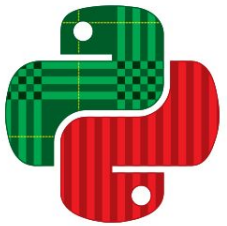

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Edinburgh 23-29 July
2018

Microservices and Serverless in Python projects

José Manuel Ortega
Europython 2018
@jmortegac

v 0.5

Agenda

- Microservices in python
- Introducing Serverless and Function as a Service
- Python frameworks for AWS
- AWS Lambda functions with **zappa** and **chalice**
- Deploy AWS lambda functions from aws console

Microservices vs Serverless

Microservices

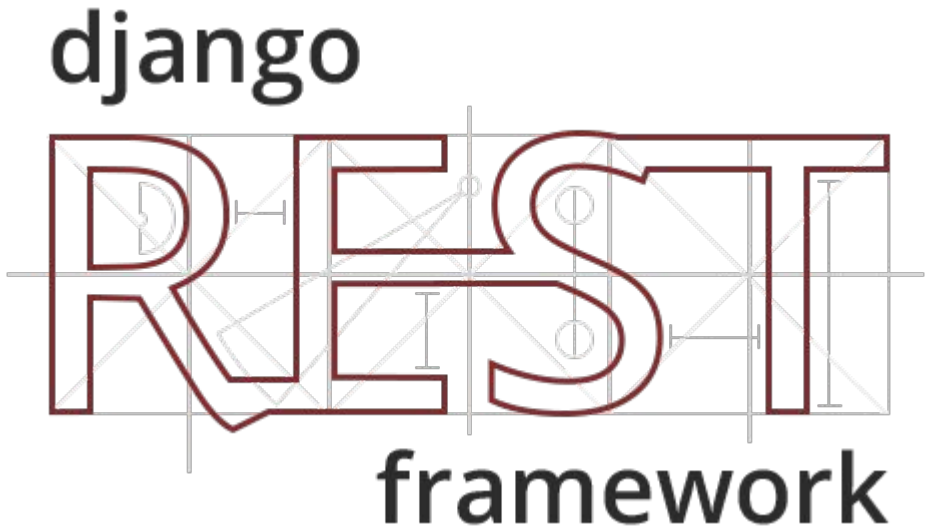
Asynchronous calls with asyncio and aiohttp

```
import asyncio
import aiohttp

@asyncio.coroutine
def fetch_page(url):
    response = yield from aiohttp.request('GET', url)
    body = yield from response.read()
    return body

content = asyncio.get_event_loop().run_until_complete(
    fetch_page('http://python.org'))
print(content)
```

REST API Development

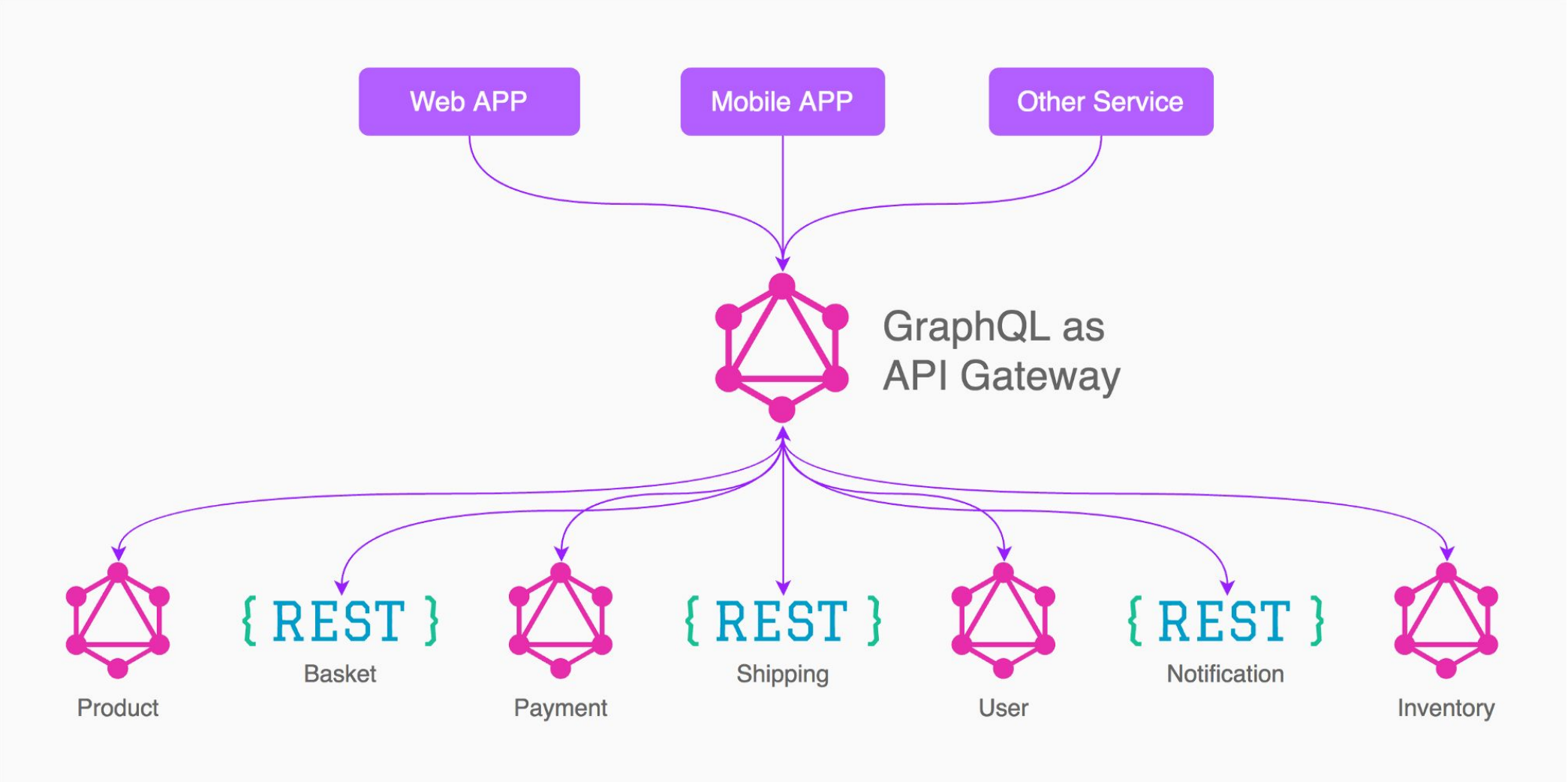


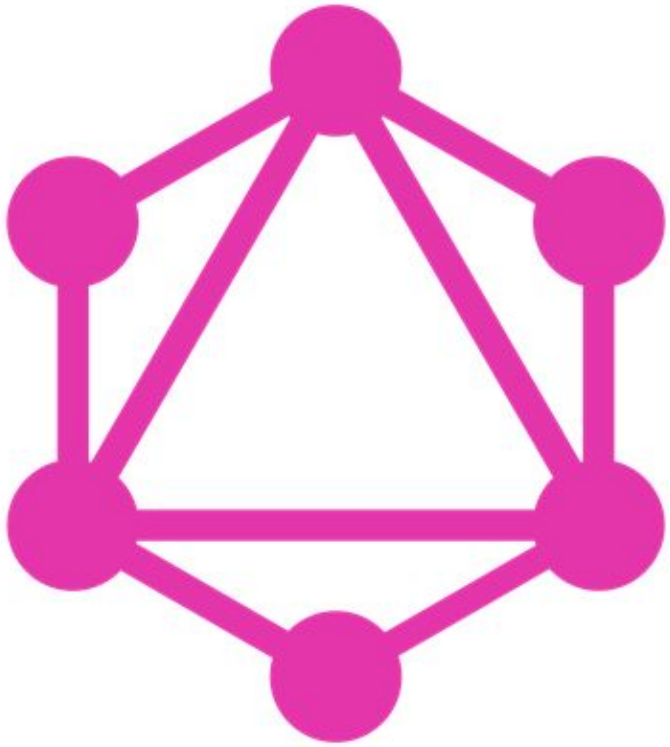
Performance

8% less memory

6% faster response times

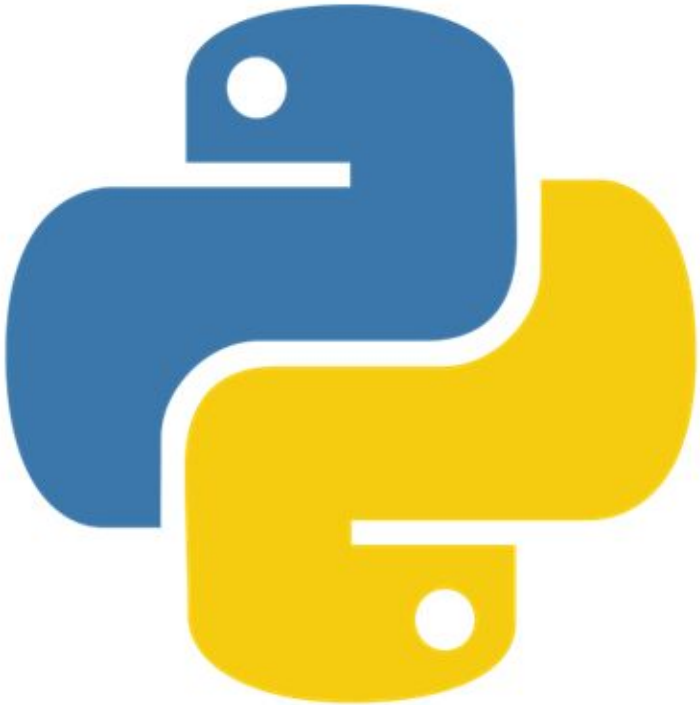
Microservices with graphql





GraphQL

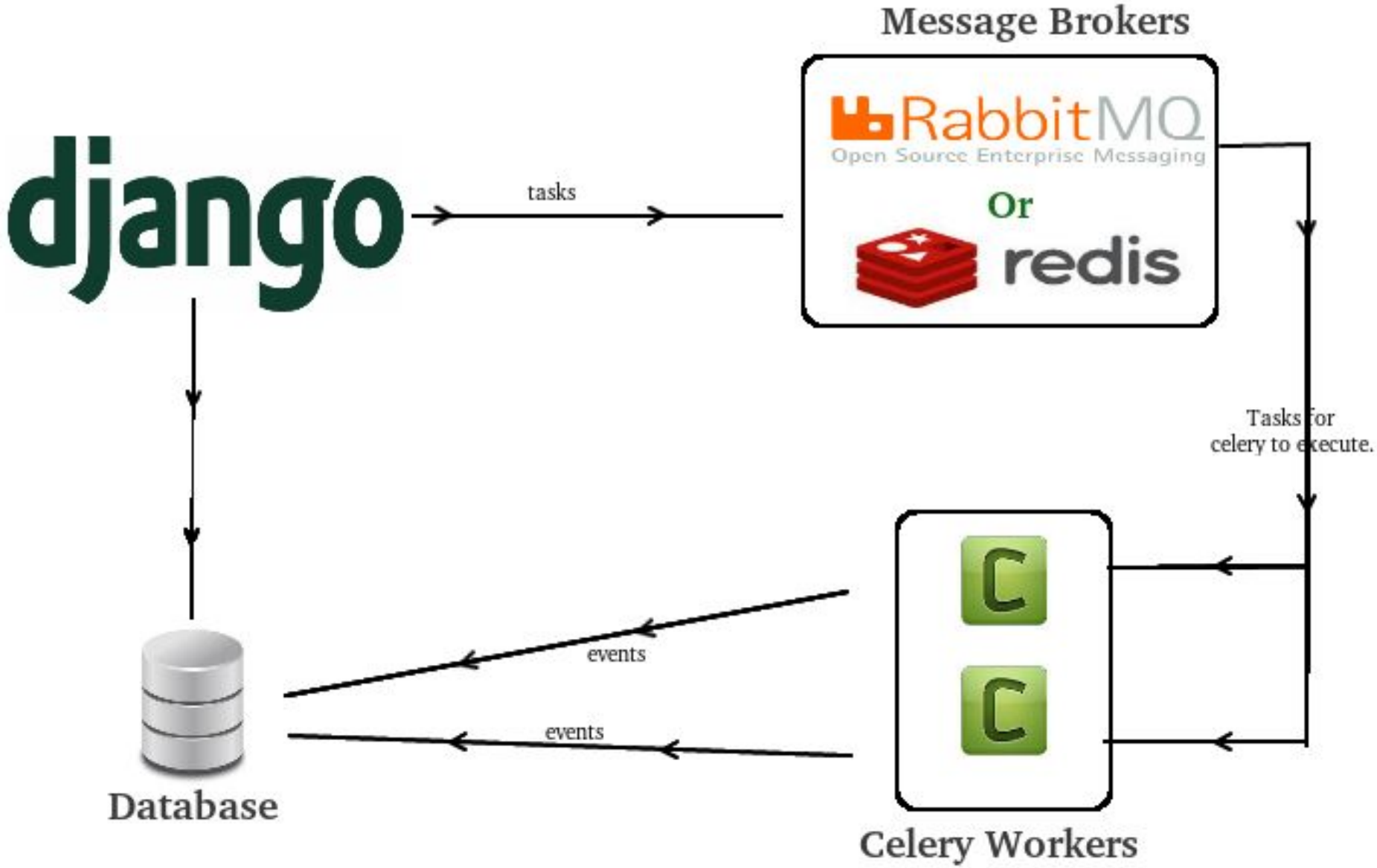
+



python™

Graphene

Python


Message Brokers
RabbitMQ
Open Source Enterprise Messaging
Or
redis
django
tasks
Tasks for
celery to execute.
events
events
Database
Celery Workers

Distributed Messaging

ZeroMQ \zero-em-queue\, \ØMQ\:

- Connect your code in any language, on any platform.
- Carries messages across inproc, IPC, TCP, TIPC, multicast.
- Smart patterns like pub-sub, push-pull, and router-dealer.
- High-speed asynchronous I/O engines, in a tiny library.
- Backed by a large and active open source community.
- Supports every modern language and platform.
- Build any architecture: centralized, distributed, small, or large.
- Free software with full commercial support.

```
_context = zmq.Context()
_publisher = _context.socket(zmq.PUB)
url = 'tcp://{}:{}'.format(HOST, PORT)


def publish_message(message):

    try:
        _publisher.bind(url)
        time.sleep(1)
        myjson = json.dumps(message)
        _publisher.send(myjson)

    except Exception as e:
        print "error {}".format(e)

    finally:
        _publisher.unbind(url)
```

SERVER

```python
class ZClient(object):

    def __init__(self, host=HOST, port=PORT):
        """Initialize Worker"""
        self.host = host
        self.port = port
        self._context = zmq.Context()
        self._subscriber = self._context.socket(zmq.SUB)
        print "Client Initiated"

    def receive_message(self):
        """Start receiving messages"""
        print "receive_message"
        self._subscriber.connect('tcp://{}:{}'.format(self.host, self.port))
        self._subscriber.setsockopt(zmq.SUBSCRIBE, b"")

        while True:
            print 'listening on tcp://{}:{}'.format(self.host, self.port)
            message = self._subscriber.recv()
            print message
            logging.info('{}    - {}'.format(message, time.strftime("%Y-%m-%d %H:%M")))

if __name__ == '__main__':
    zs = ZClient()
    zs.receive_message()
```

CLIENT

Microservices benefits

- Separation of concerns
- Services are decoupled from each other
- Managing smaller projects
- More scaling and deployment options

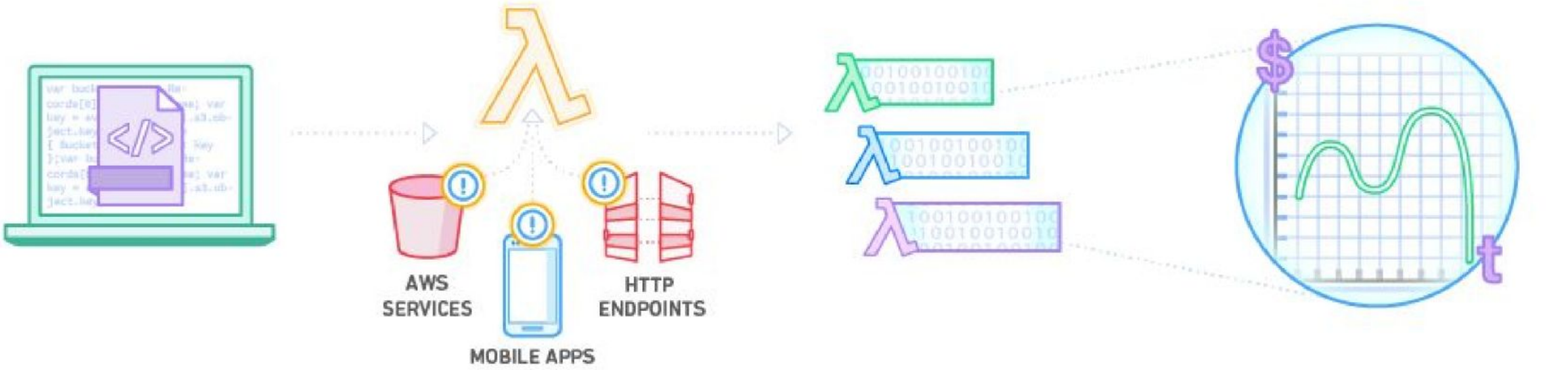
Serverless

Since the release of **AWS Lambda** (and **others** that **have followed**), all the rage has been about **serverless architectures**. These allow microservices to be deployed in the cloud, in a fully managed environment where one doesn't have to care about managing any server, but is assigned stateless, ephemeral *computing containers* that are fully managed by a provider. With this paradigm, events (such as a traffic spike) can trigger the execution of more of these *containers* and therefore give the possibility to handle "infinite" horizontal scaling.

Serverless architecture

- **FaaS - Function as a Service**
- Fully managed computing
  - Provisioning
  - Scalability
  - Monitoring
  - Logging
- Deploy your code
- Pay only for actual usage

Serverless architecture



Upload your code to AWS Lambda

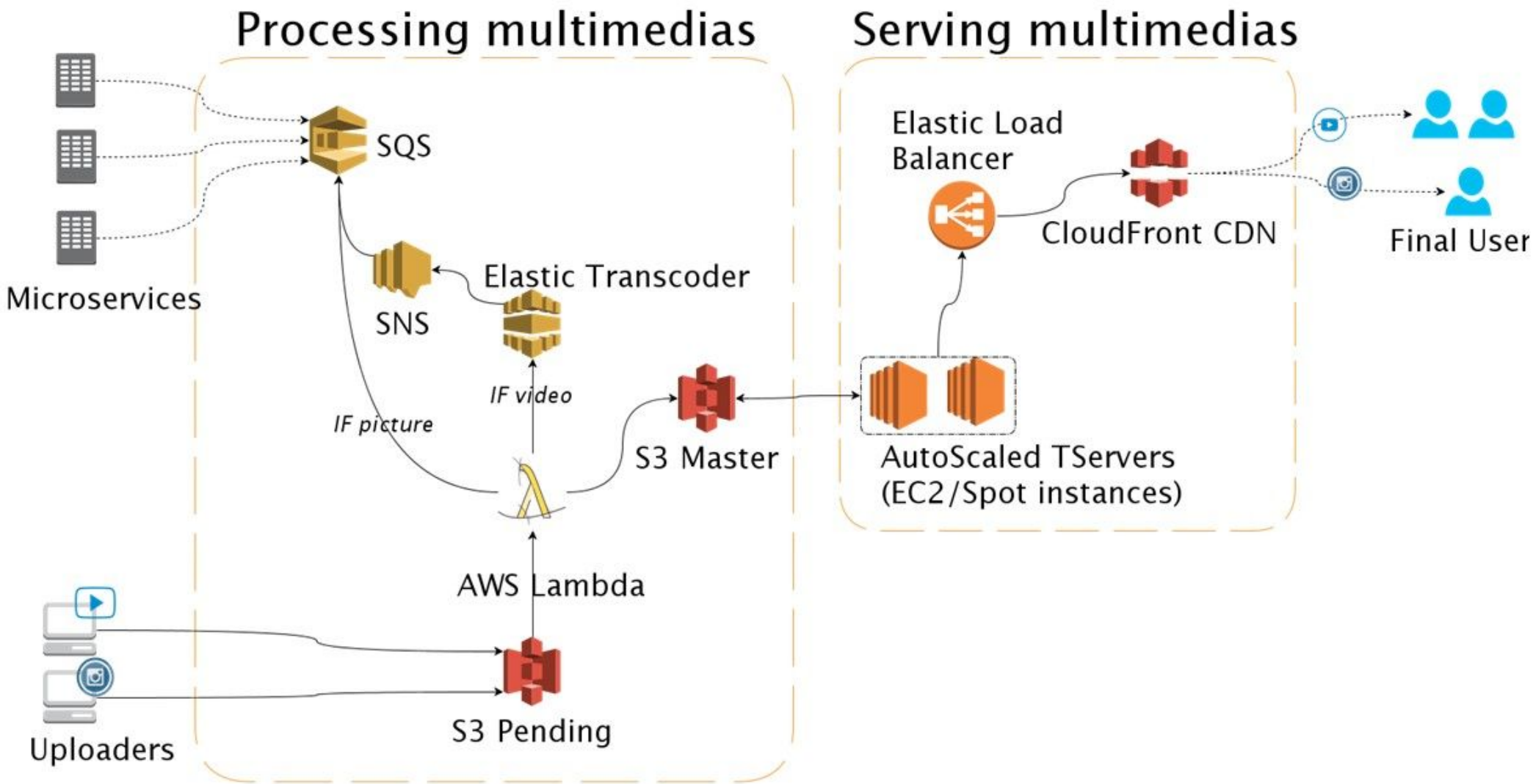
Set up your code to trigger from other AWS services, HTTP endpoints, or in-app activity

Lambda runs your code only when triggered, using only the compute resources needed

Pay just for the compute time you use

Serverless uses cases

- **REST API**
  - Stateless services and microservices
  - Suitable for Chat bots
- **Events**
  - File processing (S3 event) & Data ingestion
  - Data/Stream processing
  - Incidents handling (CloudWatch event log)
  - IoT
- **Scheduled tasks**
  - Monitoring, load testing
  - Periodical jobs


Processing multimedias
Serving multimedias
Microservices
SQS
SNS
Elastic Transcoder
IF video
IF picture
S3 Master
AWS Lambda
S3 Pending
Uploaders
Elastic Load Balancer
CloudFront CDN
Final User
AutoScaled TServers
(EC2/Spot instances)

Serverless benefits

- No server management
- Automatic scaling and load balancing
- Lower infrastructure costs
- Flexibility and high availability
- Infrastructure managed by service provider

Serverless drawbacks

- The tools around the deployment automation of serverless functions are still in development.

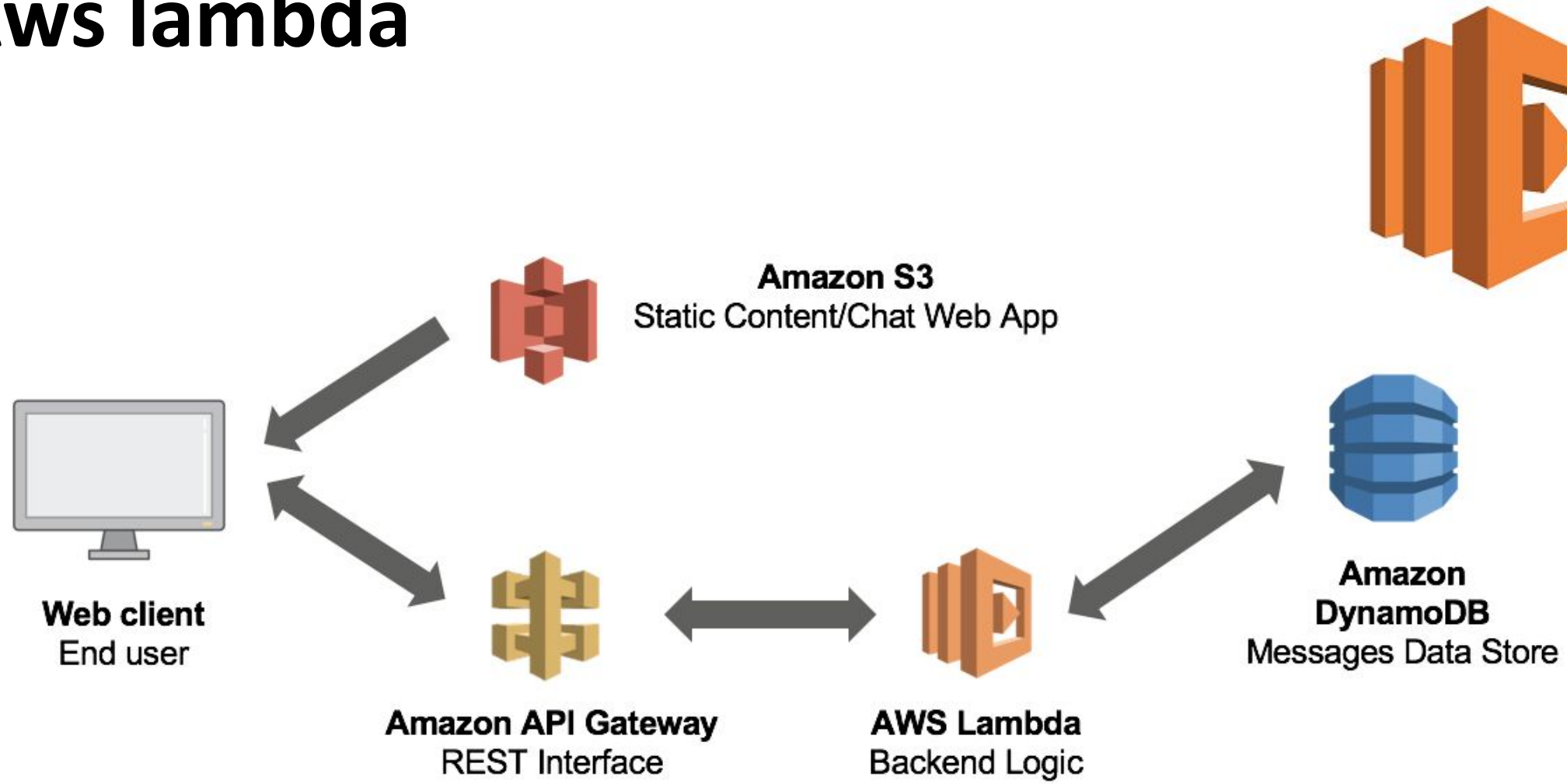
- There is **no control** over containers when the execution **environments** are created or destroyed

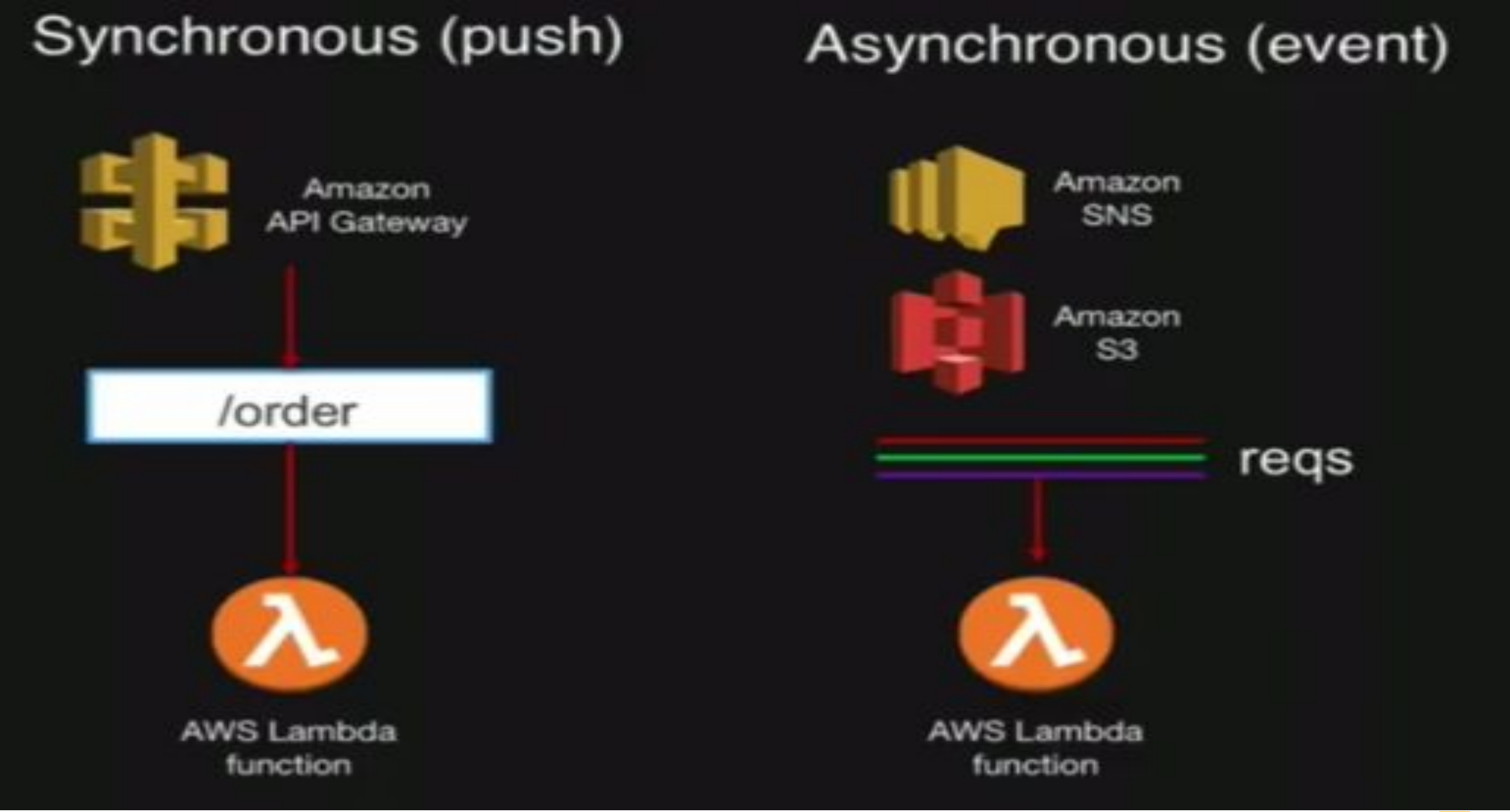
- **Debugging, Deploying** and **monitoring**

Cloud providers

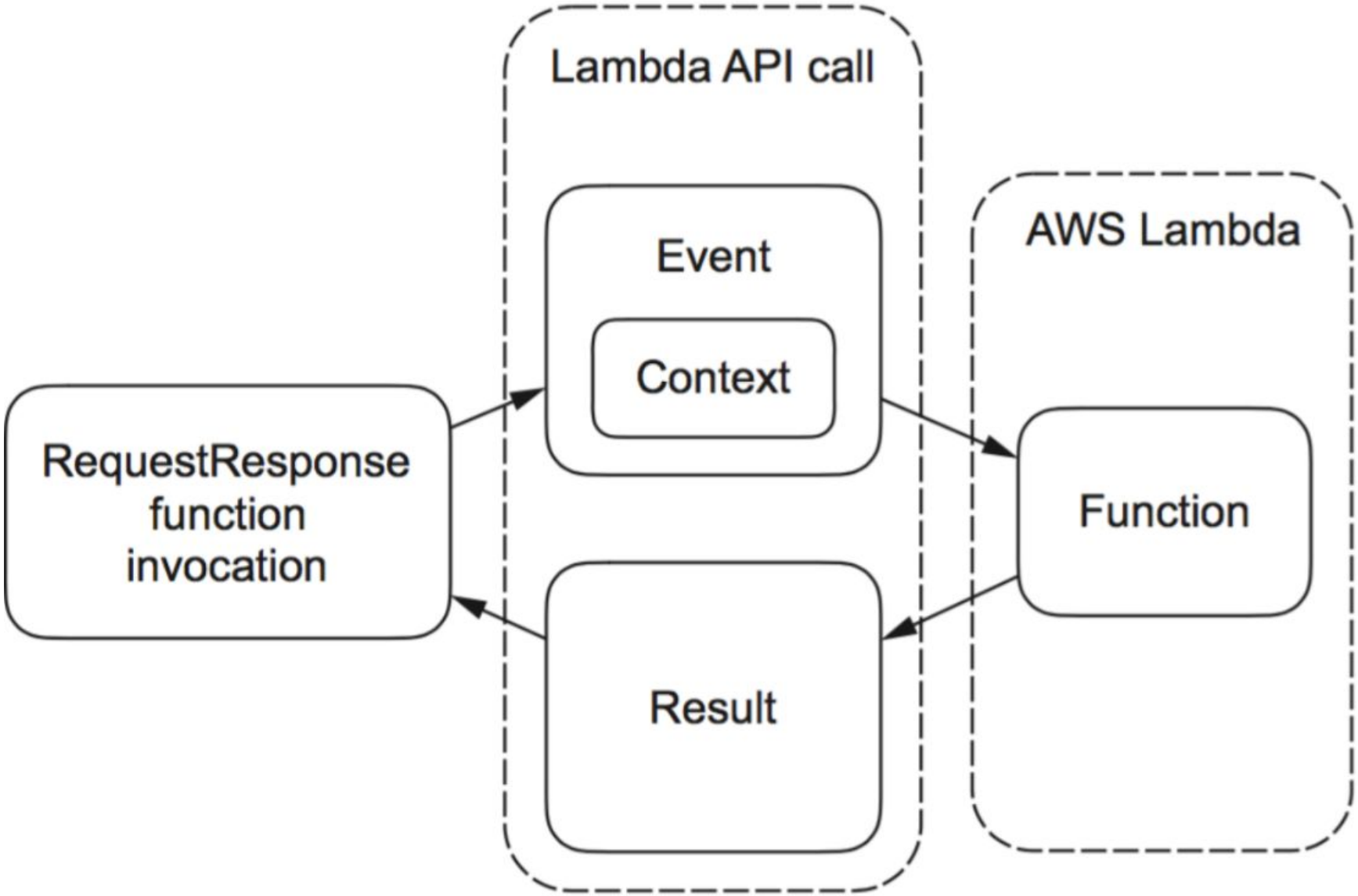
- **AWS**
- Microsoft Azure
- Cloud platform
- OpenWhisk(OS)
- Kubeless(OS)

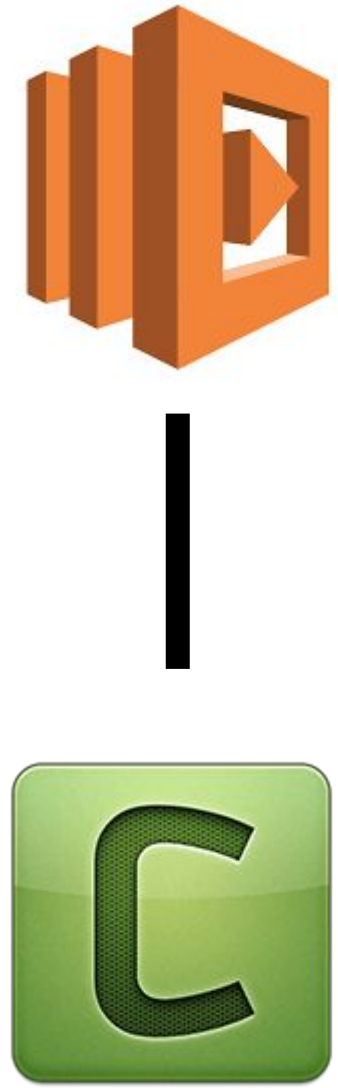
Aws lambda


Amazon S3
Static Content/Chat Web App
Web client
End user
Amazon API Gateway
REST Interface
AWS Lambda
Backend Logic
Amazon
DynamoDB
Messages Data Store


Synchronous (push)
Amazon
API Gateway
/order
AWS Lambda
function
Asynchronous (event)
Amazon
SNS
Amazon
S3
reqs
AWS Lambda
function

Aws lambda functions





Aws lambda functions

```
def lambda_handler(event, context):
    """Entry point.

    event: AWS Lambda uses this parameter to pass in
           event data to the handler.

    context: AWS Lambda uses this parameter to provide
             runtime information to your handler.
    """
    return
```

Create lambda function with awscli

```
$ aws lambda create-function \
--region eu-west-1 \
--function-name MyHandler\
--zip-file fileb://handler.zip \
--role arn:aws:iam::XXX:role/MyLambdaRole \
--vpc-config SubnetIds=XXX,SecurityGroupIds=XXX \
--handler handler.handler \
--runtime python3.6 \
--profile personal \
--timeout 10 \
--memory-size 512
```

Code | Configuration | Triggers | Tags | Monitoring

The deployment package of your Lambda function "helloworld-dev" is too large to enable inline code editing. However, you can still invoke your function right now.

Code entry type

Upload a .ZIP file

Function package*

Upload

For files larger than 10 MB, consider uploading via S3.

Environment variables

You can define Environment Variables as key-value pairs that are accessible from your function code. These are useful to store configuration settings without the need to change function code. Learn more.

Key | Value | Remove

Enable encryption helpers

For storing sensitive information, we recommend encrypting values using KMS and the console's encryption helpers.

Code | **Configuration** | Triggers | Tags | Monitoring

Basic information

Runtime

Python 3.6

Handler

The filename.handler-method value in your function. For example, "main.handler" would call the handler method defined in main.py.

handler.lambda_handler

Role

Defines the permissions of your function. Note that new roles may not be available for a few minutes after creation. Learn more about Lambda execution roles.

Choose an existing role

Existing role

You may use an existing role with this function. Note that the role must be assumable by Lambda and must have Cloudwatch Logs permissions.

helloworld-dev-ZappaLambdaExecutionRole

Description

Zappa Deployment

Frameworks

serverless

Lambdify

Programmable AWS Lambda for Python

View the Project on GitHub
ZhukovAlexander/lambdify

Download ZIP File	Download TAR Ball	View On GitHub

python-λ

Chalice

Amazon API Gateway

+

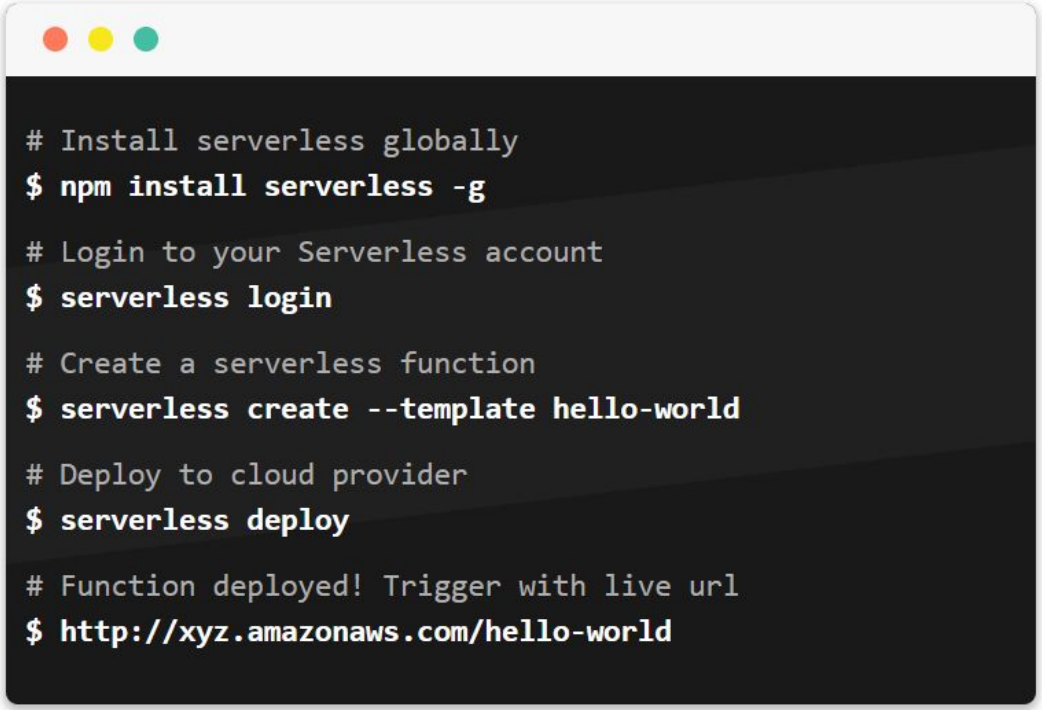
Lambda function

serverless Learn Docs Toolkit Community Blog Enterprise

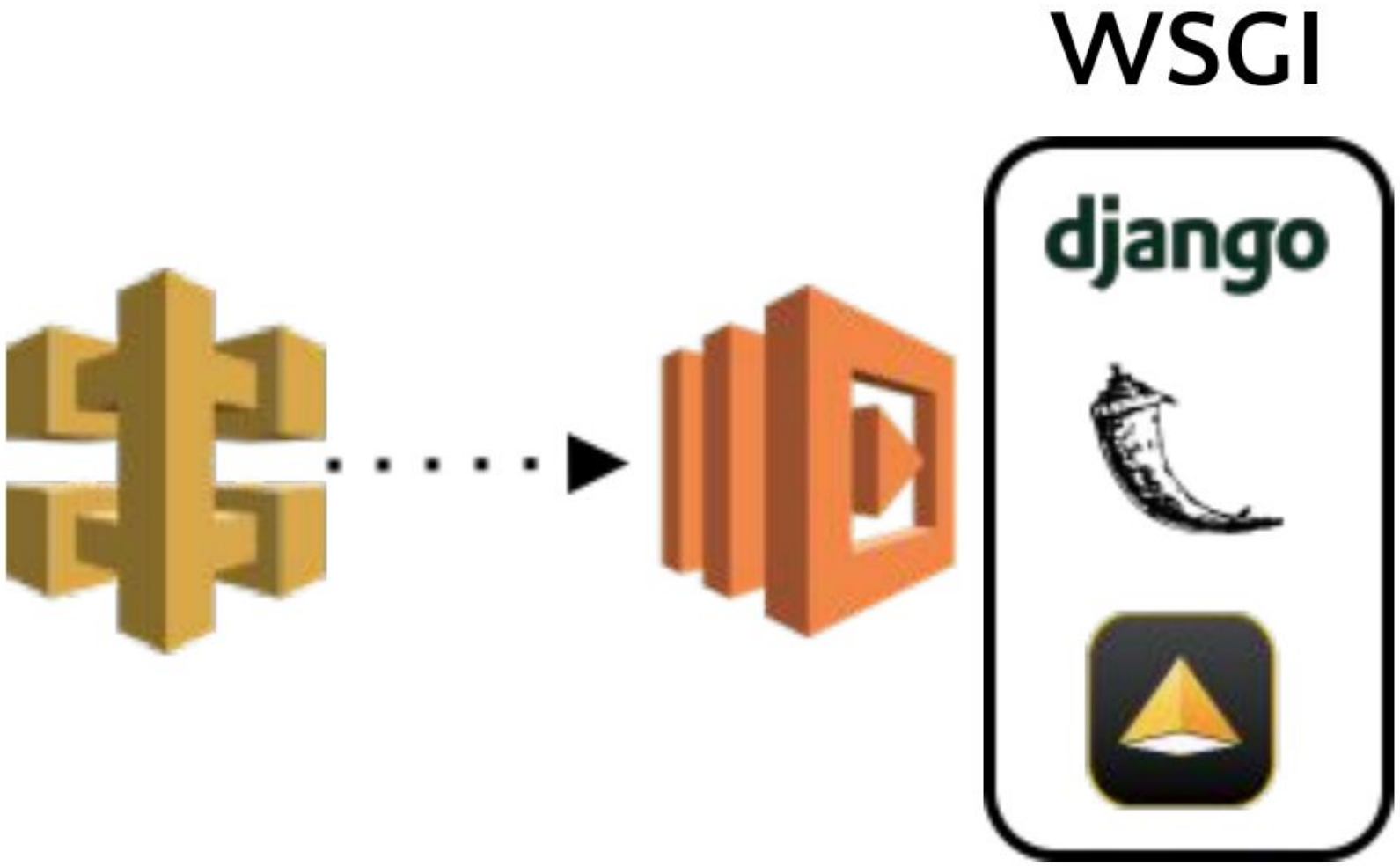
The way cloud should be.

Serverless is your toolkit for deploying and operating serverless architectures. Focus on your application, not your infrastructure.

Quick Start Docs Sign Up



Zappa architecture



Zappa

Deploy your WSGI apps on AWS Lambda

With Zappa, each request is given its own virtual HTTP "server" by Amazon API Gateway. AWS handles the horizontal scaling automatically, so no requests ever time out. After your app returns, the "server" dies.

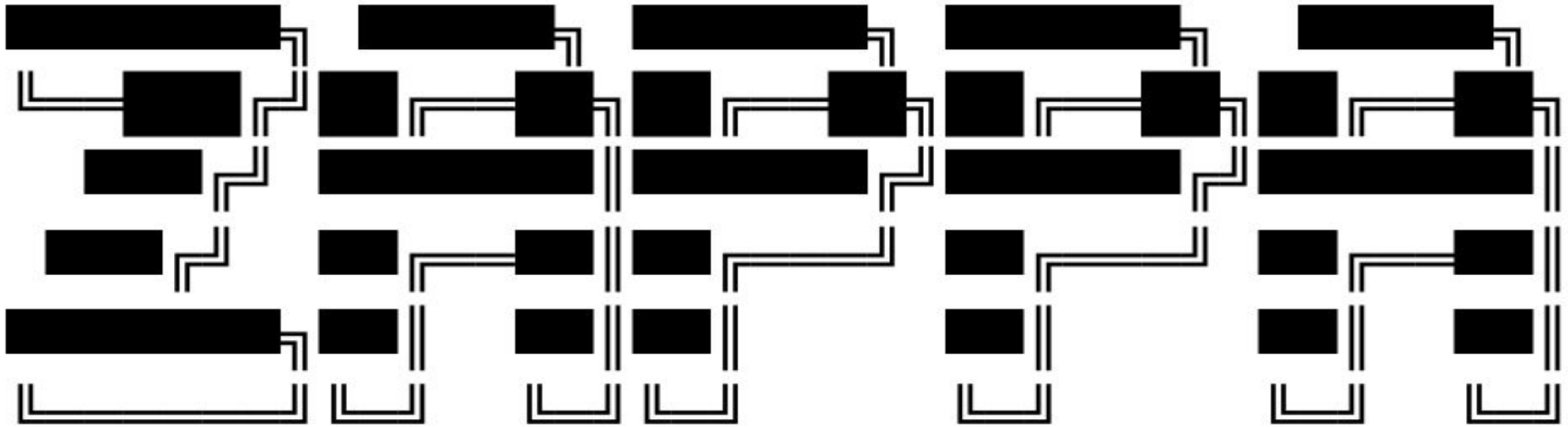
- No more tedious web server configuration!
- No more paying for 24/7 server uptime!
- No more worrying about load balancing / scalability!
- No more worrying about web server security!

```
~ $ cd demo
~/demo $ ls
env                 my_app.py           zappa_settings.json
~/demo $ source env/bin/activate
(env)~/demo $ cat my_app.py
from flask import Flask
app = Flask(__name__)

@app.route('/')
def hello():
    return 'Hello, from Zappa!\n'

if __name__ == '__main__':
    app.run()
(env)~/demo $ cat zappa_settings.json
{
        "dev": {
                "s3_bucket": "lmbda",
                "app_function": "my_app.app",
                "parameter_depth": 1
        }
}
(env)~/demo $ zappa deploy dev
Packaging project as zip...
Uploading zip (5.8MiB)...
Creating API Gateway routes..
 86%|                                                  | 82/95 [00:04<00:00, 17.85it/s]
```

```
➜ pip install zappa
➜ zappa init
```



```
Welcome to Zappa!
...
➜ zappa deploy
```

```
Welcome to Zappa!

Zappa is a system for running server-less Python web applications on AWS Lambda and AWS API Gateway.
This `init` command will help you create and configure your new Zappa deployment.
Let's get started!

Your Zappa configuration can support multiple production stages, like 'dev', 'staging', and 'production'.
What do you want to call this environment (default 'dev'):

AWS Lambda and API Gateway are only available in certain regions. Let's check to make sure you have a profile se
t up in one that will work.
We found the following profiles: default, adsk forge2?, and adsk forge. Which would you like us to use? (default
 'default'):

Your Zappa deployments will need to be uploaded to a private S3 bucket.
If you don't have a bucket yet, we'll create one for you too.
What do you want call your bucket? (default 'zappa-68fz81bc0'):

It looks like this is a Flask application.
What's the modular path to your app's function?
This will likely be something like 'your_module.app'.
We discovered: app.app
Where is your app's function? (default 'app.app'):
```

```
{
    "dev": {
        "app_function": "app.app",
        "aws_region": "eu-west-1",
        "profile_name": "default",
        "s3_bucket": "zappa-68fz81bc0"
    }
}

Does this look okay? (default 'y') [y/n]:

Done! Now you can deploy your Zappa application by executing:

        $ zappa deploy dev

After that, you can update your application code with:

        $ zappa update dev

To learn more, check out our project page on GitHub here: https://github.com/Miserlou/Zappa
and stop by our Slack channel here: https://slack.zappa.io

Enjoy!,
 ~ Team Zappa!
```

 # zappa_settings.json

```
{
    "dev": {
        "aws_region": "us-east-1",
        "django_settings": "hello.settings",
        "profile_name": "default",
        "project_name": "hello",
        "runtime": "python3.6",
        "s3_bucket": "zappa-huyg6op0s"
    }
}
```

Zappa deploy

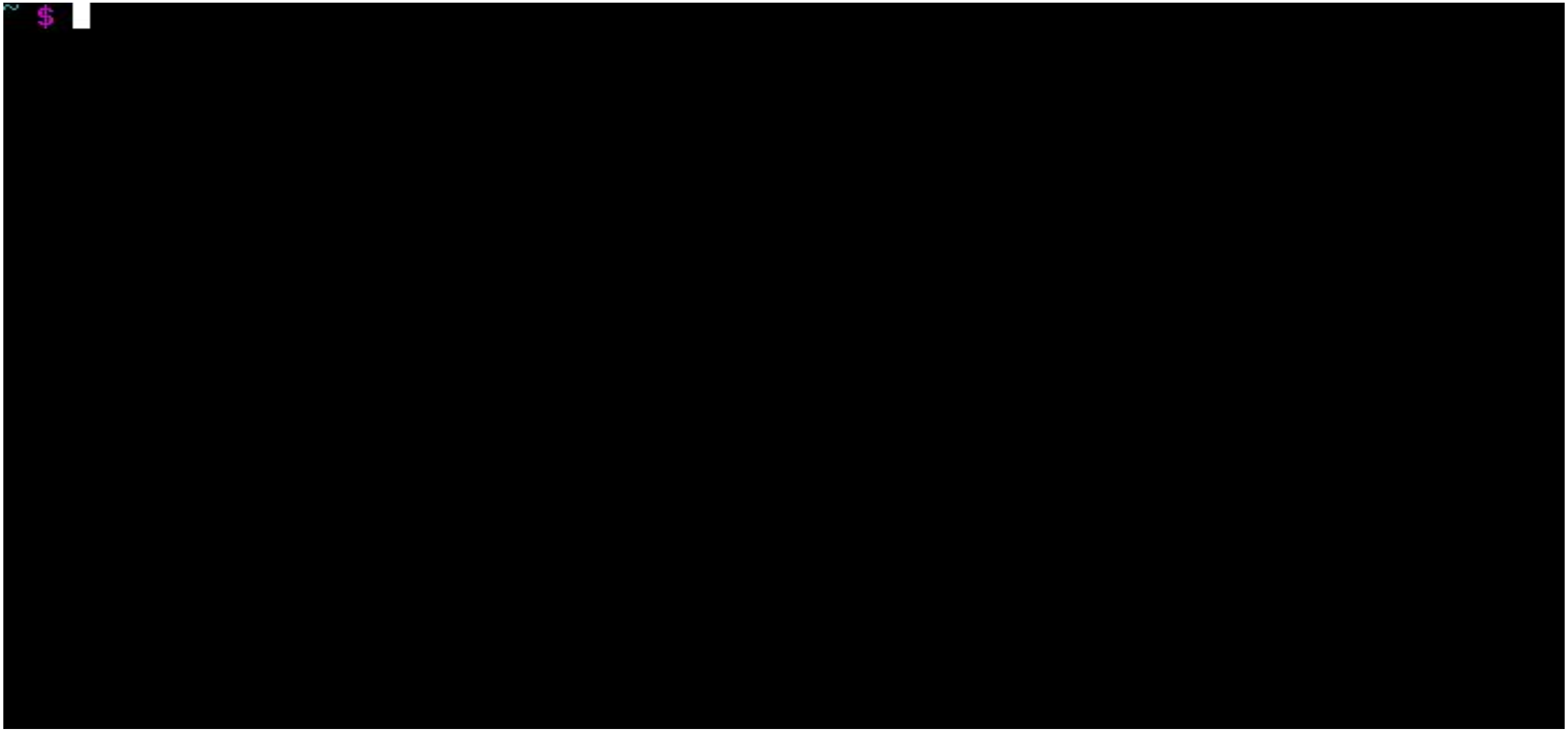
$ zappa deploy <env>

- Zips code and dependencies
- Create AWS Lambda and deploys the zip
- Creates endpoint on API Gateway and links to AWS Lambda

Zappa deploy

```
(py36) ➜ zappa zappa deploy
Calling deploy for stage dev6..
Downloading and installing dependencies..
 - sqlite==python36: Using precompiled lambda package
Packaging project as zip.
Uploading zappa-dev6-1523116120.zip (12.8MiB)..
100%|                                                                                | 13.5M/13.5M [00:09<00:00, 1.43MB/s]
Scheduling..
Scheduled zappa-dev6-zappa-keep-warm-handler.keep_warm_callback with expression rate(4 minutes)!
Uploading zappa-dev6-template-1523116139.json (1.6KiB)..
100%|                                                                                | 1.60K/1.60K [00:00<00:00, 3.09KB/s]
Waiting for stack zappa-dev6 to create (this can take a bit)..
 75%|                                                                              | 3/4 [00:06<00:02,  2.17s/res]
Deploying API Gateway..
```

Zappa



Zappa Asynchronous Task

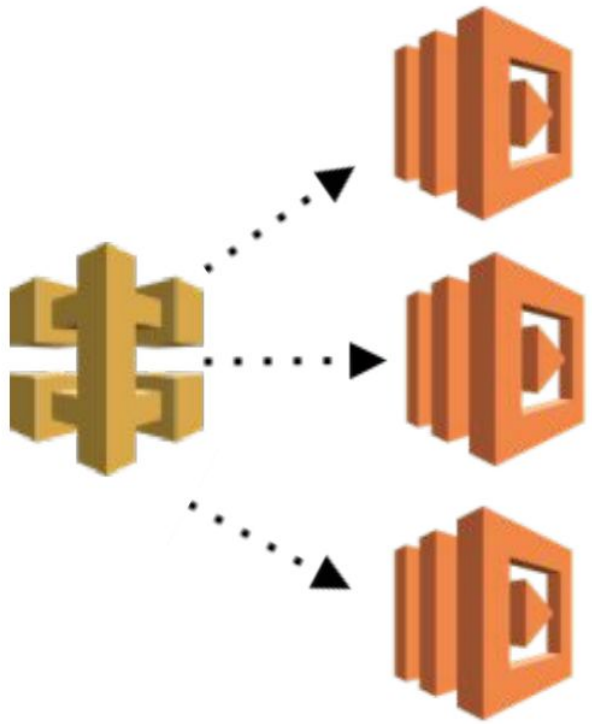
```
from flask import Flask
from zappa.async import task
app = Flask(__name__)

@task
def make_pie():
    """ This takes a long time! """
    ingredients = get_ingredients()
    pie = bake(ingredients)
    deliver(pie)

@app.route('/api/order/pie')
def order_pie():
    """ This returns immediately! """
    make_pie()
    return "Your pie is being made!"
```

Chalice

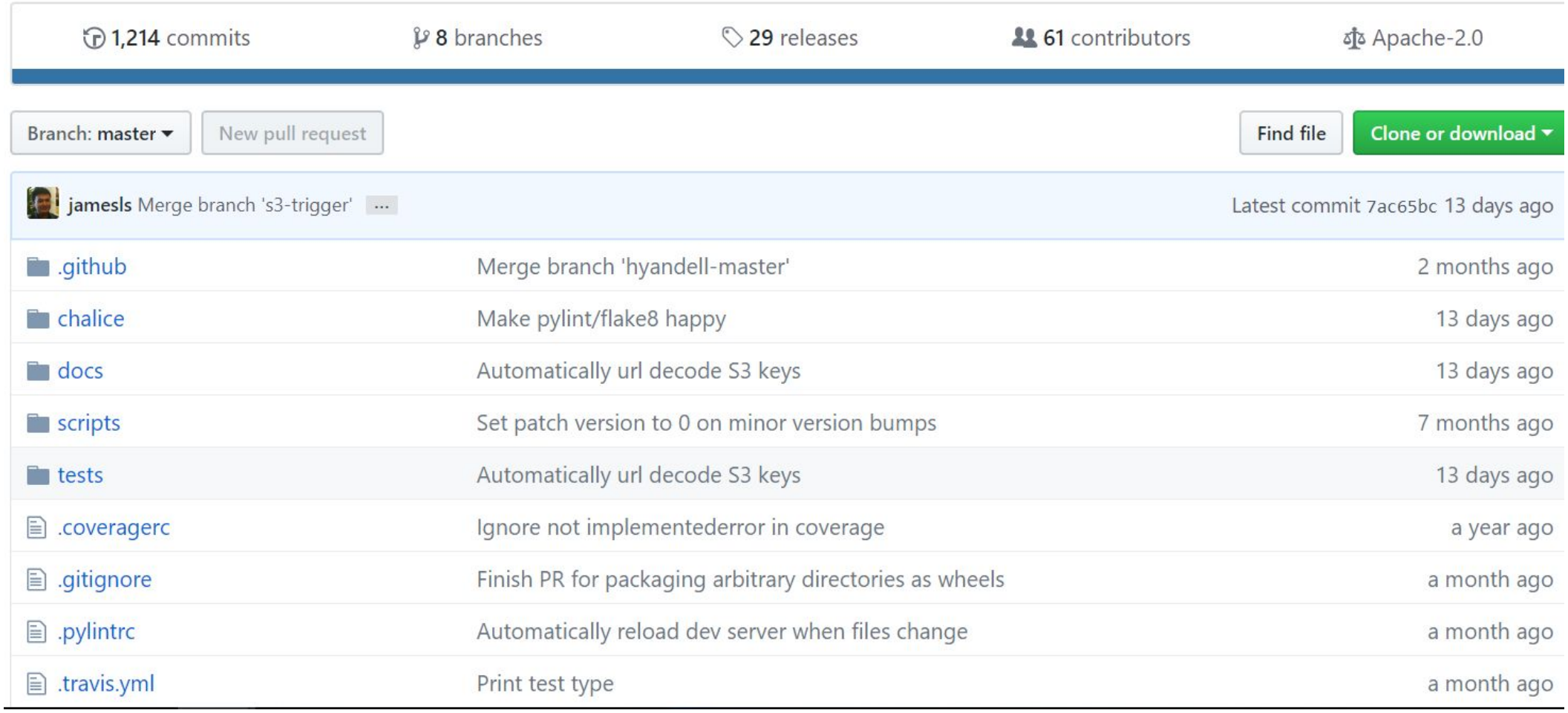
- Python Serverless Microframework for AWS
- Each endpoint is a separate function



Chalice

Python Serverless Microframework for AWS

python aws aws-lambda cloud serverless serverless-framework aws-apigateway lambda python3 python27



Chalice

```
$ pip install chalice
$ chalice new-project helloworld && cd helloworld

$ cat app.py
from chalice import Chalice

app = Chalice(app_name="helloworld")

@app.route("/")
def index():
    return {"hello": "world"}

$ chalice deploy
```

Chalice example

```
import requests


URL = 'http://api.apixu.com/v1/current.json?key=51deeb4a20ef476db6b165025181907&q='

@app.route('/weather/{city}')
def weather(city):
    try:
        if city is None:
            return _error("Invalid data (required city)")

        response = requests.get(URL+city).json()
        return Response(body=response,
                        status_code=200,
                        headers={'Content-Type': 'application/json'})

    except Exception as exception:
        raise BadRequestError("Unknown url '%s'" % (URL))
```

Chalice methods

Resource	HTTP Verb	AWS Lambda
/talks	GET	get_talks
/talk	POST	add_new_talk
/talks/{ID}	PUT	update_talk
/talks/{ID}	DELETE	delete_talk

Chalice methods

```python
@app.route('/talks', methods=['GET'])
def get_talks():
    return get_app_db().list_items()


@app.route('/talks', methods=['POST'])
def add_new_talk():
    body = app.current_request.json_body
    return get_app_db().add_item(
        id=body['id'],
        description=body['description']
    )
```

```python
@app.route('/talks/{id}', methods=['DELETE'])
def delete_talk(id):
    return get_app_db().delete_item(id)


@app.route('/talks/{id}', methods=['PUT'])
def update_talk(id):
    body = app.current_request.json_body
    get_app_db().update_item(id,description=body.get('description'),state=body.get('state'))
```

Chalice options

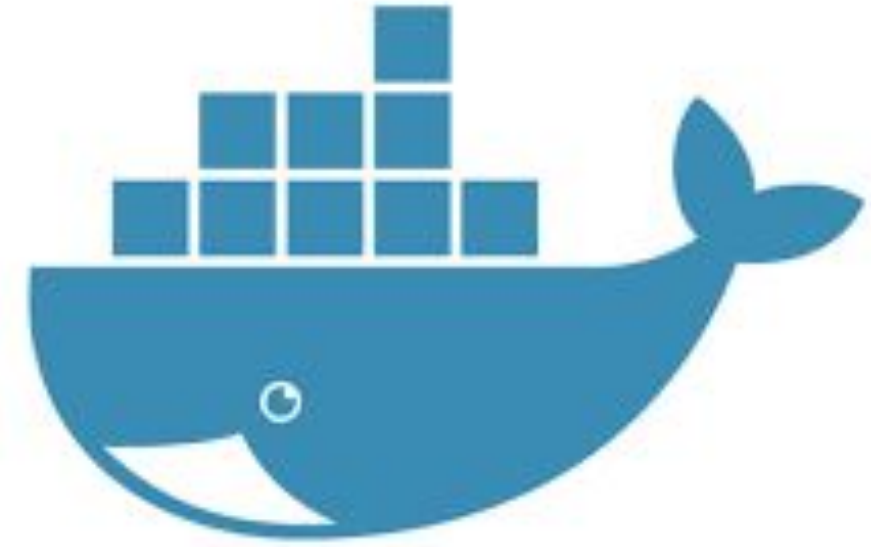
```
Usage: chalice [OPTIONS] COMMAND [ARGS]...

Options:
  --version                    Show the version and exit.
  --project-dir TEXT           The project directory.  Defaults to CWD
  --debug / --no-debug         Print debug logs to stderr.
  --help                       Show this message and exit.

Commands:
  delete
  deploy
  gen-policy
  generate-pipeline  Generate a cloudformation template for a...
  generate-sdk
  local
  logs
  new-project
  package
  url
```

Chalice deploy

```
Updating IAM policy.
Updating lambda function...
Regen deployment package...
Sending changes to lambda.
API Gateway rest API already found.
Deploying to: dev
```




AWS Lambda

https://github.com/lambci/docker-lambda

docker-lambda

A sandboxed local environment that replicates the live AWS Lambda environment almost identically – including installed software and libraries, file structure and permissions, environment variables, context objects and behaviors – even the user and running process are the same.

```
~ docker run -v "$PWD":/var/task lambci/lambda
START RequestId: 4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49 Version: $LATEST
2016-05-26T03:47:37.994Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    process.execPath:
2016-05-26T03:47:37.995Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    /usr/local/lib64/node-v4.3.x/bin/node
2016-05-26T03:47:37.995Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    process.cwd():
2016-05-26T03:47:37.995Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    /var/task
2016-05-26T03:47:37.996Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    child_process.execSync('ls -la /tmp'):
2016-05-26T03:47:38.010Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    total 8
drwx------  2 sbx_user1051  495 4096 May 26 02:14 .
drwxr-xr-x 27 root         root 4096 May 26 03:47 ..

2016-05-26T03:47:38.011Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    context.getRemainingTimeInMillis():
2016-05-26T03:47:38.011Z        4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49    299978
END RequestId: 4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49
REPORT RequestId: 4ce0a79f-5a50-1c09-1a8a-c0c4c6431a49  Duration: 24.40 ms      Billed Duration: 100 ms Memory
Size: 1536 MB   Max Memory Used: 24 MB
null~
```

http://serverlesscalc.com/

Calculating cost for AWS Lambda, Azure Functions, Google Cloud Functions, and IBM OpenWhisk

1000000 — Number of Executions

100 — Estimated Execution Time (ms)

1024MB — Memory Size

Include Free-Tier: ○ True ◉ False

HTTP Requests: ◉ True ○ False

Vendor	Request Cost	Compute Cost	Total
AWS Lambda	$3.70	$1.67	$5.37
Azure Functions	$0.20	$1.60	$1.80
Google Cloud Functions	$0.40	$1.65	$2.05

Author from scratch

Start with a simple "hello world" example.

Blueprints

Choose a preconfigured template as a starting point for your Lambda function.

Serverless Application Repository

Find and deploy serverless apps published by developers, companies, and partners on AWS.

Blueprints Info

Export

Filter by tags and attributes or search by keyword

1 2 3 4 5 6 7 ... 10

kinesis-firehose-syslog-to-json

An Amazon Kinesis Firehose stream processor that converts input records from RFC3164 Syslog format to JSON.

nodejs · kinesis-firehose

logicmonitor-send-cloudwatch-events

Creates LogicMonitor OpsNotes for CloudWatch Events, thereby enabling correlation between events and performance data.

python · cloudwatch-events · monitoring · eventstream · ext-libraries

splunk-elb-application-access-logs-processor

Stream Application ELB access logs from S3 to Splunk's HTTP event collector

nodejs6.10 · splunk · elb · s3 · application-elb

https://github.com/serverless/examples

aws-python-alexa-skill	Add front matter to the examples readme for pusblishing to site.	a year ago
aws-python-auth0-custom-authoriz...	Added Python AWS Lambda Authorizer	9 days ago
aws-python-pynamodb-s3-sigurl	Fix issues from reviewer suggestions.	8 months ago
aws-python-rest-api-with-dynamodb	Fixing SETUP typo in README.md	7 months ago
aws-python-rest-api-with-faunadb	Add front matter to the examples readme for pusblishing to site.	a year ago
aws-python-rest-api-with-pynamodb	Update to docs	a year ago
aws-python-scheduled-cron	Add front matter to the examples readme for pusblishing to site.	a year ago
aws-python-simple-http-endpoint	Add front matter to the examples readme for pusblishing to site.	a year ago
aws-python-telegram-bot	Add aws-python-telegram-bot	9 months ago
azure-node-simple-http-endpoint	Update the Azure example to match recent updates.	a year ago
google-node-simple-http-endpoint	Merge pull request #159 from serverless/update-gcf-npm-package-version	a year ago
kubeless-python-schedule	Adapt examples to kubeless 0.5	4 months ago
kubeless-python-simple	Adapt examples to kubeless 0.5	4 months ago

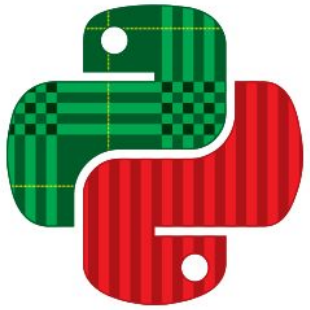
References

- https://aws.amazon.com/blogs/compute/microservices-without-the-servers

- https://github.com/Miserlou/Zappa
- https://github.com/pmuens/awesome-serverless

- https://github.com/aws/chalice
- https://chalice.readthedocs.io/en/latest

Serverless architecture is the next generation of cloud evolution



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Thank you!

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