Skylink
https://github.com/IBM-Bluemix/skylink


skylink
Your cognitive eye in the sky...
(view full resolution in a new window)
State of Virginia, Esri, HERE, DeLorme, INCREM...

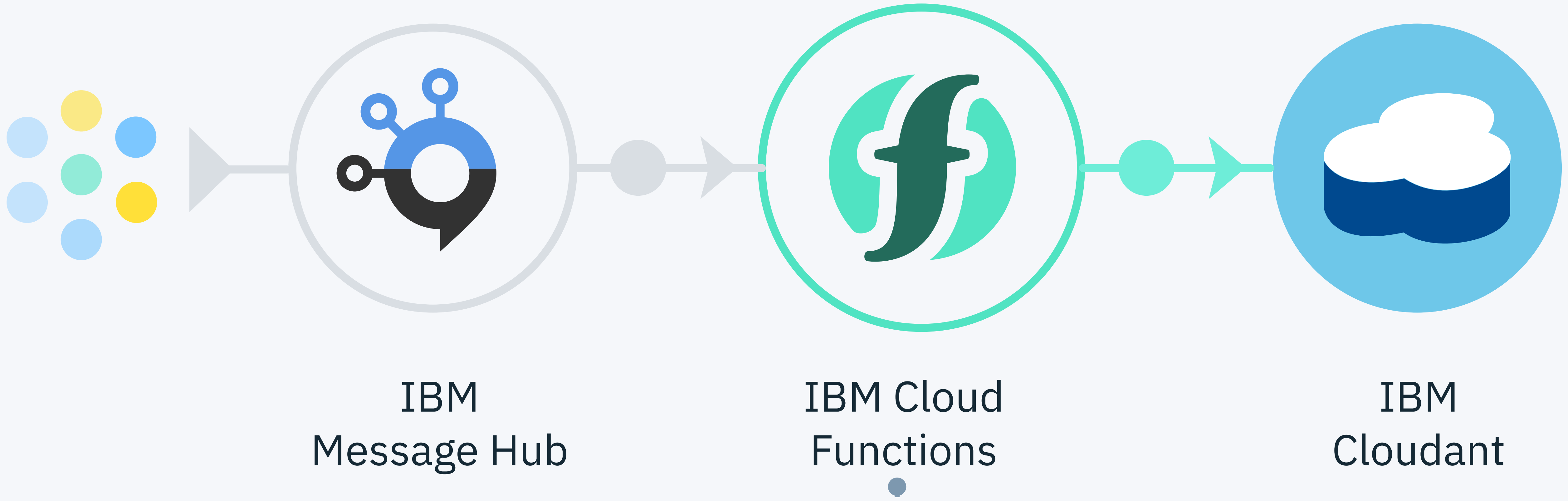
Aircraft: Phantom 3 Advanced

Timestamp: 2016-04-15 19:40:32 +0000
Longitude: -75.668555
Latitude: 38.347910
Altitude: 39.6 (m)
Heading: -135.9
Camera: Head: -134.8
Pitch: -55.8

Watson Image Tagging

Outdoors	68.02%
Bird	67.87%
Nature Scene	66.35%
Vertebrate	62.45%
Animal	60.00%
Food	50.46%

Event stream processing via Message Hub



Managed Apache Kafka service for real-time build outs of data pipelines and streaming apps

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

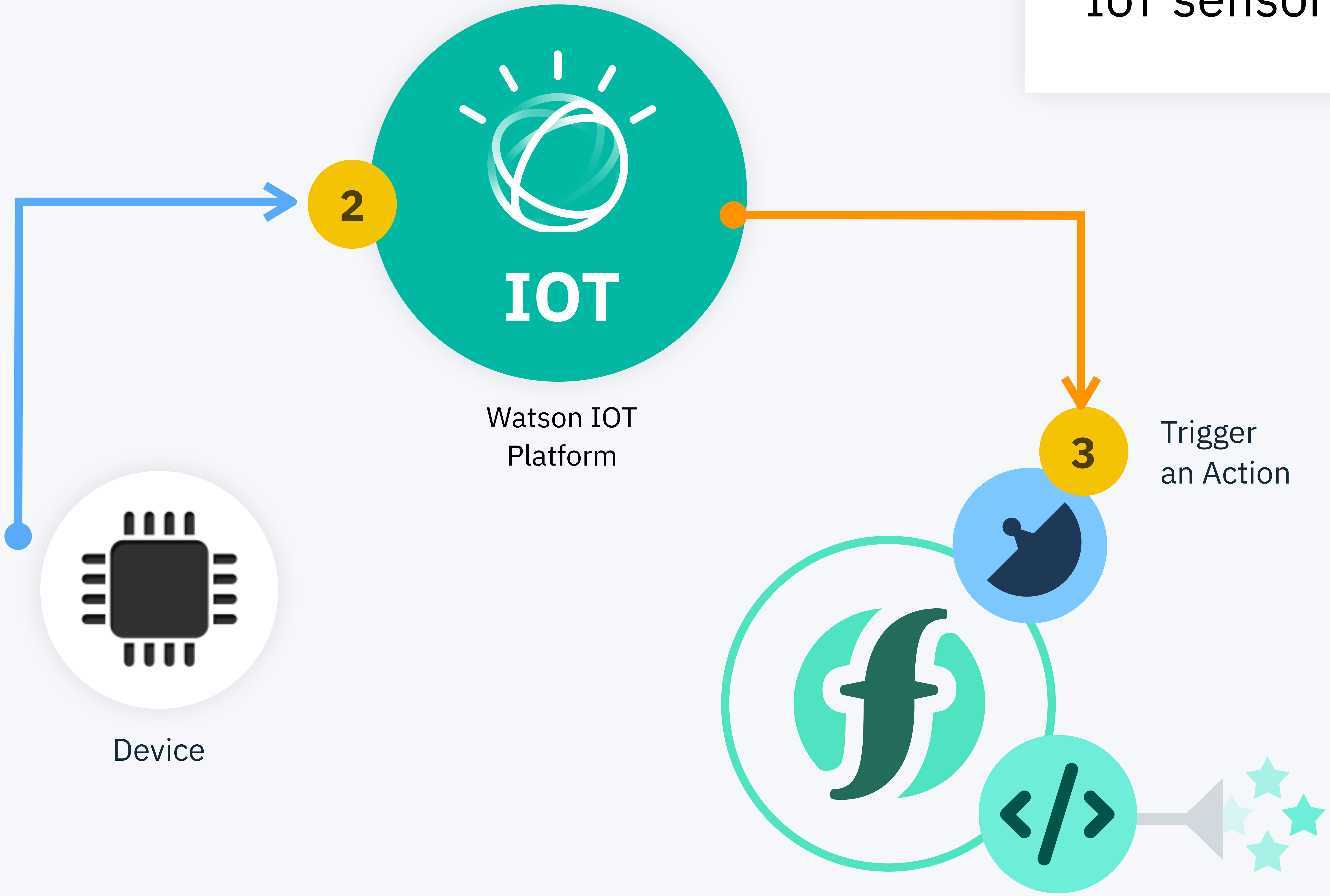
Log data

Financial (market) data

What is IBM Cloud Functions good for?

IoT

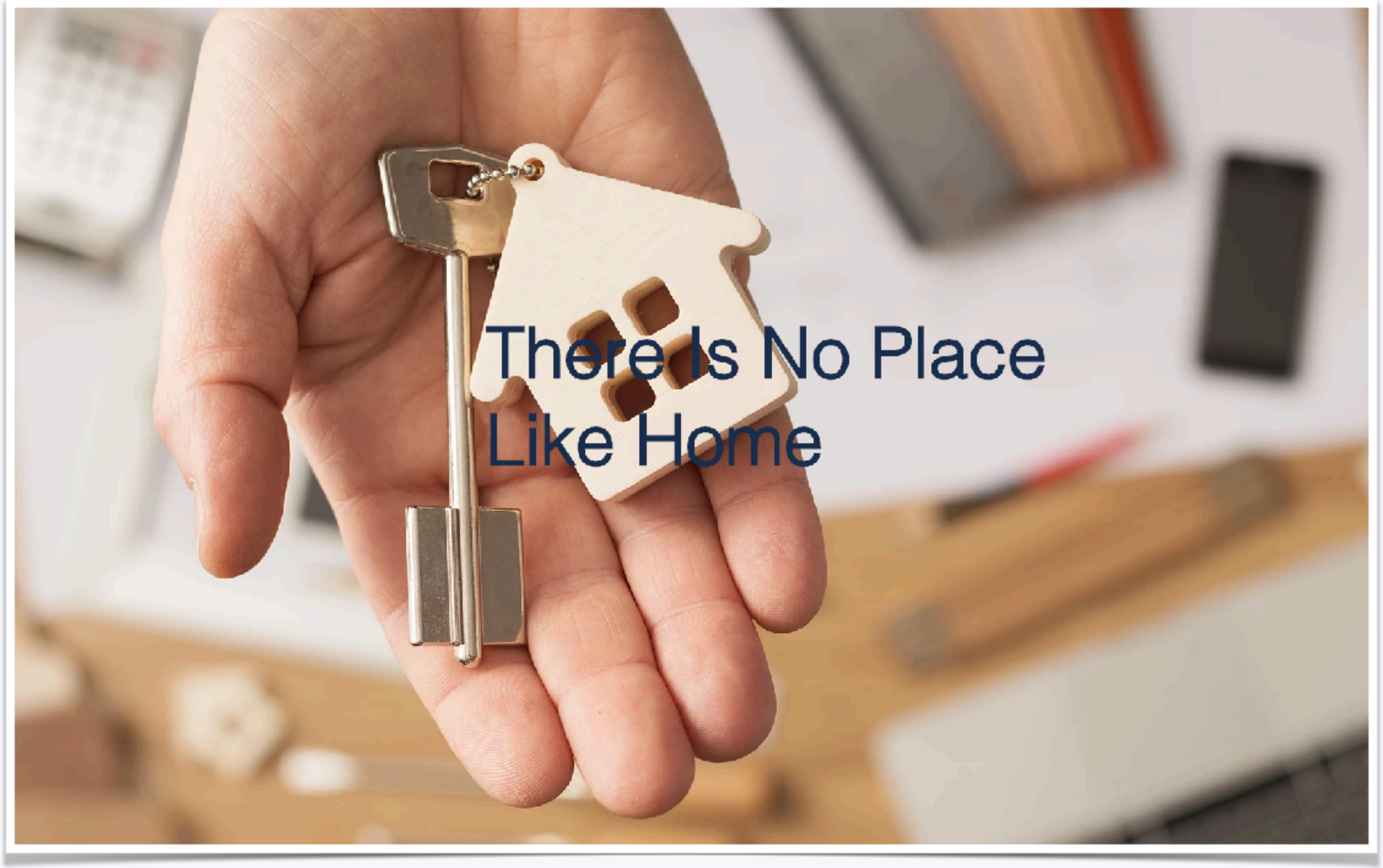
Trigger events based on IoT sensor data



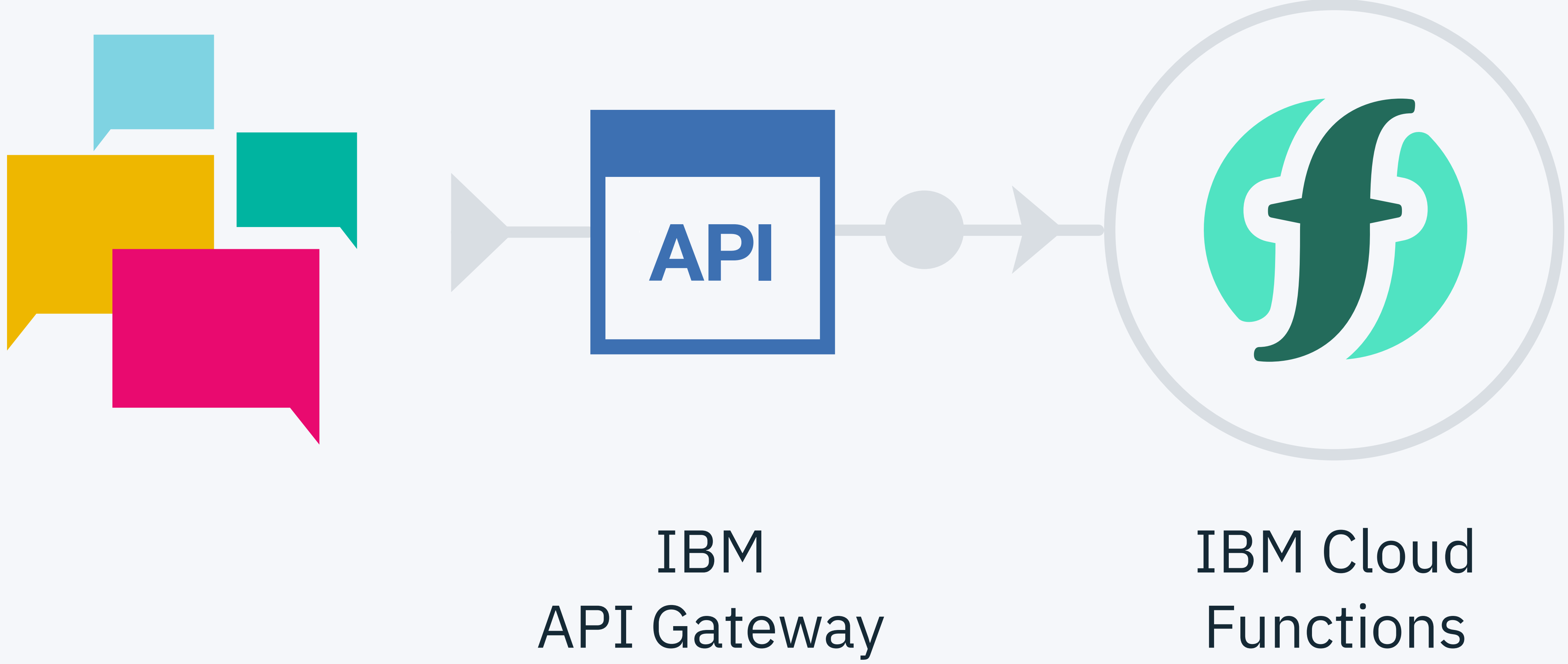
What is IBM Cloud Functions good for?

AbiliSense

Abilisense
https://www.abilisense.com/



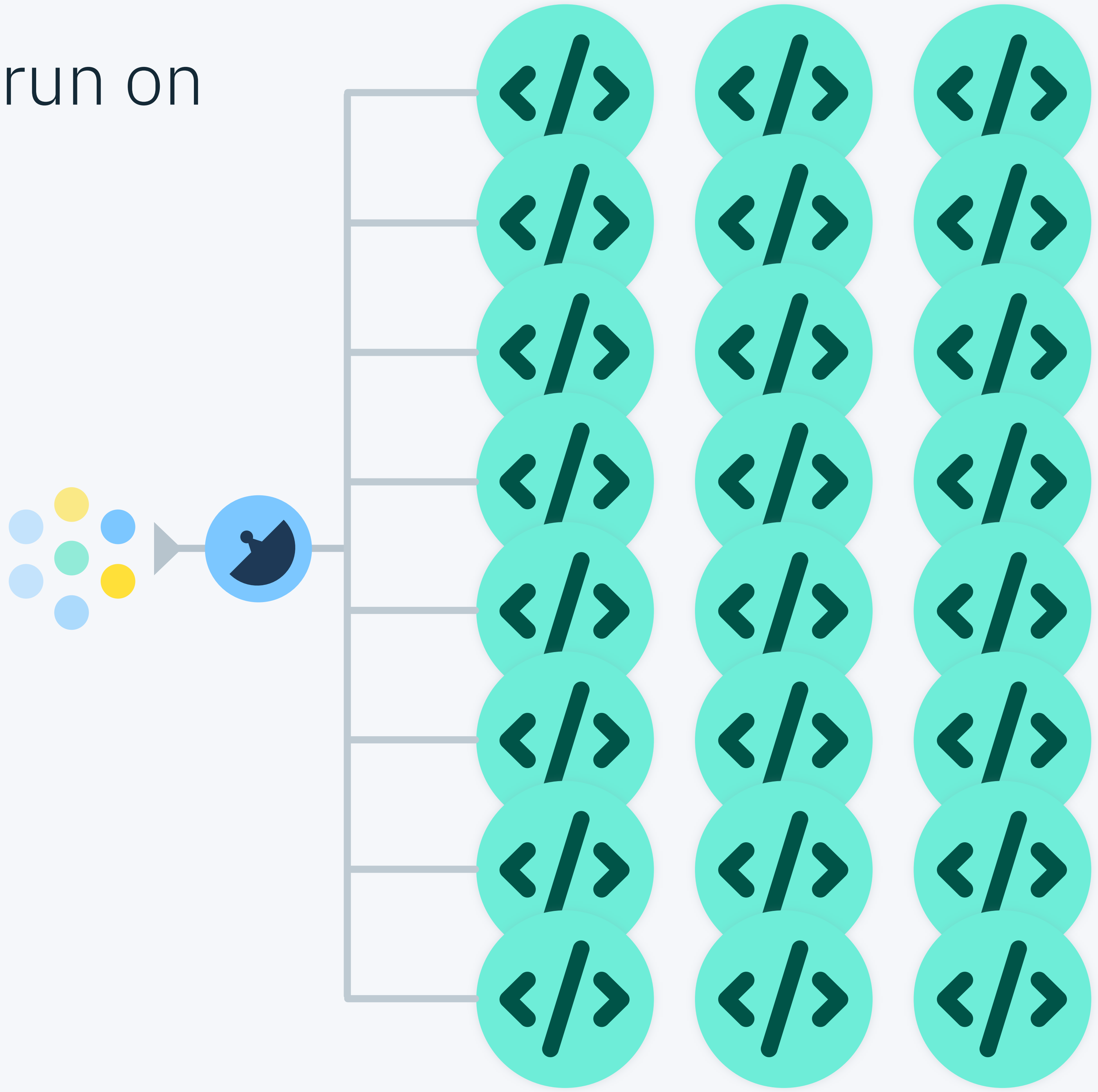
Conversational applications



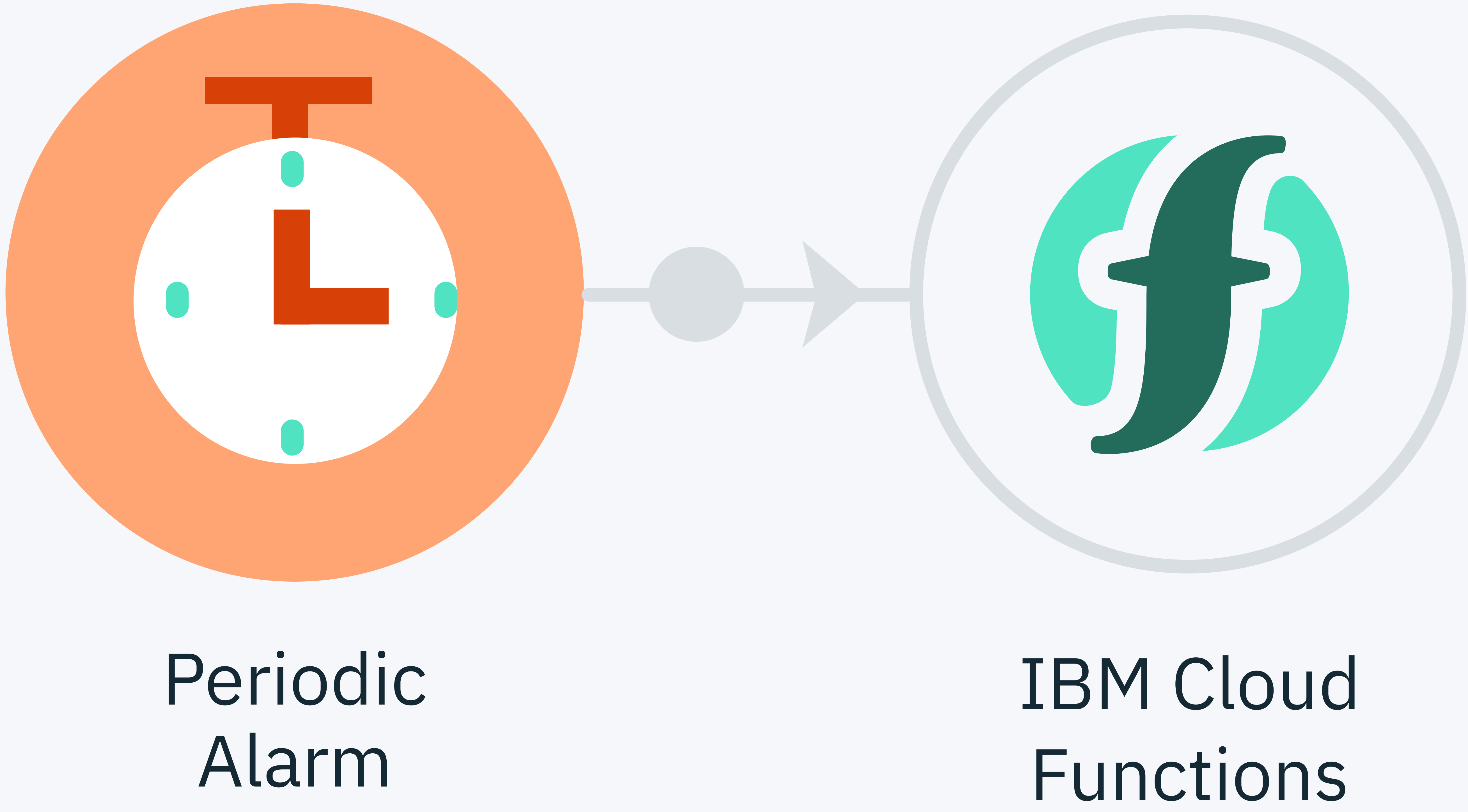
Massively parallel compute / “Map” operations

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

- Data search & processing (specifically Cloud Object Storage)
- Map(-Reduce) operations
- Monte-Carlo Simulations
- Hyperparameter tuning
- Web scraping
- Genome processing
- …



Scheduled tasks



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A serverless CI/CD pipeline

- **Deploy** multiple actions consistently across various stages
  - Serverless Framework
  - wskdeploy
- **Source code usually managed** via git, but not limited to that
- **Build & test** run via your tool of choice

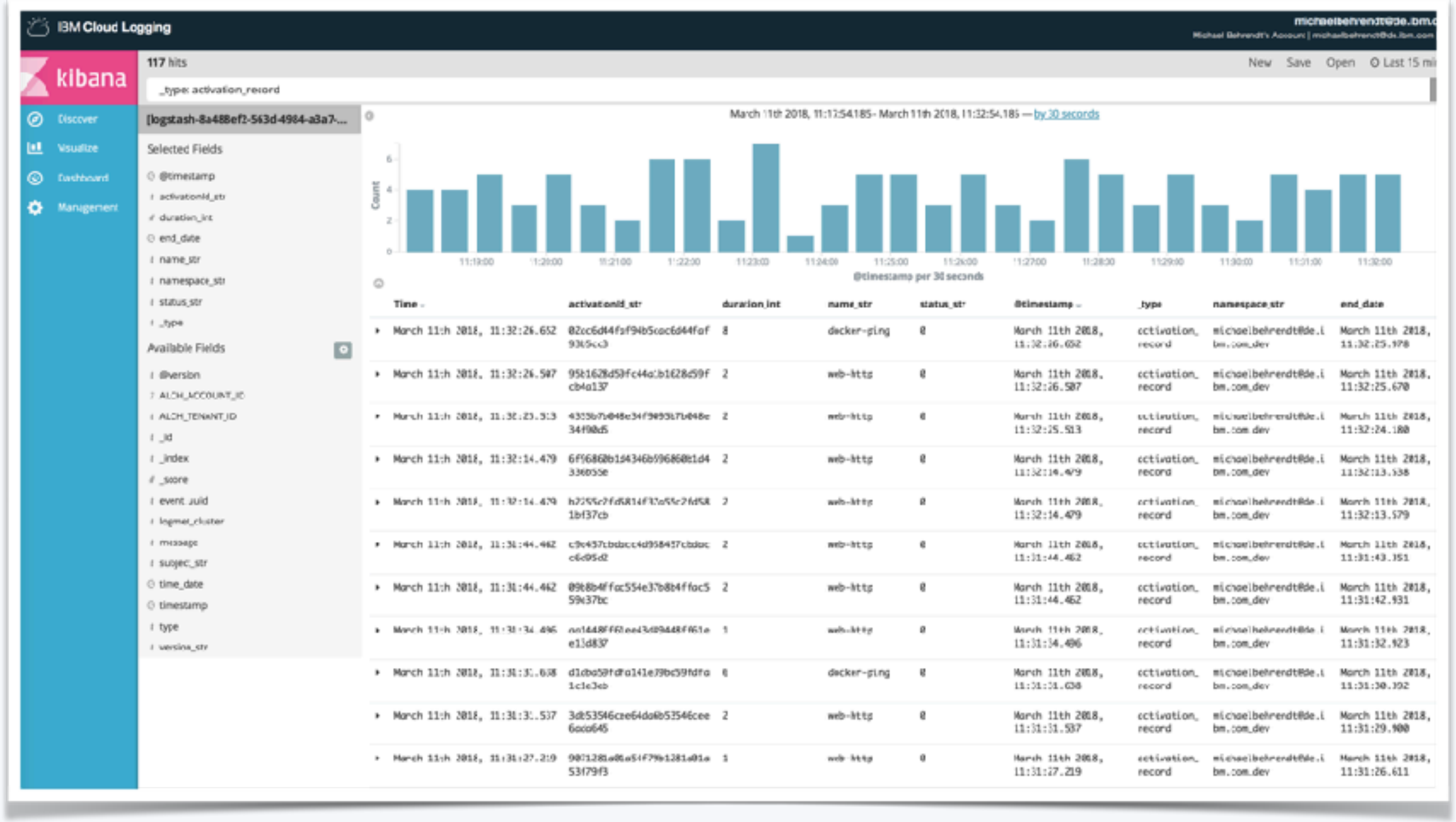
Integration with IBM Logging Service

- 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



117 hits

_type: activation_record

[logstash-8a488ef2-563d-4984-a3a7-...

Selected Fields

- @timestamp
- activationId_str
- duration_int
- end_date
- name_str
- namespace_str
- status_str
- _type

Available Fields

- @version
- ALCH_ACCOUNT_ID
- ALCH_TENANT_ID
- _id
- _index
- _score
- event_uuid
- logmet_cluster
- message
- subject_str
- time_date
- timestamp
- type
- version_str

March 11th 2018, 11:17:54.185 - March 11th 2018, 11:32:54.185 — by 30 seconds

Time	activationId_str	duration_int	name_str	status_str	@timestamp	_type	namespace_str	end_date
March 11th 2018, 11:32:26.652	02cc6d44faf94b5cac6d44faf93b5cc3	8	docker-ping	0	March 11th 2018, 11:32:26.652	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:32:25.970
March 11th 2018, 11:32:26.507	95b1628d50fc44acb1628d59fcb4a137	2	web-http	0	March 11th 2018, 11:32:26.507	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:32:25.670
March 11th 2018, 11:32:25.513	4335b7b048e34f9095b7b048e34f90d5	2	web-http	0	March 11th 2018, 11:32:25.513	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:32:24.180
March 11th 2018, 11:32:14.479	6f96860b1d4346b596860b1d4336055e	2	web-http	0	March 11th 2018, 11:32:14.479	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:32:13.538
March 11th 2018, 11:32:14.479	b2255c2fd5814f32a55c2fd581bf37cb	2	web-http	0	March 11th 2018, 11:32:14.479	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:32:13.579
March 11th 2018, 11:31:44.462	c9c457cbdacc4d958457cbdacc6d95d2	2	web-http	0	March 11th 2018, 11:31:44.462	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:31:43.351
March 11th 2018, 11:31:44.462	09b8b4ffac554e37b8b4ffac559e37bc	2	web-http	0	March 11th 2018, 11:31:44.462	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:31:42.931
March 11th 2018, 11:31:34.496	aa1448ff61ae43d09448ff61ae13d837	1	web-http	0	March 11th 2018, 11:31:34.496	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:31:32.923
March 11th 2018, 11:31:31.638	d1dba59fdfa141e39ba59fdfa1c1e3eb	6	docker-ping	0	March 11th 2018, 11:31:31.638	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:31:30.392
March 11th 2018, 11:31:31.537	3db53546cee64da0b53546cee6aca645	2	web-http	0	March 11th 2018, 11:31:31.537	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:31:29.900
March 11th 2018, 11:31:27.219	9071281a86a54f79b1281a01a53f79f3	1	web-http	0	March 11th 2018, 11:31:27.219	activation_record	michaelbehrendt@de.ibm.com_dev	March 11th 2018, 11:31:26.611

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Regions

- Dallas
- London
- Frankfurt
- More to come...

Compliance standards

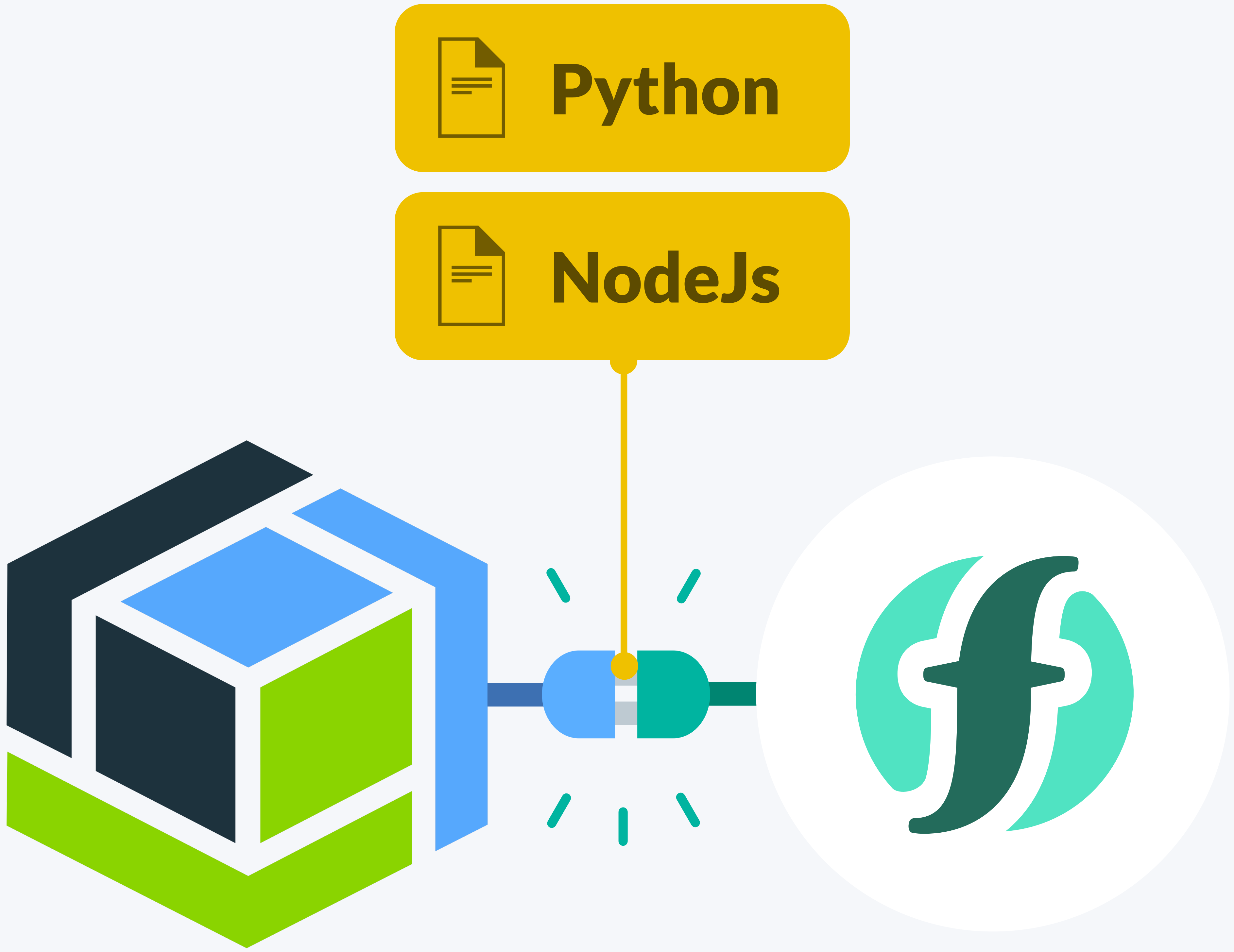
We are **certified** for...

- **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

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

New service integrations (Cloud Object Storage)

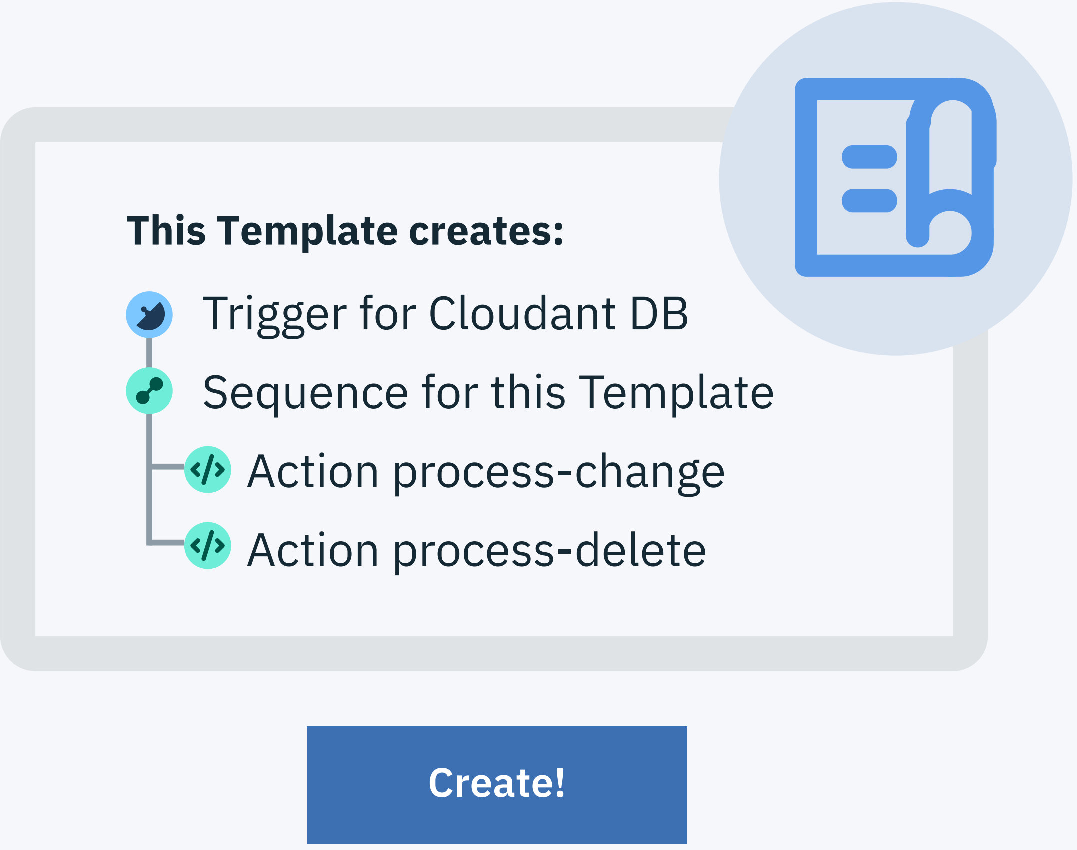
Just added **1st class COS support** by providing libraries in NodeJS and Python to make it super easy to code against COS



Improved getting started experience (Templates)

From new account to **running code in 5 minutes** with serverless templates

Templates can be any combination of actions, triggers, and sequences connected together to **form a solution**



This Template creates:

- Trigger for Cloudant DB
- Sequence for this Template
  - Action process-change
  - Action process-delete

Different templates available out of the box

Increased system limits

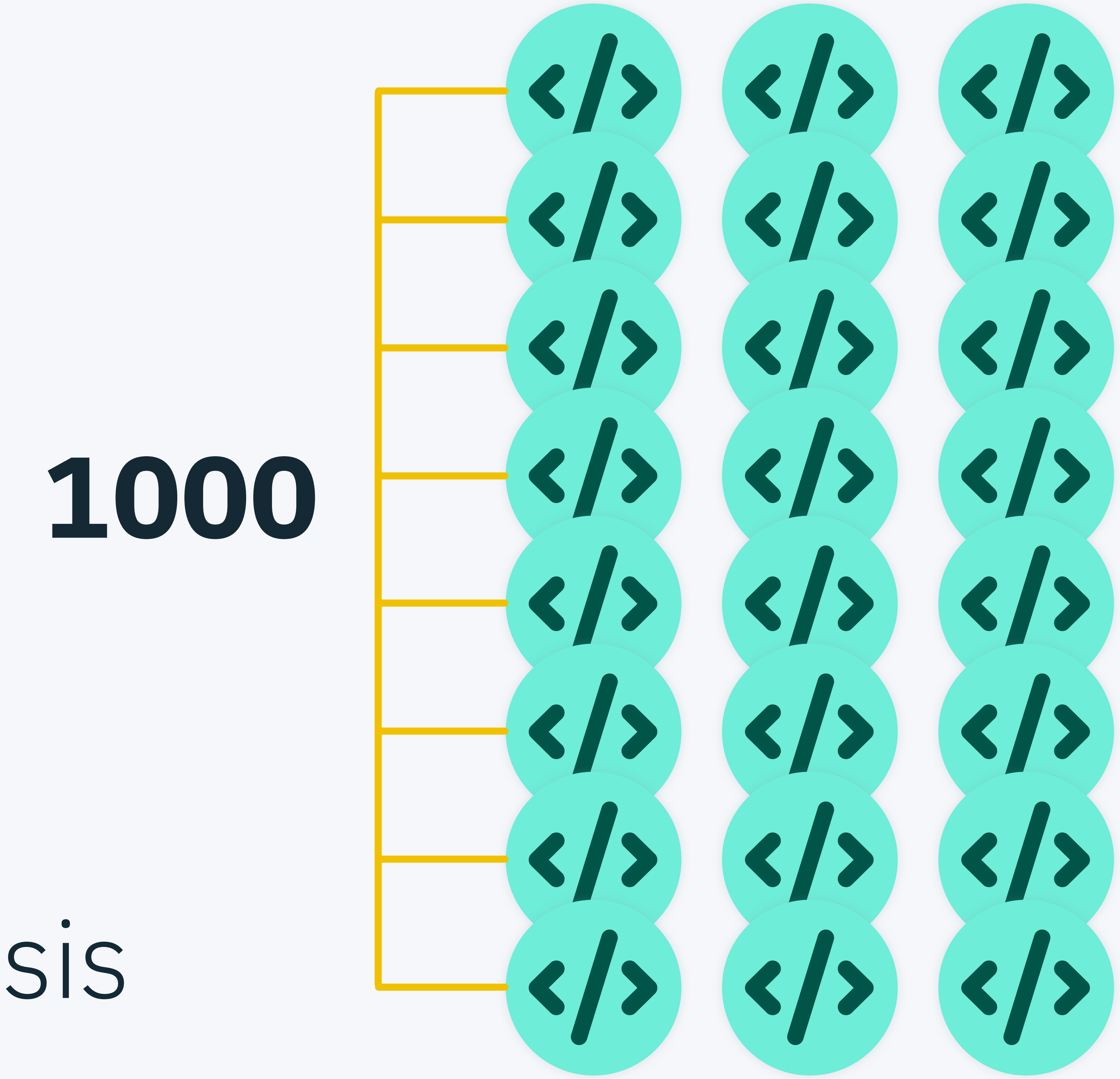
We doubled the maximum allowed execution time from 5 minutes to **10 minutes**

We can raise this even further on a per client basis

Increased system limits

We currently support the invocation of **1000 concurrent** actions by default

We can raise this on a per client basis



Increased system limits

We currently allow your actions to consume **512 MB of memory** and we will allow them to consume more soon

512mb

Increased system limits

We currently allow your actions' **payload** to be up to **5 MB** (not yet officially announced)

5 MB

Composer

The obvious trend:

FROM rather **simple single functions** behaving like microservices focusing on dedicated tasks…

TO more complex serverless **applications** by composing/orchestrating **multiple functions** using control logic and state

Composer

The why:

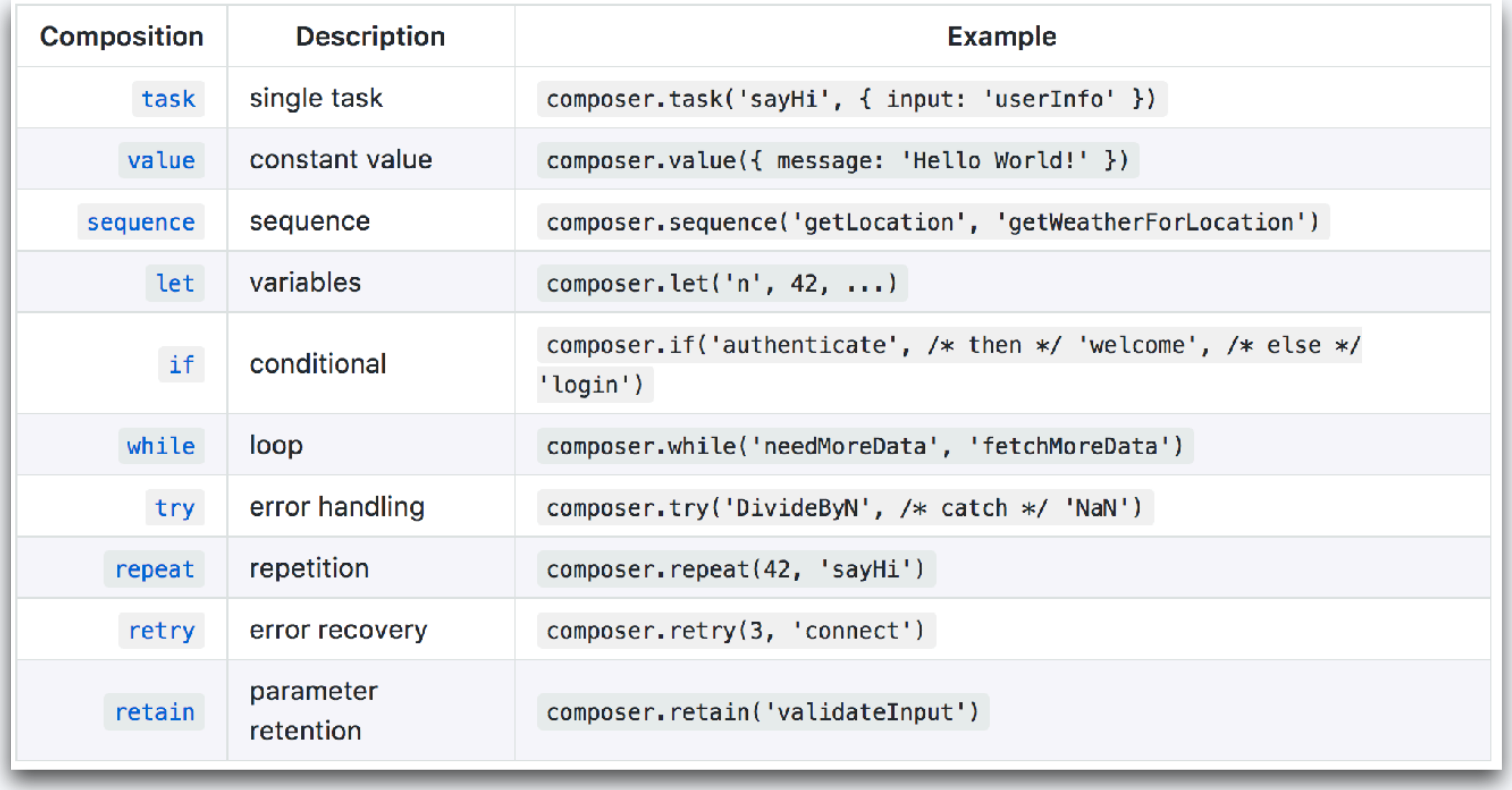
Developers want to develop more **complex serverless applications** like **chatbots**, **workflows** in a **simple, scalable, cost effective, polyglot** way

Composer

The solution:

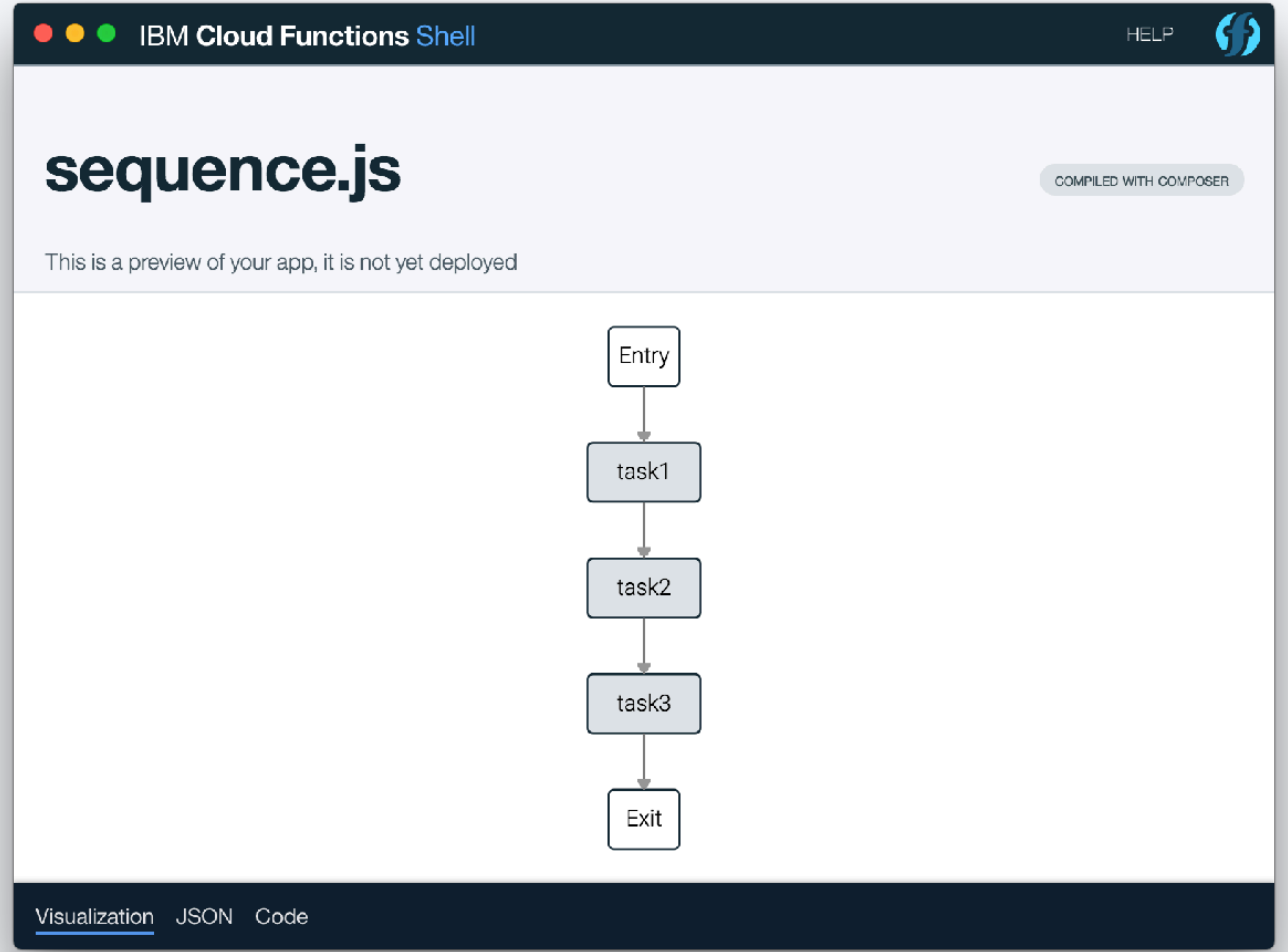
Composer is a **new programming model for composing** individual functions into such more **complex applications**

Composer



Composition	Description	Example
`task`	single task	`composer.task('sayHi', { input: 'userInfo' })`
`value`	constant value	`composer.value({ message: 'Hello World!' })`
`sequence`	sequence	`composer.sequence('getLocation', 'getWeatherForLocation')`
`let`	variables	`composer.let('n', 42, ...)`
`if`	conditional	`composer.if('authenticate', /* then */ 'welcome', /* else */ 'login')`
`while`	loop	`composer.while('needMoreData', 'fetchMoreData')`
`try`	error handling	`composer.try('DivideByN', /* catch */ 'NaN')`
`repeat`	repetition	`composer.repeat(42, 'sayHi')`
`retry`	error recovery	`composer.retry(3, 'connect')`
`retain`	parameter retention	`composer.retain('validateInput')`

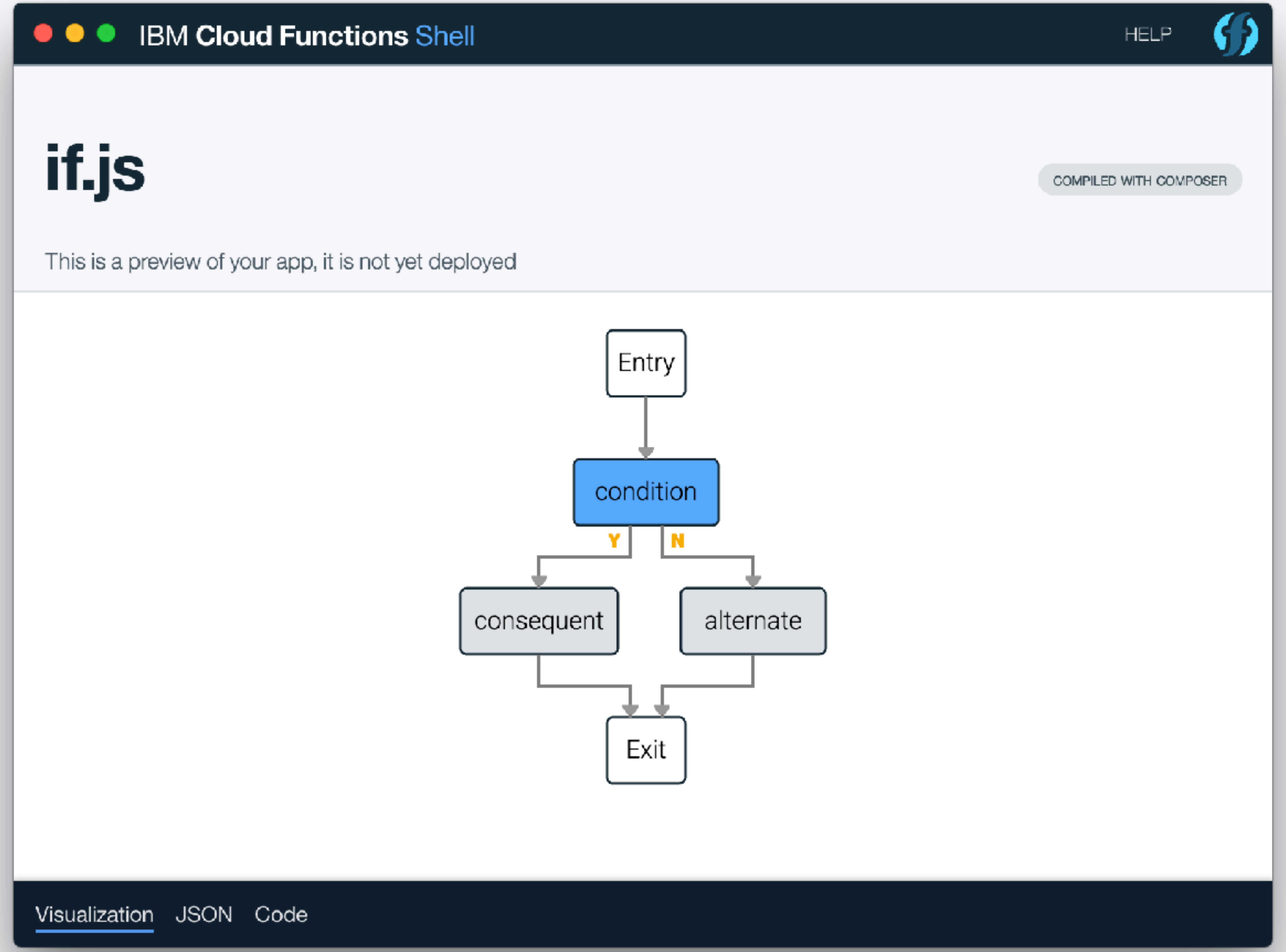
Composer



sequence.js

This is a preview of your app, it is not yet deployed

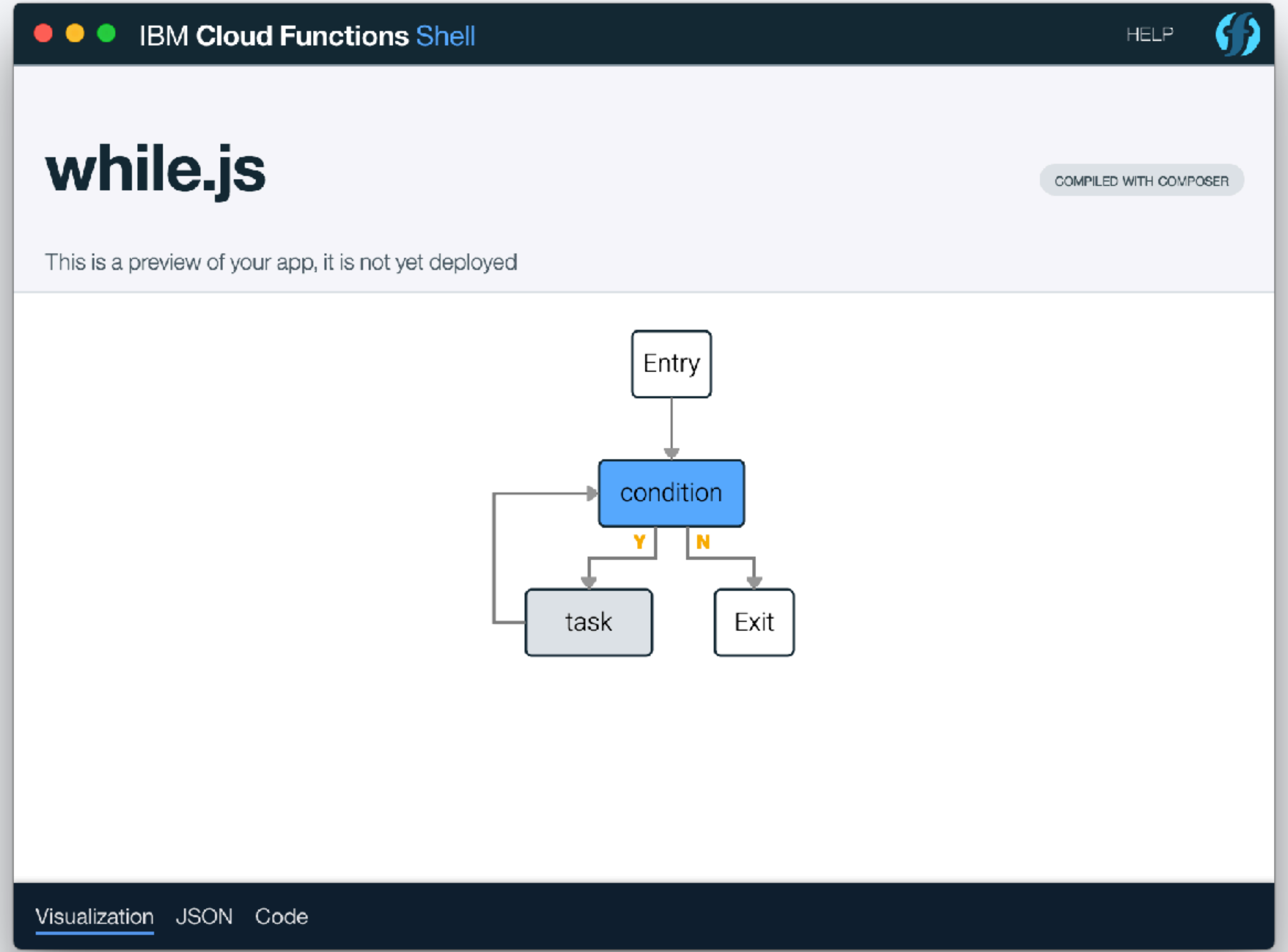
Composer



if.js

This is a preview of your app, it is not yet deployed

Composer

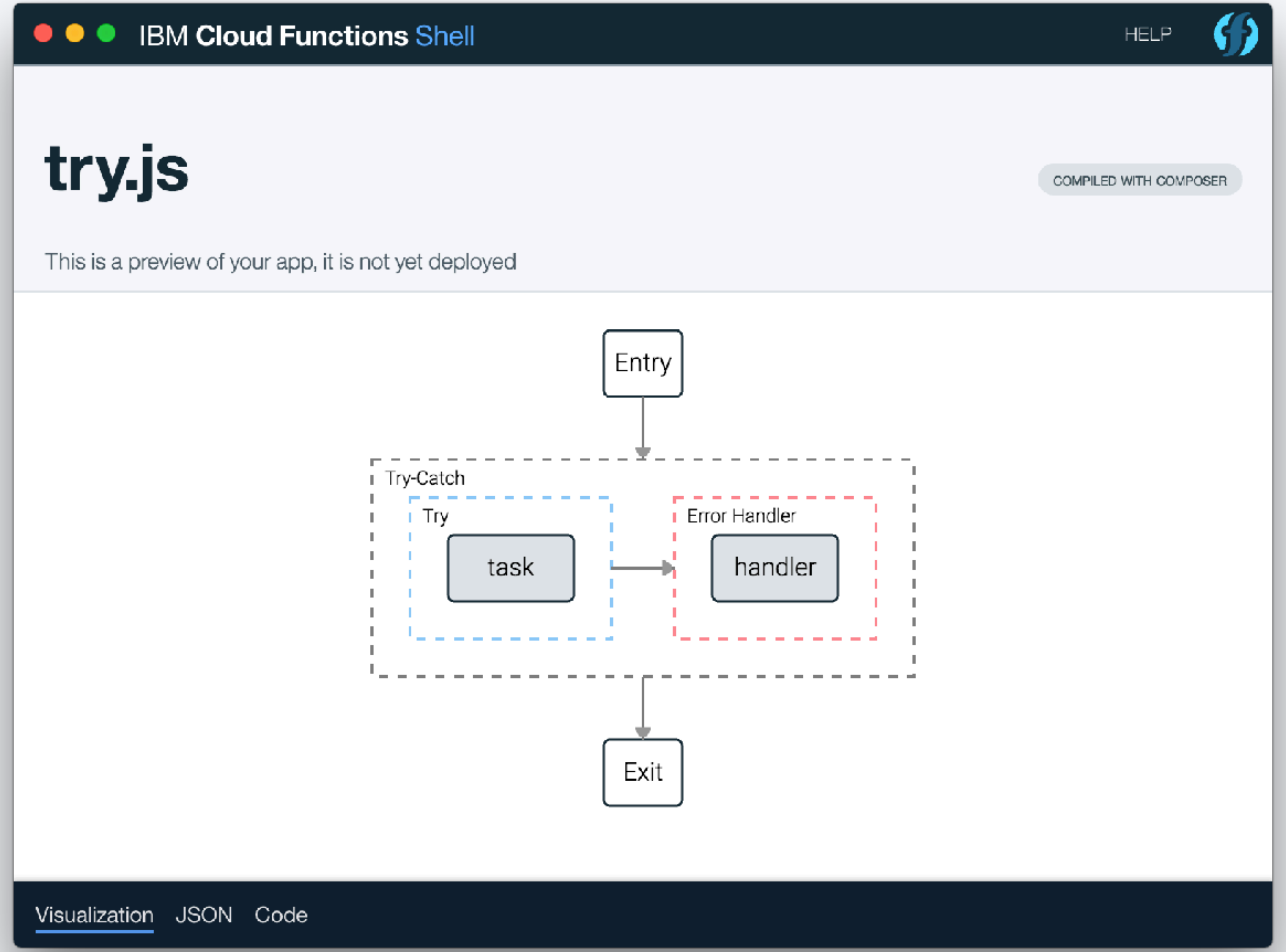


IBM Cloud Functions Shell

while.js

This is a preview of your app, it is not yet deployed

Composer



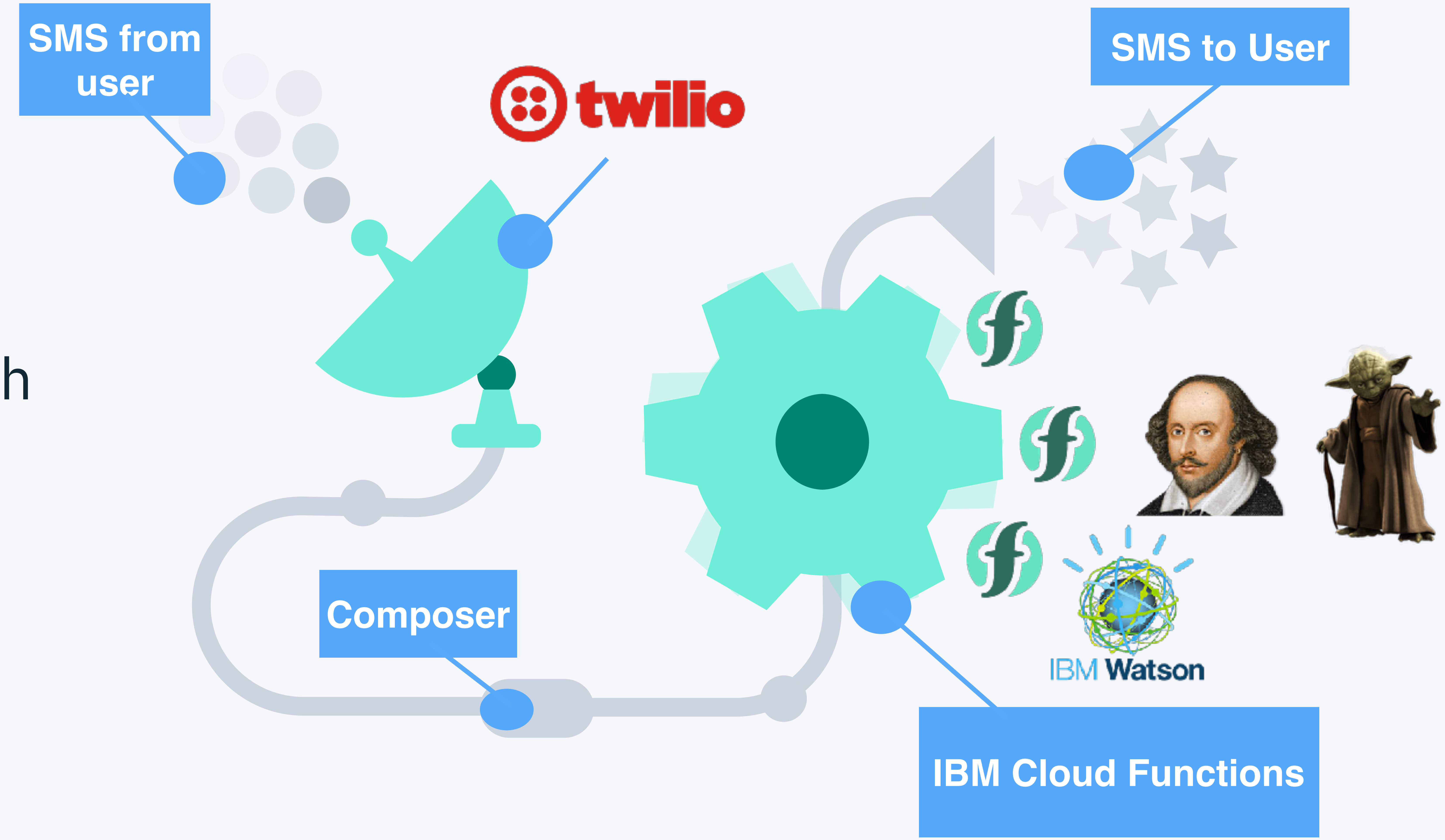
try.js

This is a preview of your app, it is not yet deployed

Composer

Example…

- Receives an SMS
- Translates it into English or old/yoda English
- Replies back with the translation



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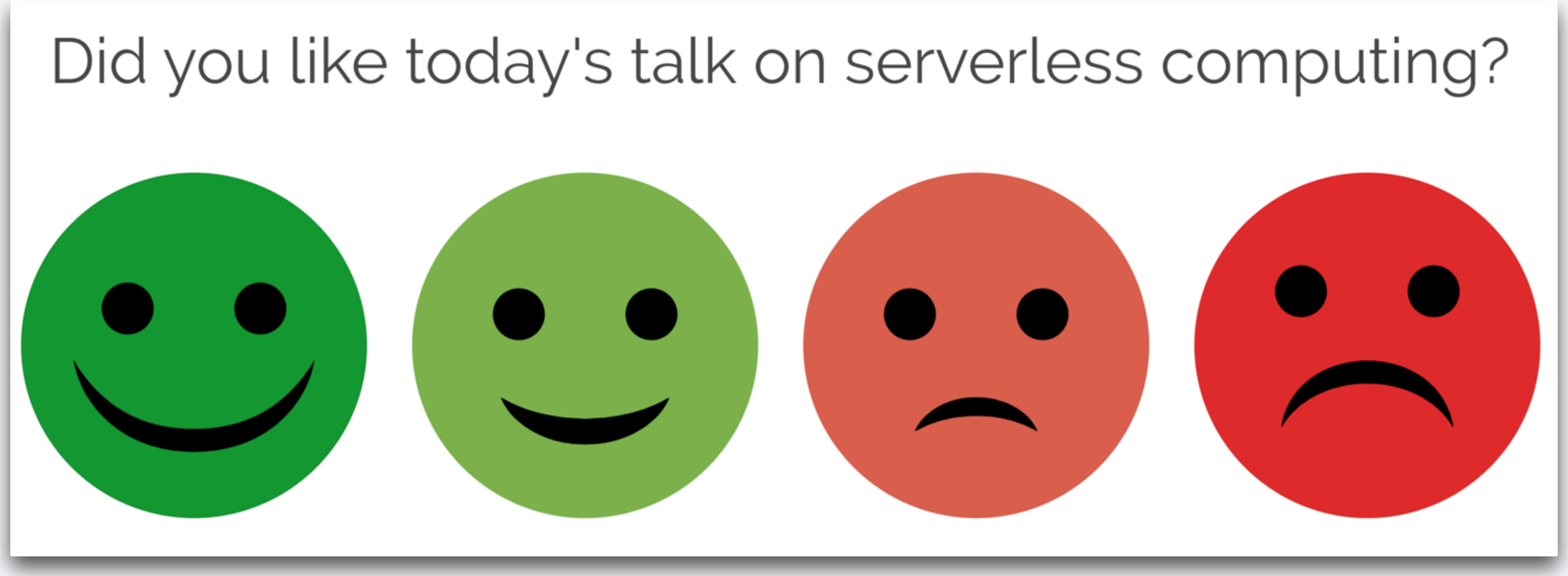
(Mobile) demo app

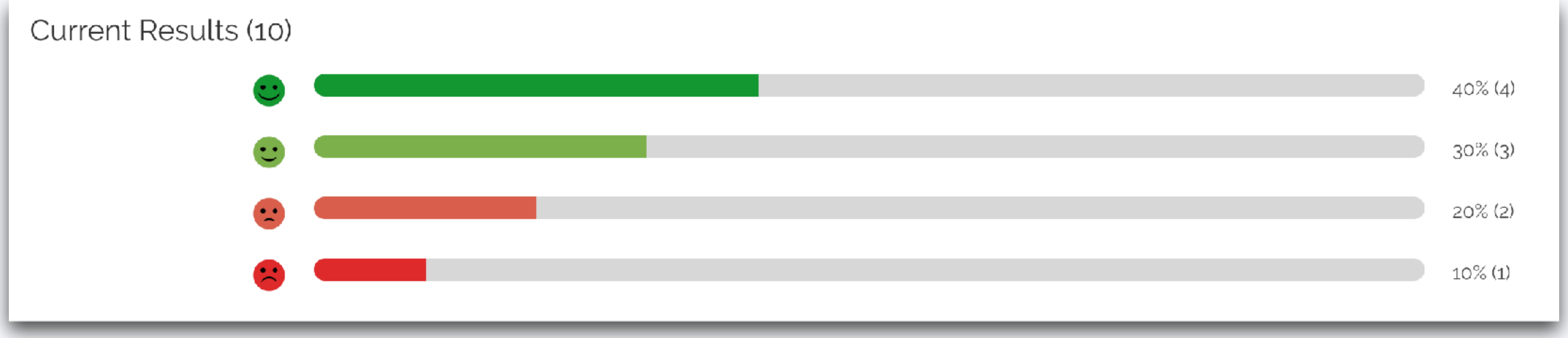
The app:
Simple app that allows attendees to rate talks, presentations, or whatever by clicking one out of 4 smileys to provide presenters with immediate feedback.

(Mobile) demo app



Did you like today's talk on serverless computing?

(Mobile) demo app



Current Results (10)

40% (4)

30% (3)

20% (2)

10% (1)

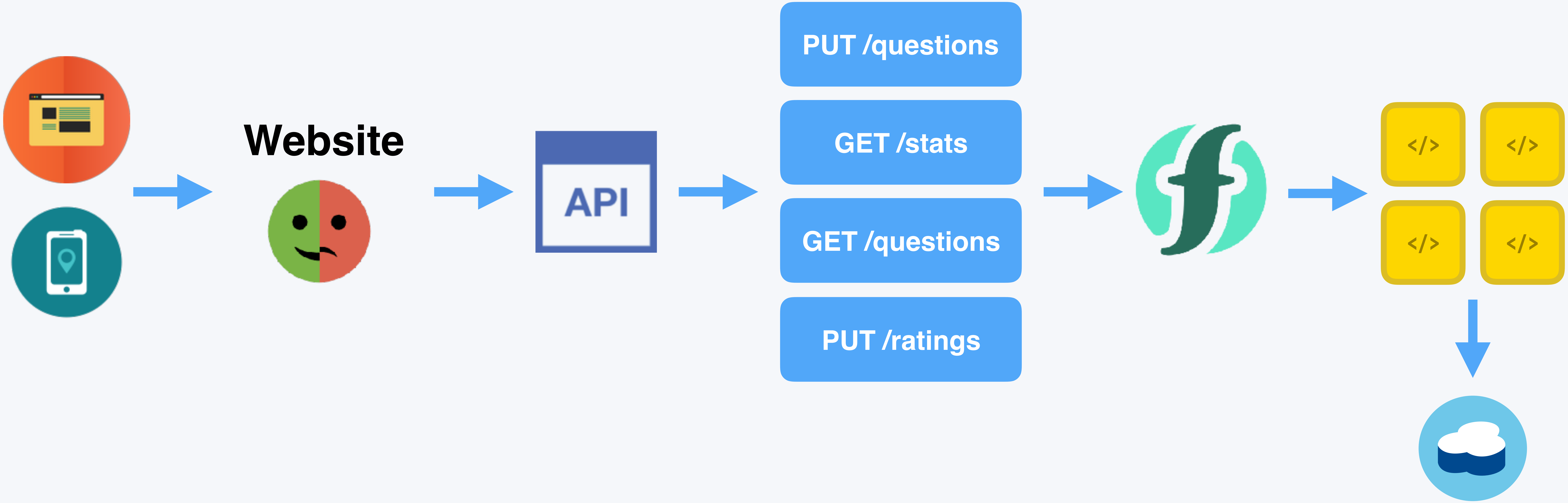
(Mobile) demo app

4 actions to…

- create a new poll (*information stored in a database*)
- read (information about) a poll
- provide a rating (*ratings stored in a databse*)
- retrieve all ratings (statistics)

With all actions being exposed via an **API endpoint** accessible by **any client** be it a desktop browser, a **mobile**, …

Demo



Website
API
PUT /questions
GET /stats
GET /questions
PUT /ratings
</>
</>
</>
</>

Demo

http://bit.ly/summersoc2018

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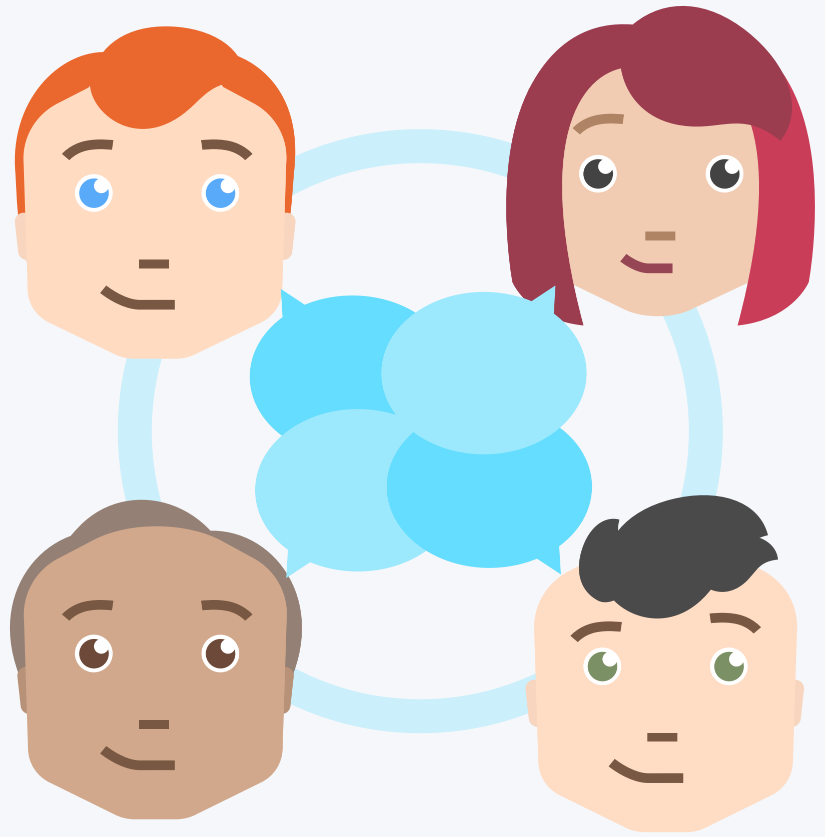
Getting started...



Commercial offering home:

bluemix.net/openwhisk

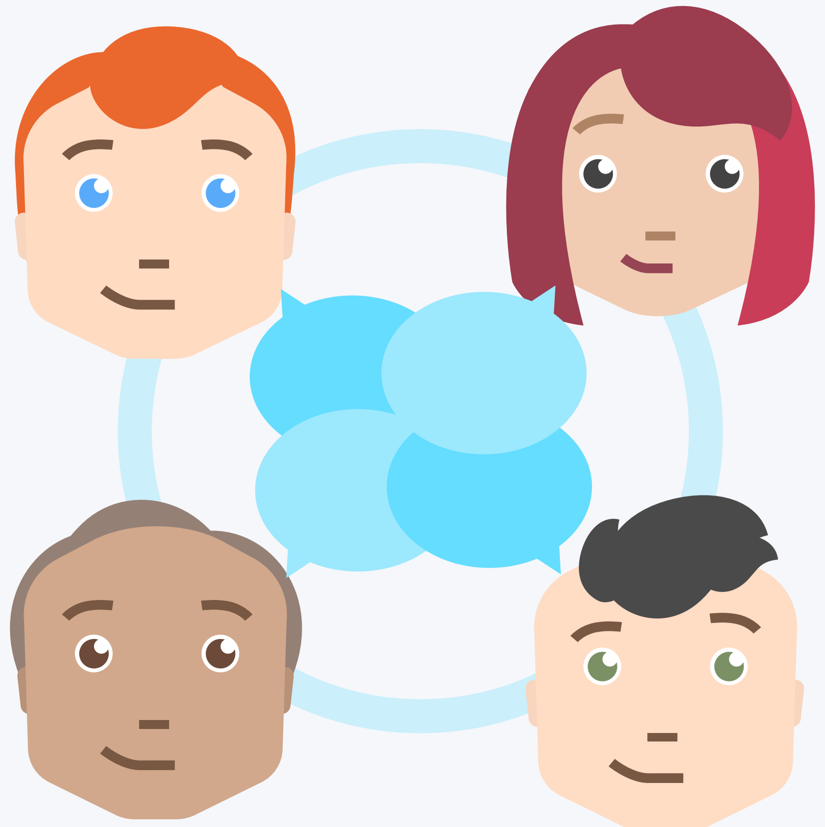
Open-source project home:

openwhisk.org

Slack:

slack.openwhisk.org

Getting started...



Github **github.com/openwhisk**

Twitter **twitter.com/openwhisk**

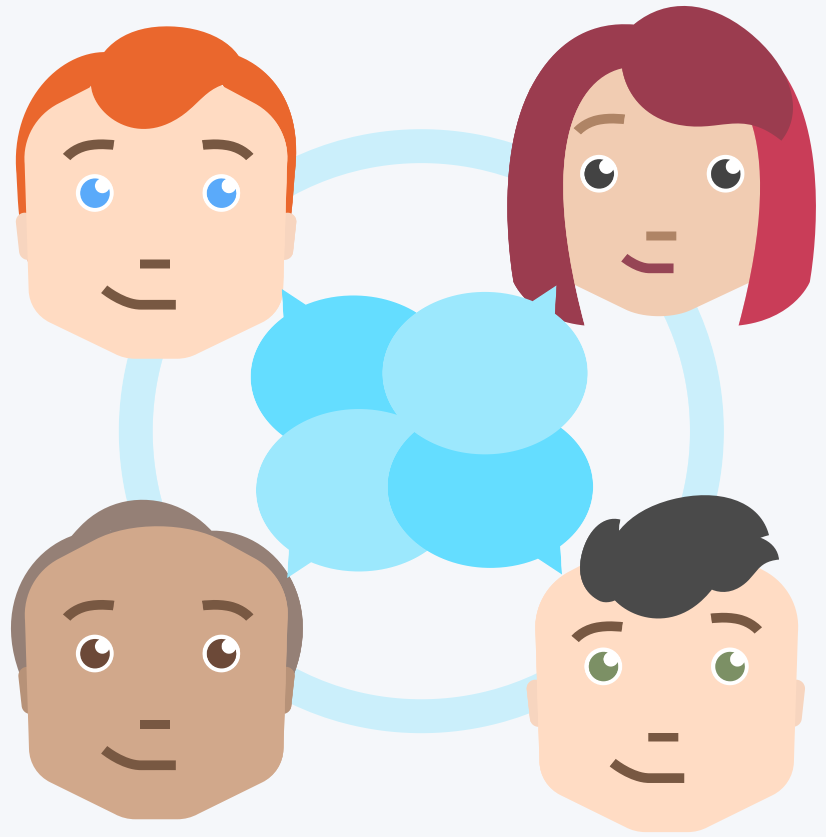
Medium **medium.com/openwhisk**

Slideshare **slideshare.net/openwhisk**

Youtube **youtube.com/c/openwhisk**

Getting started...

Workshop **bit.ly/cfn-workshop**



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