DEV333

AWS re:INVENT

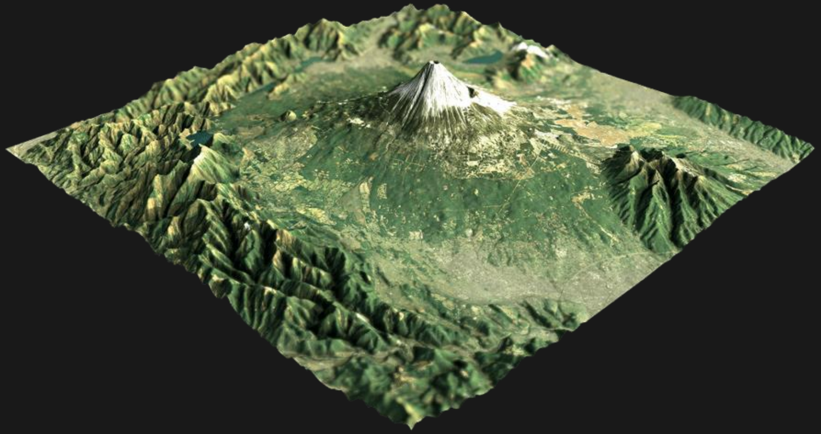
Using Amazon CloudWatch for Amazon ECS Resource Monitoring at Scale

Brendan McFarland
Platform Cost Engineer @ Mapbox

November 28, 2017

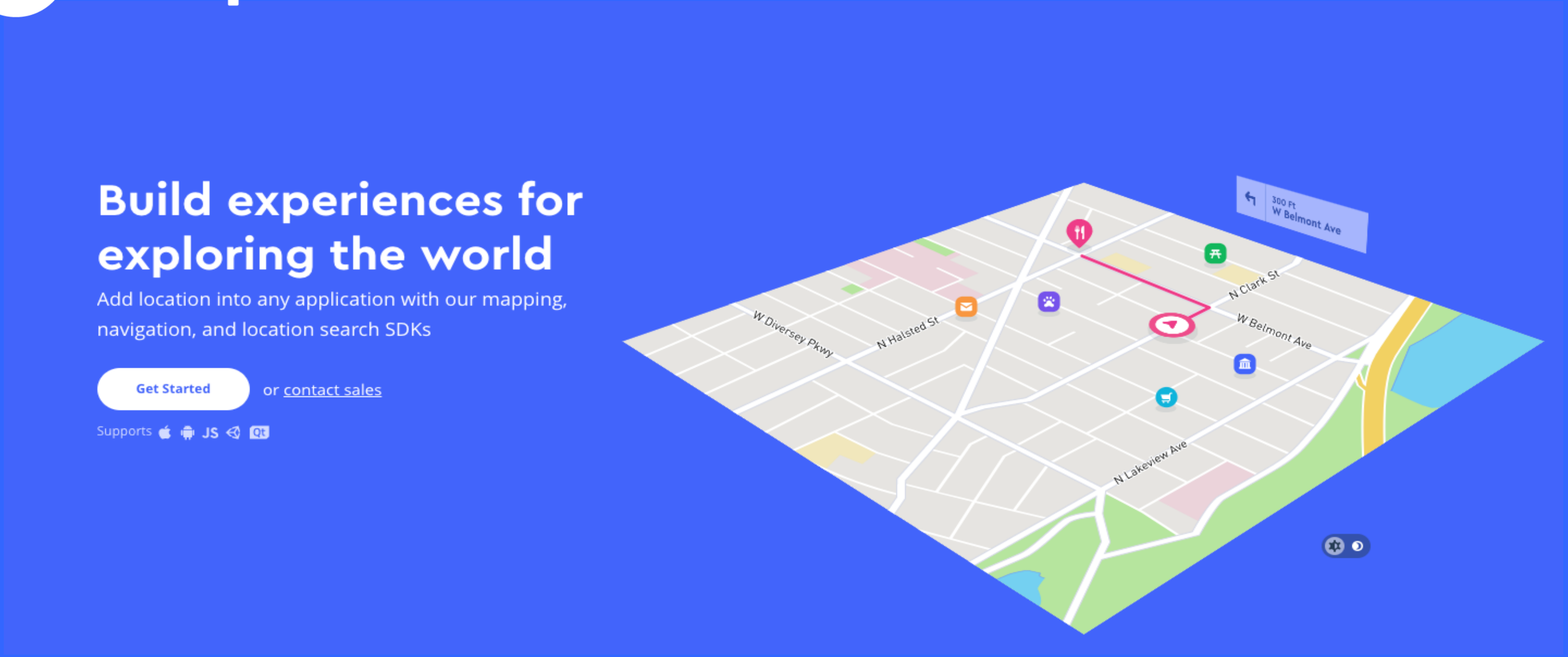
DEV333: Agenda

- Mapbox + platform cost engineering
- EC2 → ECS
- ECS + the shared resource problem
- ECS + Amazon CloudWatch
- Building a solution
- Results and lessons learned
- What's next @ Mapbox



mapbox

mapbox



Build experiences for exploring the world

Add location into any application with our mapping, navigation, and location search SDKs

Get Started or contact sales

Supports JS

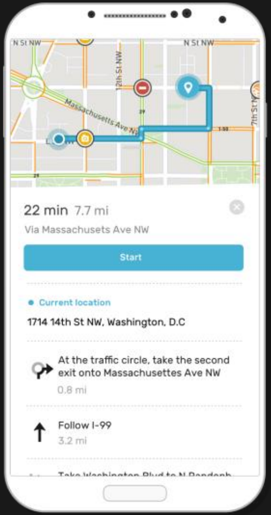
AWS re:Invent

aws

mapbox

Maps

Navigation



22 min 7.7 mi

Via Massachusets Ave NW

Start

Current location

1714 14th St NW, Washington, D.C

At the traffic circle, take the second exit onto Massachusettes Ave NW

0.8 mi

Follow I-99

3.2 mi

Take Washington Blvd to N Randolph

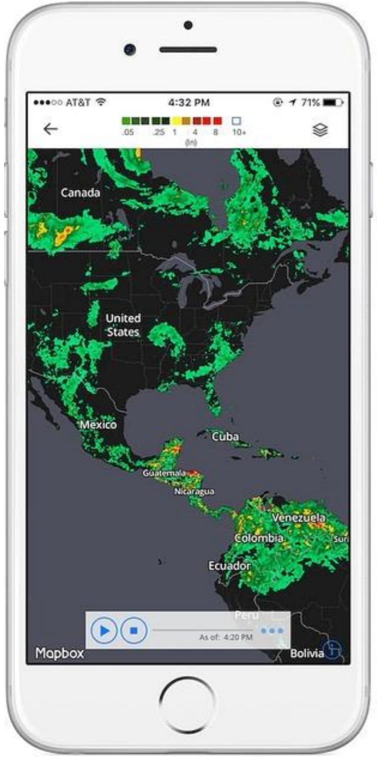
Search

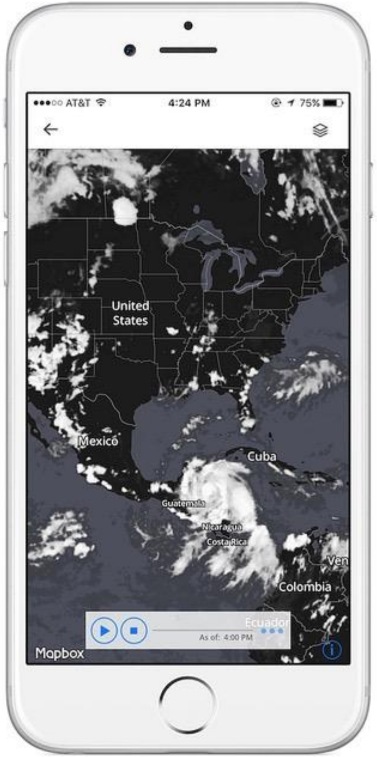
AWS re:Invent

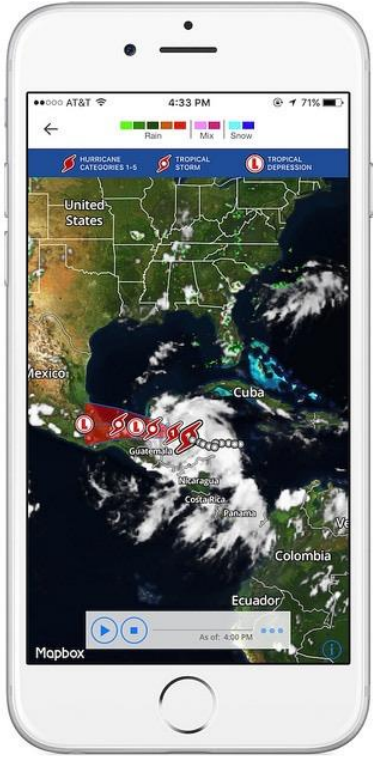
aws

The Weather Company

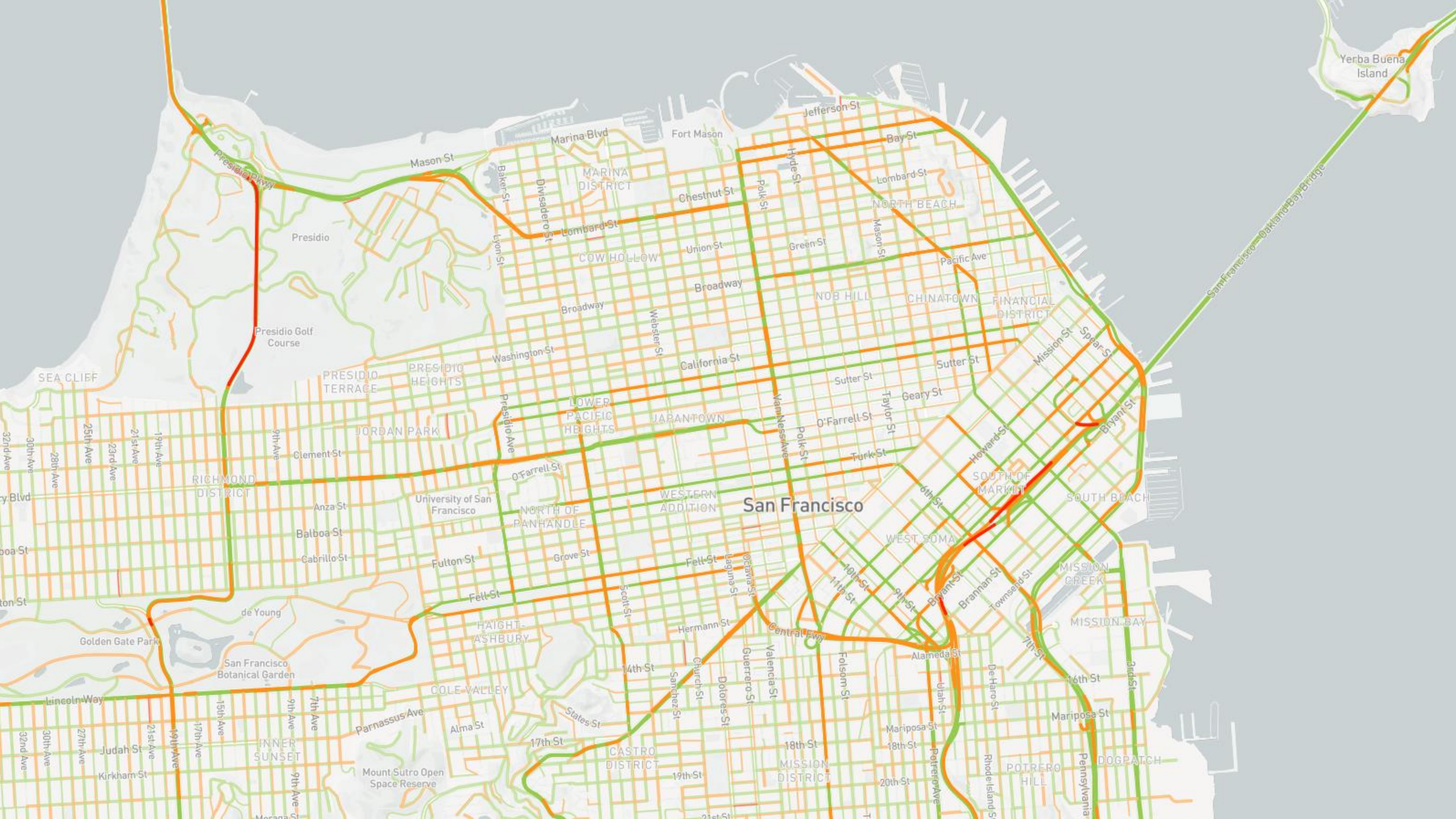
An IBM Business

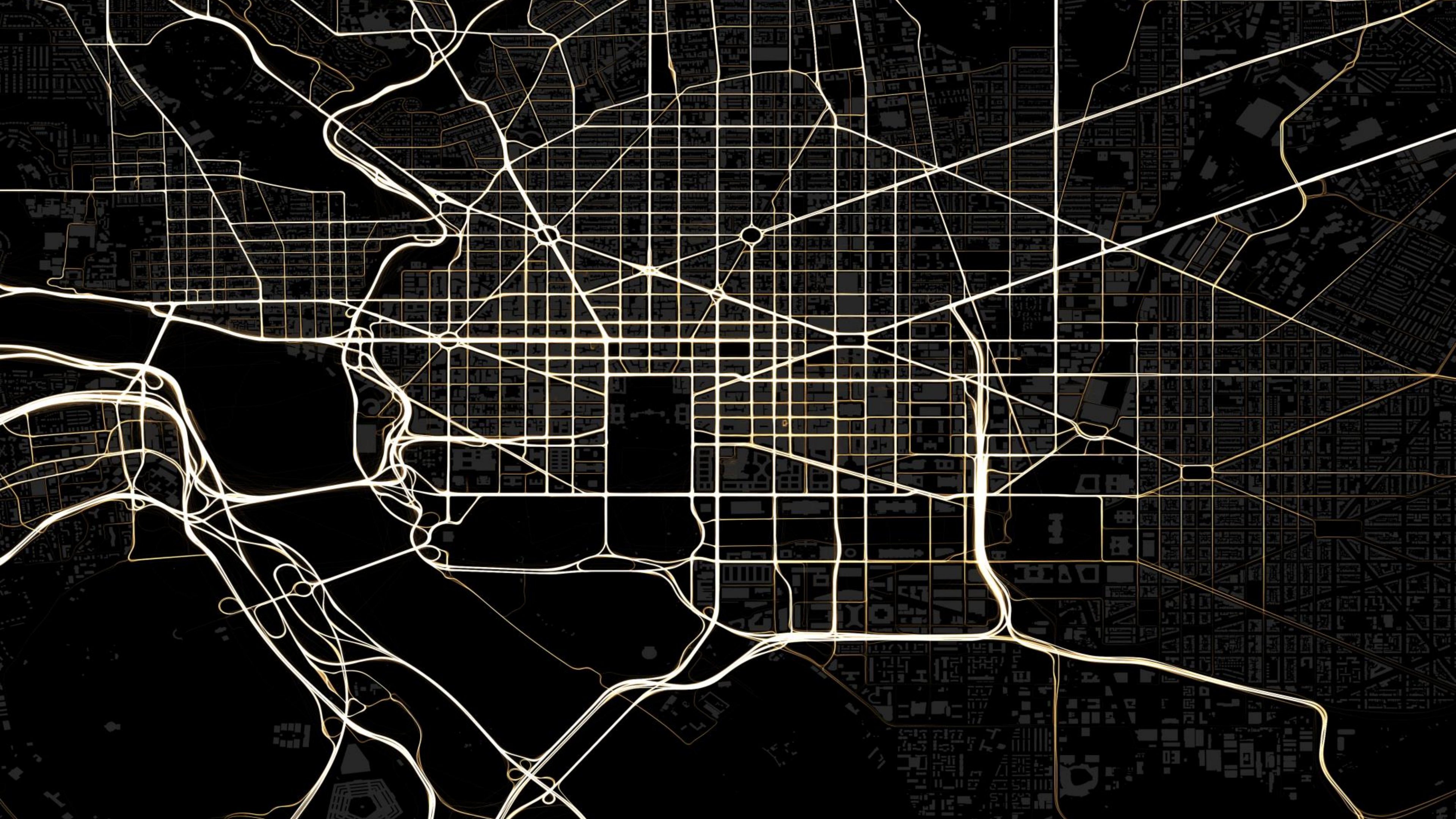






tableau®
SOFTWARE


Yerba Buena
Island
San Francisco—Oakland Bay Bridge
Jefferson St
Bay St
Lombard St
Marina Blvd
Fort Mason
Mason St
Presidio Pkwy
MARINA
DISTRICT
Chestnut St
Lombard St
Baker St
Divisadero St
Hyde St
Polk St
Mason St
NORTH BEACH
Presidio
Lyon St
COW HOLLOW
Union St
Green St
Pacific Ave
Broadway
Broadway
NOB HILL
CHINATOWN
FINANCIAL
DISTRICT
Webster St
Presidio Golf
Course
Washington St
California St
Sutter St
Mission St
Spear St
SEA CLIFF
PRESIDIO
TERRACE
PRESIDIO
HEIGHTS
Sutter St
Geary St
Taylor St
LOWER
PACIFIC
HEIGHTS
JAPANTOWN
O'Farrell St
Van Ness Ave
Polk St
Bryant St
JORDAN PARK
Presidio Ave
32nd Ave
30th Ave
28th Ave
25th Ave
23rd Ave
21st Ave
19th Ave
9th Ave
Clement St
Howard St
Turk St
O'Farrell St
RICHMOND
DISTRICT
SOUTH OF
MARKET
SOUTH BEACH
ry Blvd
University of San
Francisco
Anza St
NORTH OF
PANHANDLE
WESTERN
ADDITION
San Francisco
6th St
Balboa St
WEST SOMA
boa St
Grove St
Fell St
Laguna St
Octavia St
Cabrillo St
Fulton St
10th St
11th St
9th St
Bryant St
Brannan St
Townsend St
MISSION
CREEK
ton St
Fell St
Scott St
de Young
HAIGHT-
ASHBURY
Hermann St
Central Fwy
MISSION BAY
Golden Gate Park
San Francisco
Botanical Garden
14th St
Church St
Guerrero St
Valencia St
Alameda St
7th St
16th St
Lincoln Way
COLE VALLEY
Sanchez St
Dolores St
Folsom St
Utah St
De Haro St
3rd St
Parnassus Ave
States St
Mariposa St
Mariposa St
32nd Ave
30th Ave
27th Ave
Judah St
21st Ave
19th Ave
17th Ave
15th Ave
9th Ave
7th Ave
INNER
SUNSET
Alma St
17th St
CASTRO
DISTRICT
18th St
18th St
Kirkham St
Mount Sutro Open
Space Reserve
19th St
MISSION
DISTRICT
20th St
POTRERO
HILL
Potrero Ave
Rhode Island St
Pennsylvania
DOGPATCH
9th Ave
Moraga St
21st St



AWS from the beginning

- Thousands of customers
- Thousands of mobile applications
- Hundreds of millions of users
- Three billion probes a day, 100 million miles of anonymized telemetry

All this consumes trillions of compute seconds every day on Amazon EC2 Container Service (Amazon ECS)

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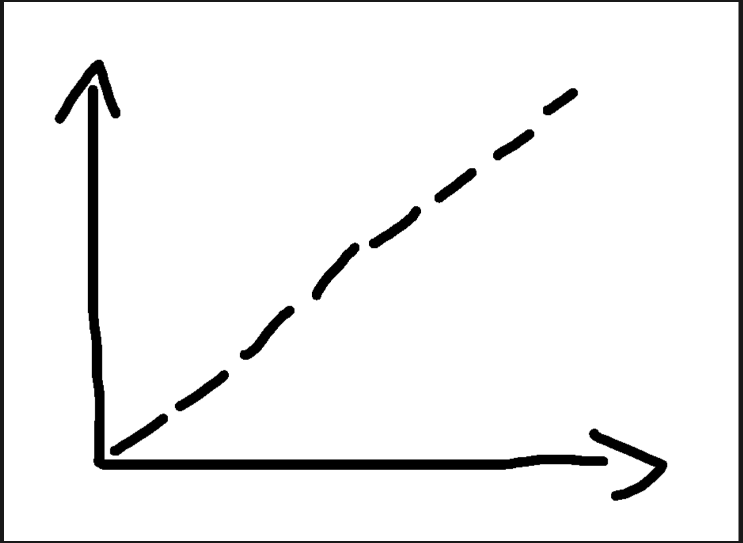
Platform Cost Engineering

Platform Cost Engineering

Role

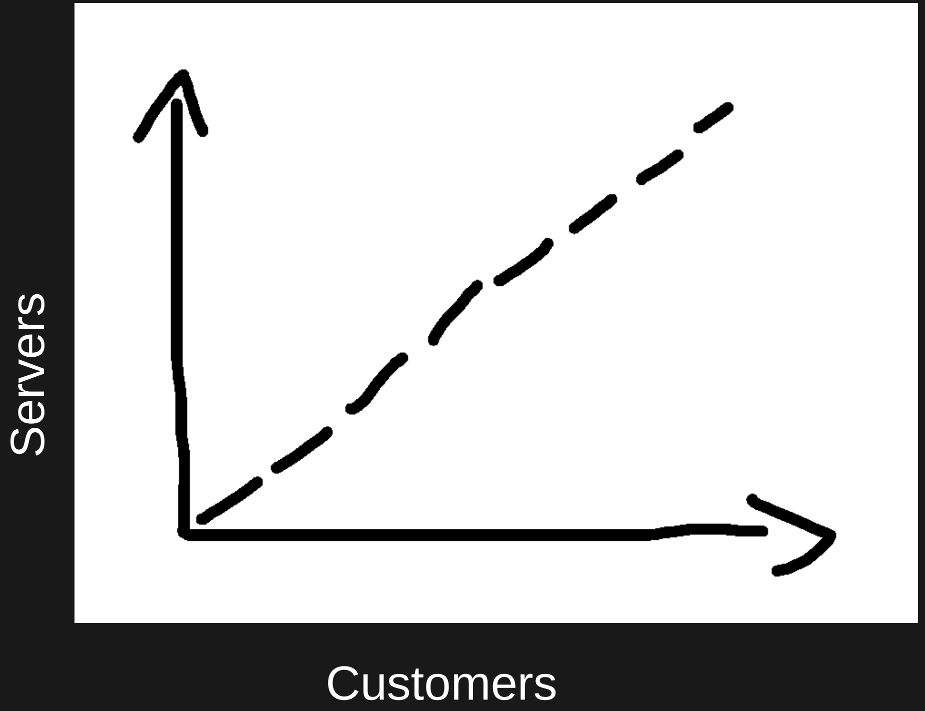
- Cost monitoring
- On-call rotation
- Consult with stakeholders
- Innovate and advance



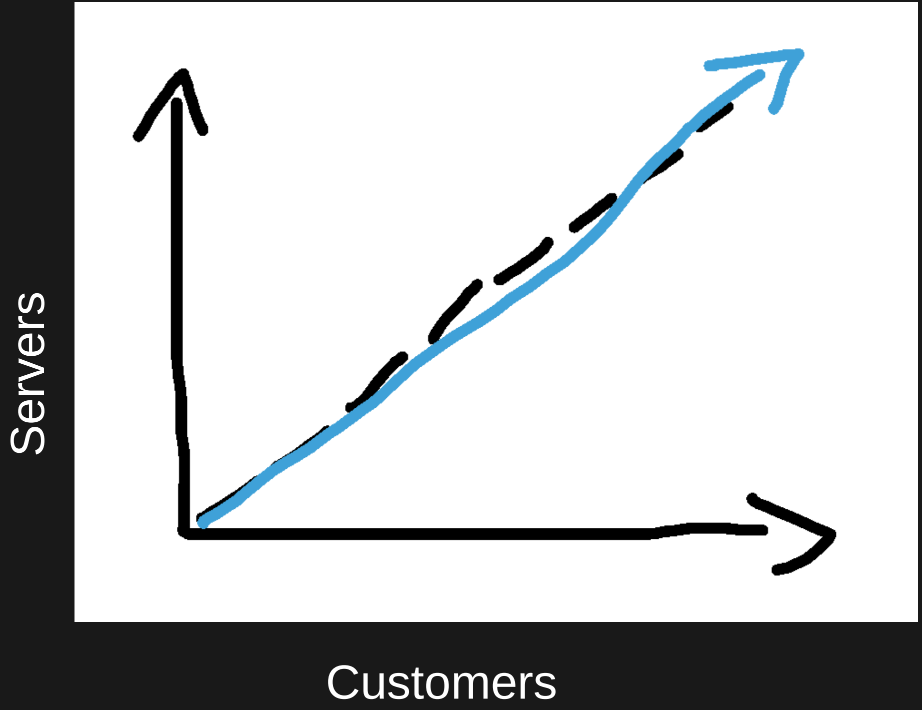
Principles

- Inform and empower stakeholders
- Stewardship of resource usage
- The x-axis is coming

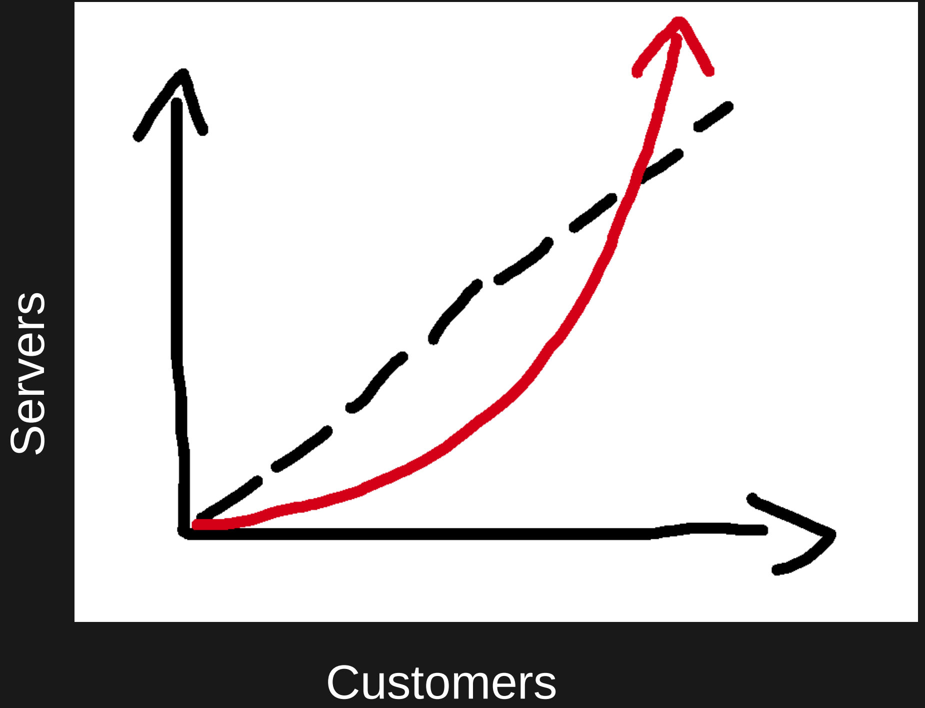
Scale @ Mapbox



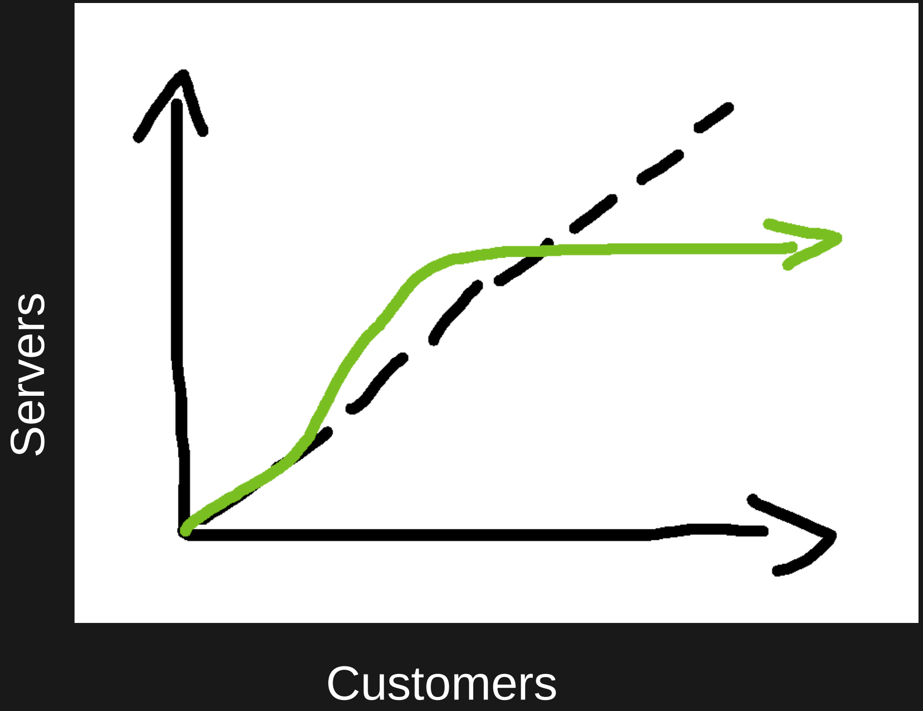
Scale @ Mapbox



Scale @ Mapbox

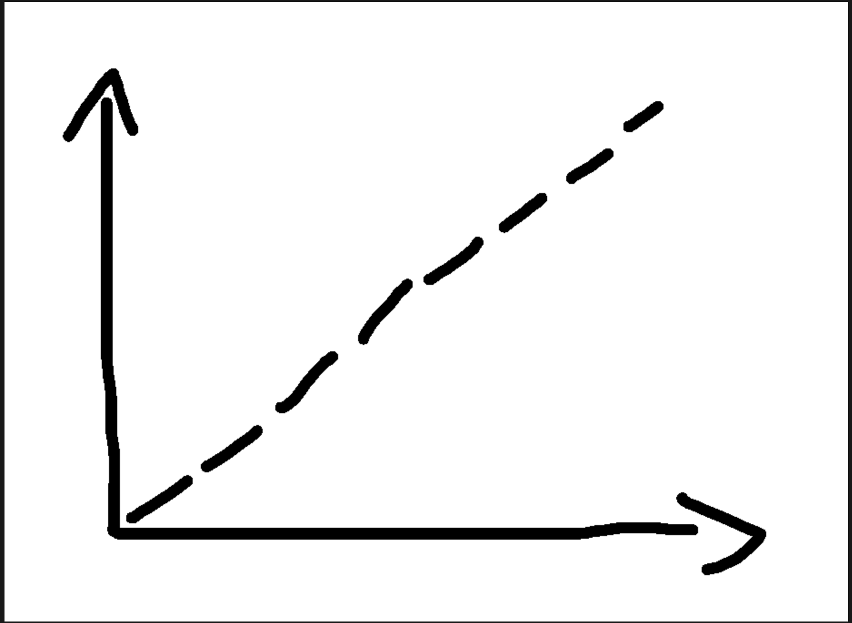


Scale @ Mapbox



Many Dimensions of Scale

Resources:
- Servers
- Engineers
- Cost
- Alarms
- Architectures



Scale: customers, requests, applications, products

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EC2 → ECS

Moving to ECS

Lower Cost

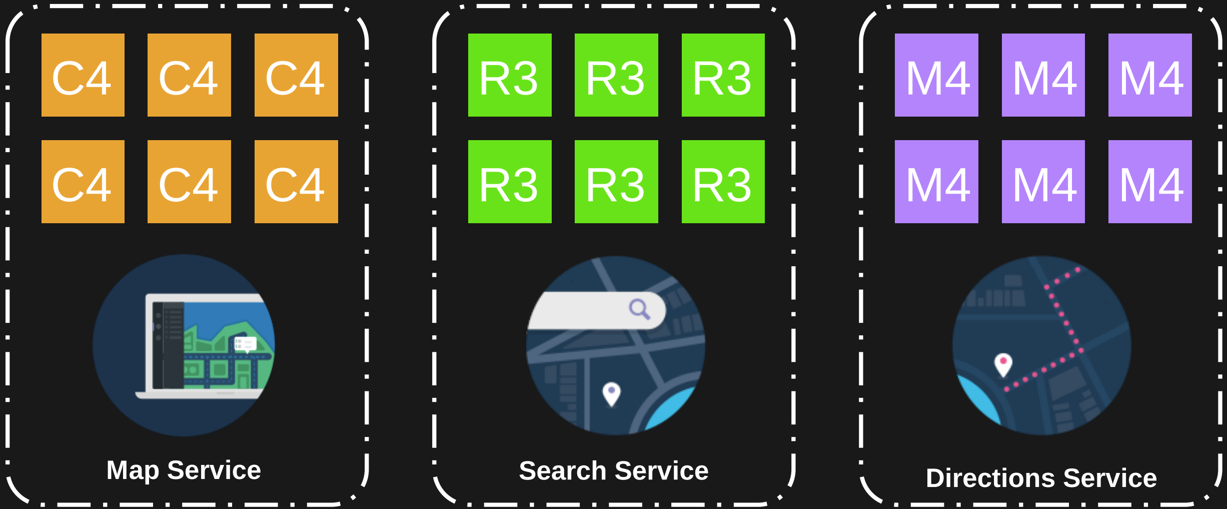
- Utilization
- Spot by default
- Centralized Capacity

Moving to ECS

Efficient Operations

- Separate Infrastructure from Code
- Uniform architecture
- Security / Credentialing
- Local development environments

Before ECS



C4 C4 C4
C4 C4 C4

Map Service

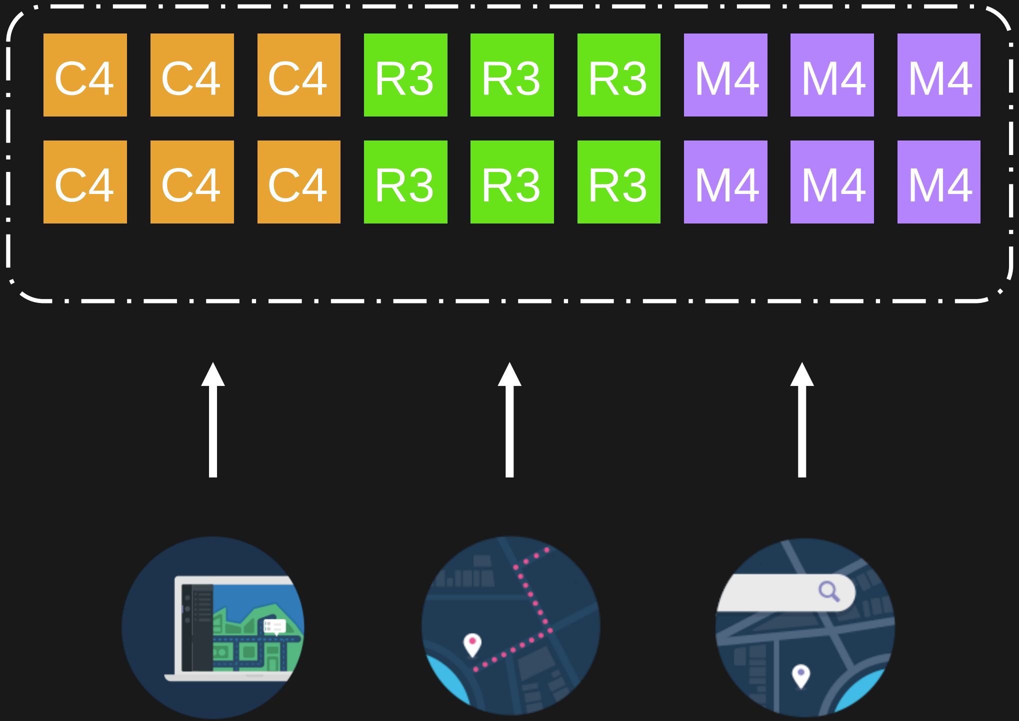
R3 R3 R3
R3 R3 R3

Search Service

M4 M4 M4
M4 M4 M4

Directions Service

ECS

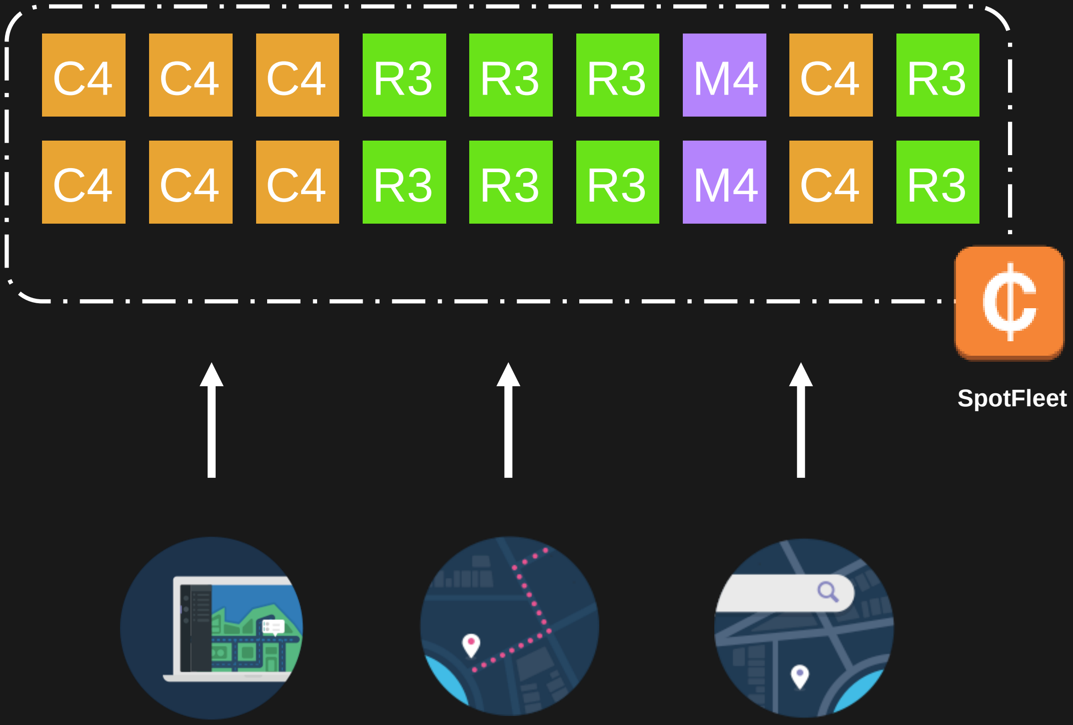


C4 C4 C4 R3 R3 R3 M4 M4 M4

C4 C4 C4 R3 R3 R3 M4 M4 M4

Map Service **Directions Service** **Search Service**

Spot & Instance Diversity



C4 C4 C4 R3 R3 R3 M4 C4 R3

C4 C4 C4 R3 R3 R3 M4 C4 R3

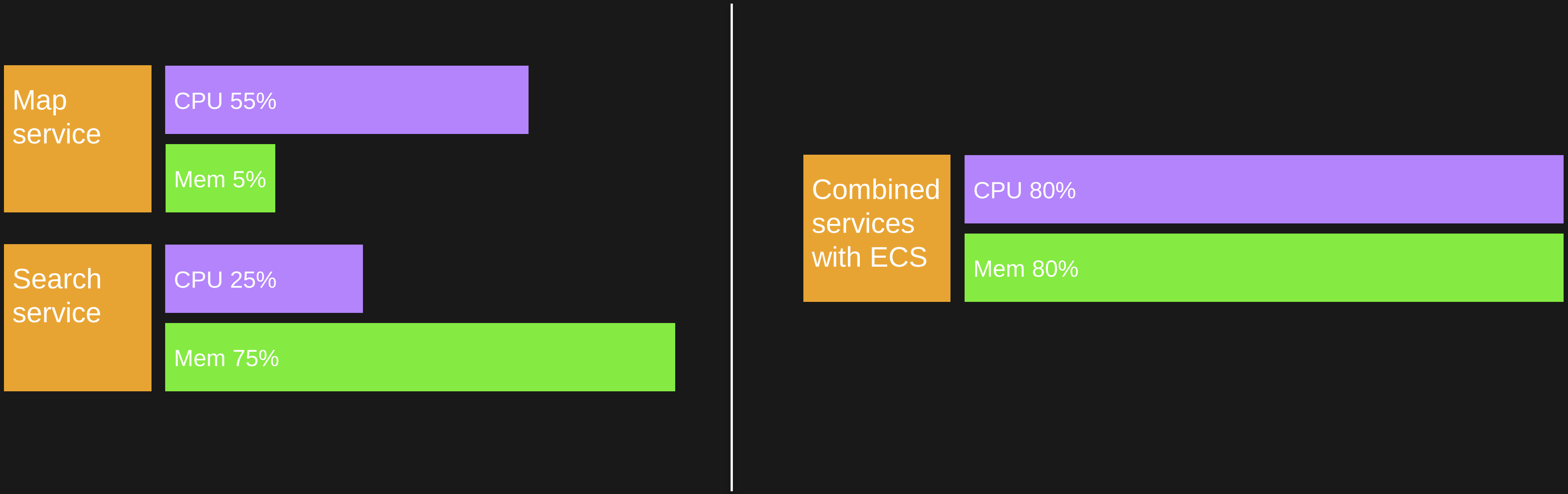
SpotFleet

Map Service

Directions Service

Search Service

Improved Instance Packing



Map service

CPU 55%

Mem 5%

Search service

CPU 25%

Mem 75%

Combined services with ECS

CPU 80%

Mem 80%

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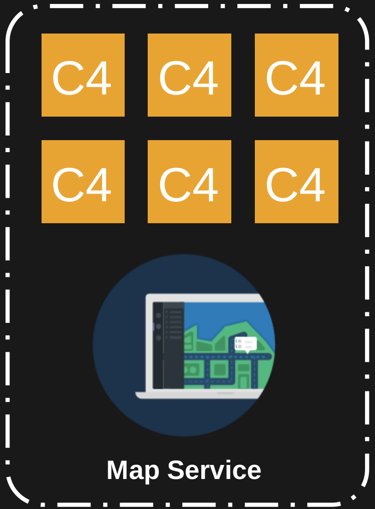
ECS + the shared resource problem

Before ECS



C4 C4 C4

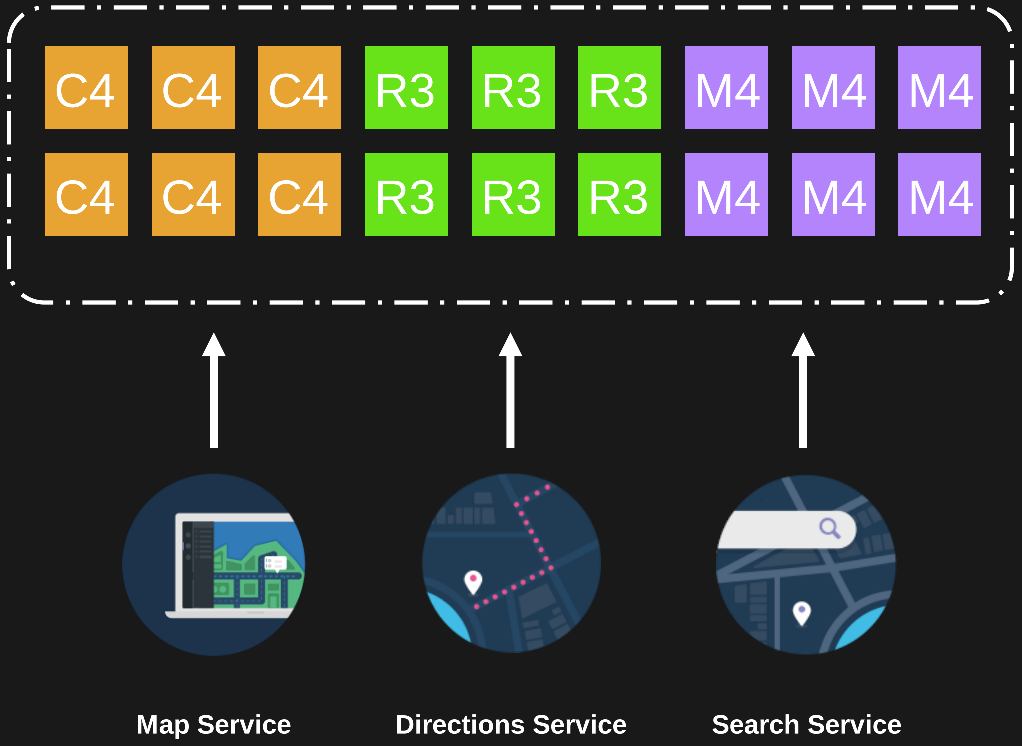
C4 C4 C4

Map Service

A maps instance is a maps instance

= $100

After ECS Migration



C4 C4 C4 R3 R3 R3 M4 M4 M4

C4 C4 C4 R3 R3 R3 M4 M4 M4

Map Service

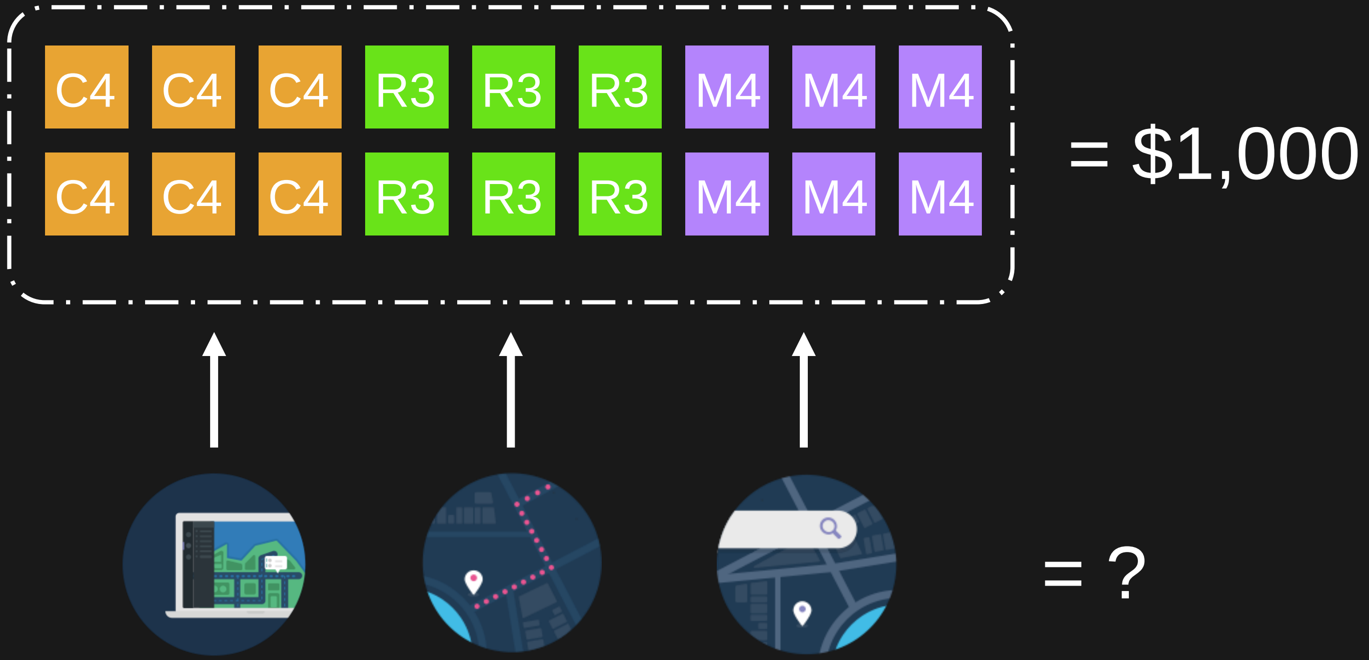
Directions Service

Search Service

A cluster instance is…

a maps instance,
a directions instance,
a search and directions instance,
a maps and search instance,
all within the same day…

ECS Billing



C4	C4	C4	R3	R3	R3	M4	M4	M4
C4	C4	C4	R3	R3	R3	M4	M4	M4

= $1,000

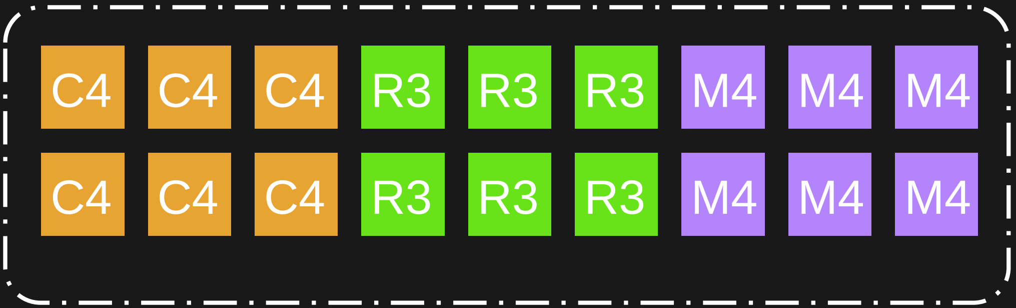
Map Service

Directions Service

Search Service

= ?

Still missing part of the picture



Challenges in a shared resource environment

- Tags at cluster level
- Multiple teams in one resource
- Loss of granularity for teams

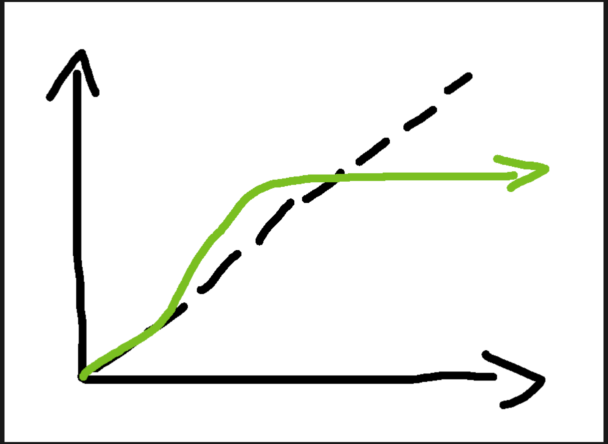
We needed service & task resource consumption within our ECS environment

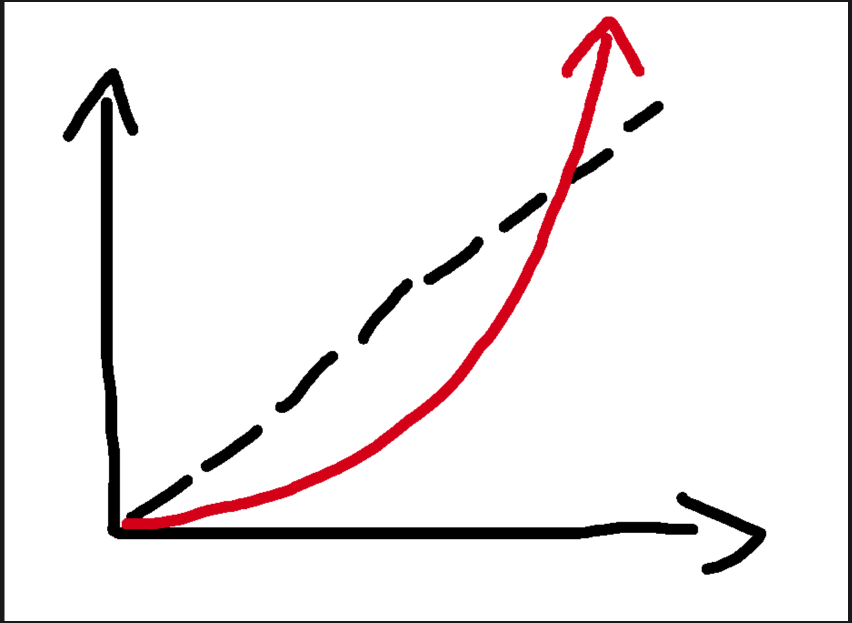
ECS is great!

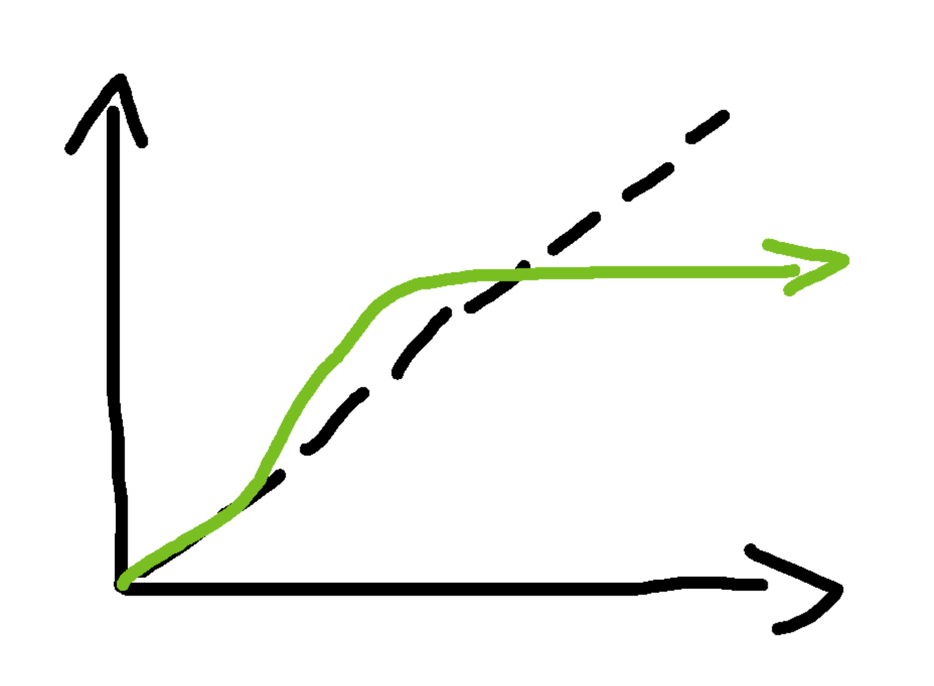
ECS is a whole different monitoring space

Hard to answer previously basic questions:

- How much did Maps cost this month?







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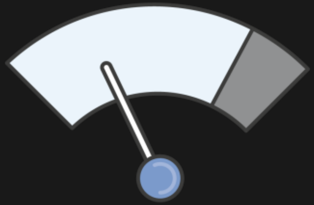
ECS + CloudWatch

ECS CloudWatch Metrics



Cluster Level

- CPU utilization
- CPU reservation
- Memory utilization
- Memory reservation

Cluster and service level

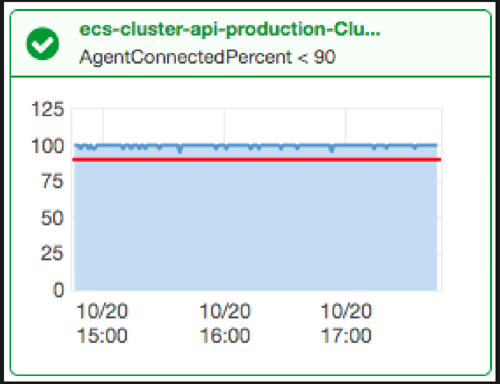
- CPU utilization
- CPU reservation
- Memory utilization
- Memory reservation

Custom Metrics

Mapbox uses 31 custom metrics per cluster*

Some examples

- AgentConnectedPercent
- FailedTaskPlacement
- ActiveInstanceCount
- StatusCheckFailedInstances
- RunningTasksPerInstances
- Spot Termination



Cluster Dashboards

AWS CloudFormation creates a CloudWatch dashboard for each cluster

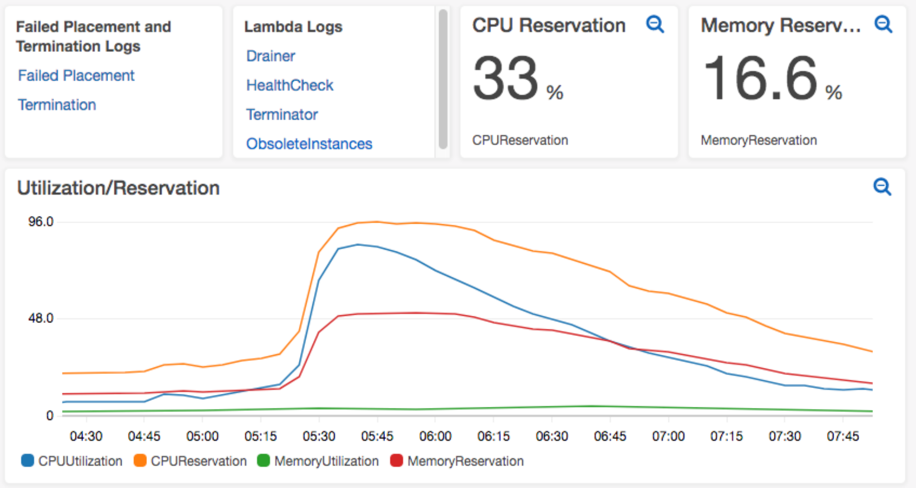
```
var dashboard = require('./dashboard');

Resources: {
  // .....
  Dashboard: {
    Type: 'AWS::CloudWatch::Dashboard',
    Properties: { DashboardName: cf.sub('${AWS::StackName}-${AWS::Region}'),
    DashboardBody: cf.sub(dashboard) }
  }
}
```

- Include dashboard widgets in a ./dashboard.js file
- cf references are for https://github.com/mapbox/cloudfriend an open source tool for cloudformation

A Sample Widget

```
{ type: 'metric', x: 0, y: 3, width: 24, height: 6,
    properties: {
      view: 'timeSeries',
      stacked: false,
      metrics: [
        ['AWS/ECS', 'CPUUtilization', 'ClusterName',
        '${Cluster}'],
        ['.', 'CPUReservation', '.', '.'],
        ['.', 'MemoryUtilization', '.', '.', { yAxis: 'left' }],
        ['.', 'MemoryReservation', '.', '.', { yAxis: 'left' }] ],
      region: '${AWS::Region}',
      title: 'Utilization/Reservation',
      period: 300,
      yAxis: { left: { min: 0 }, right: { min: 0 } }
    }
}
```



Failed Placement and Termination Logs

Failed Placement

Termination

Lambda Logs

Drainer

HealthCheck

Terminator

ObsoleteInstances

CPU Reservation

33 %

CPUReservation

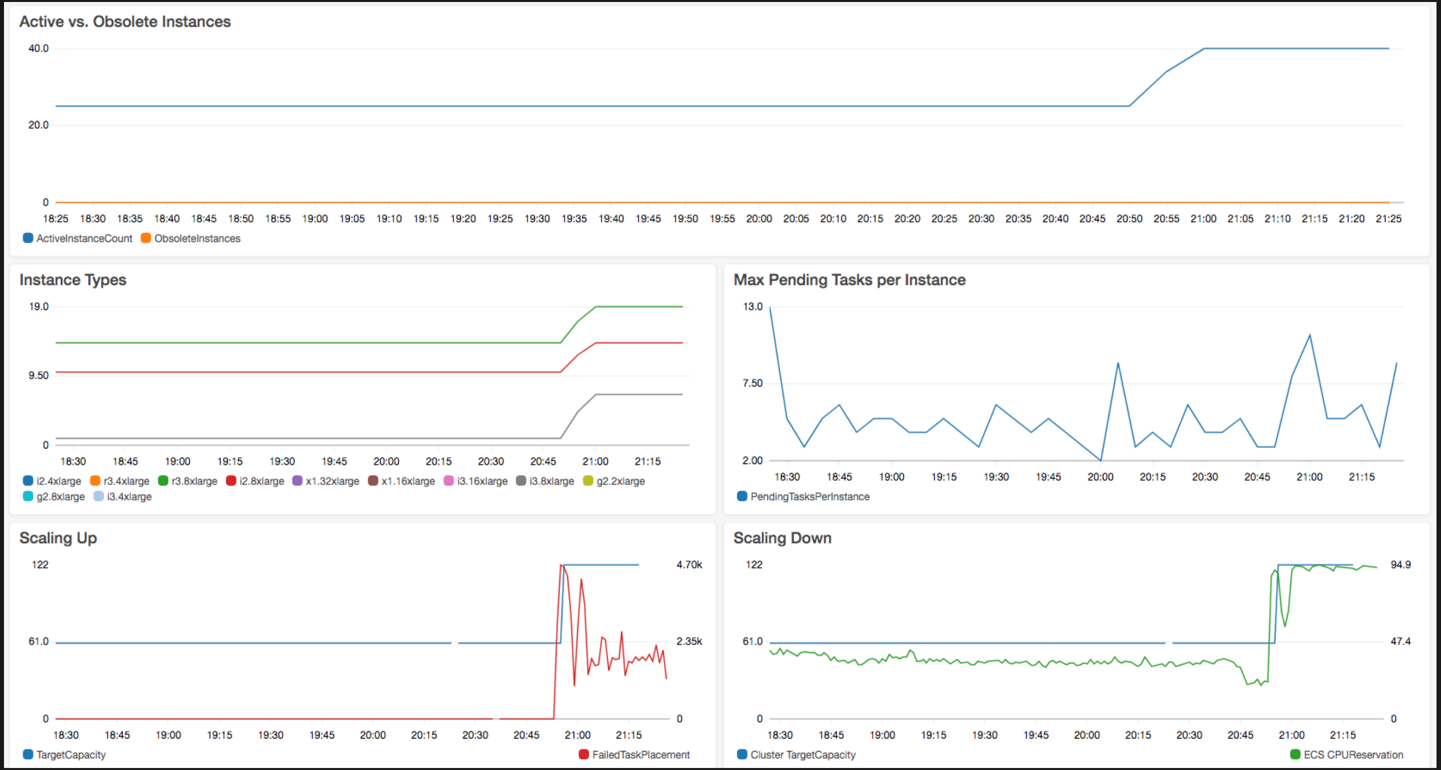
Memory Reserv...

16.6 %

MemoryReservation

Utilization/Reservation

Additional Dashboard



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But wait, how much did Maps cost this month?

Variables

- 10+ clusters
- 10+ Spotfleet mixes with different az’s, prices, etc.
- Very different task profiles running
- Services v. RunTask

But wait, how much did Maps cost this month?

Data

- How long a task ran on a cluster
- What resources that task reserved on the cluster
- The cost of resources on the cluster while the task ran

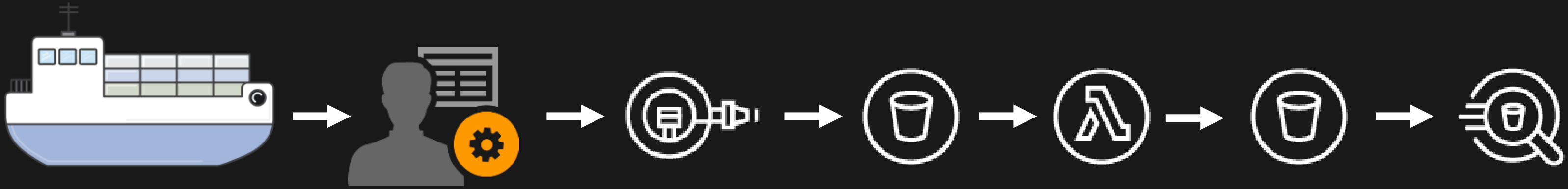
Recording Task Duration

CloudWatch Event Rules

- Collect the start and stop event for every task on our infrastructure

Take 1:

ECS Task start/stop → CloudWatch Event rule → Amazon Kinesis Firehose → Amazon Simple Storage Service (Amazon S3) → AWS Lambda → S3 → Amazon Athena



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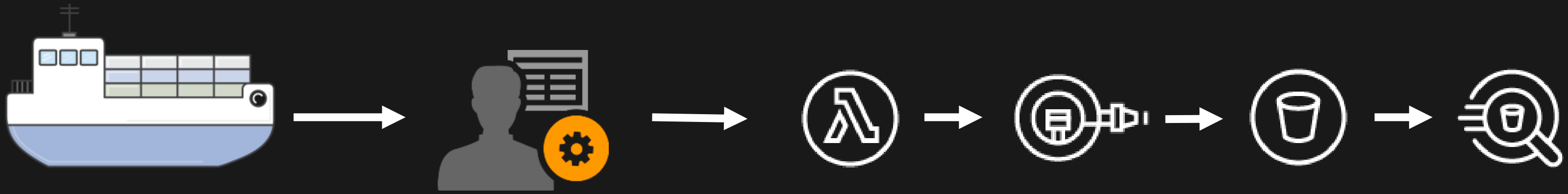
Recording Task Duration Part 2

Challenges:

- Infrastructure running in all but two ECS regions
- Kinesis Firehose not supported in all ECS regions
- Volume of start and stop events

Take 2:

ECS Task start/stop → CloudWatch Event Rule → Lambda → Kinesis Firehose → S3 → Athena



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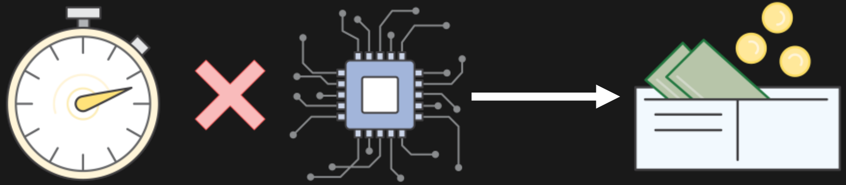
Putting It Together



Duration x Resources reserved → Task Resource Cost

Resources reserved
- ECS task names – Service_Team_CostCategory_Suffix:Revision

Resource usage pipeline:
Task definition registered → CloudWatch Event Rule → Lambda → S3 → Athena

Cost pipeline
Bucket notification → ECS Task → S3 → Athena

Taking a pause

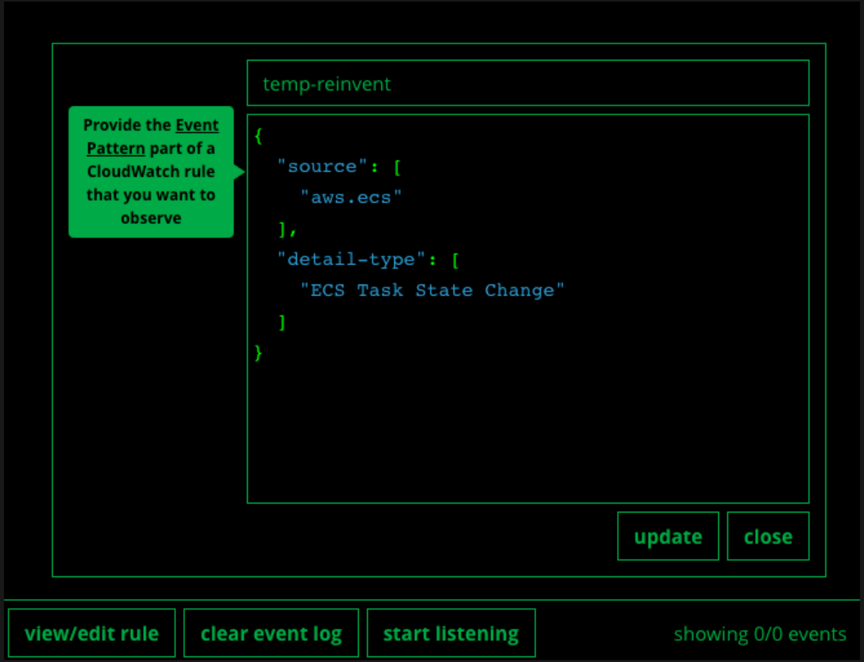
How much spending on tracking spending?

- Massive Task Volume
- One Athena query cost what?

Social impacts of information

- Socializing why
- High cost of faulty reporting

Recording Task Duration

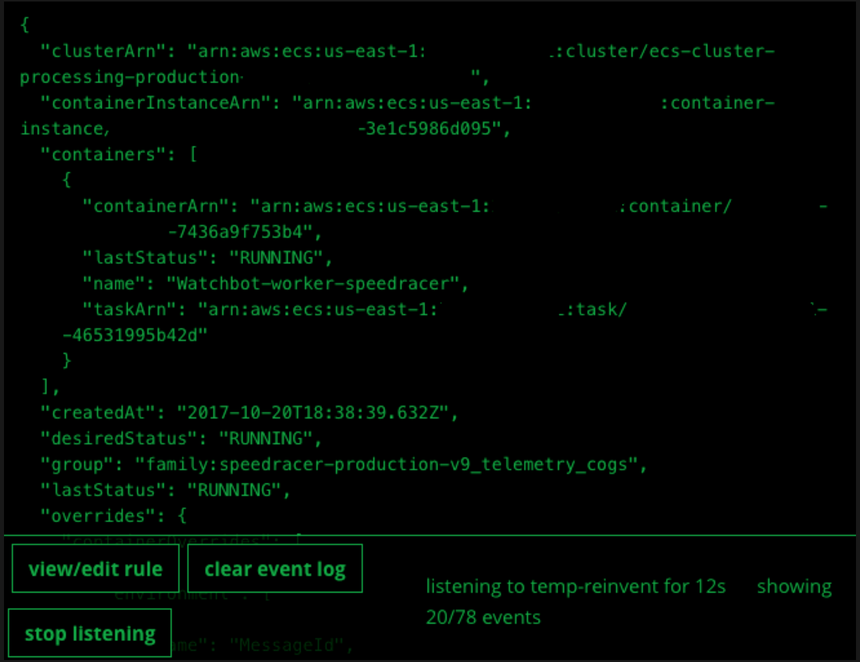


temp-reinvent

Provide the Event Pattern part of a CloudWatch rule that you want to observe

```
{
  "source": [
    "aws.ecs"
  ],
  "detail-type": [
    "ECS Task State Change"
  ]
}
```

showing 0/0 events



```
{
  "clusterArn": "arn:aws:ecs:us-east-1:[redacted]:cluster/ecs-cluster-
processing-production[redacted]",
  "containerInstanceArn": "arn:aws:ecs:us-east-1:[redacted]:container-
instance/[redacted]-3e1c5986d095",
  "containers": [
    {
      "containerArn": "arn:aws:ecs:us-east-1:[redacted]:container/[redacted]-
              -7436a9f753b4",
      "lastStatus": "RUNNING",
      "name": "Watchbot-worker-speedracer",
      "taskArn": "arn:aws:ecs:us-east-1:[redacted]:task/[redacted]-
    -46531995b42d"
    }
  ],
  "createdAt": "2017-10-20T18:38:39.632Z",
  "desiredStatus": "RUNNING",
  "group": "family:speedracer-production-v9_telemetry_cogs",
  "lastStatus": "RUNNING",
  "overrides": {
    "containerOverrides": [
          "environment": [
              me": "MessageId",
```

listening to temp-reinvent for 12s showing 20/78 events

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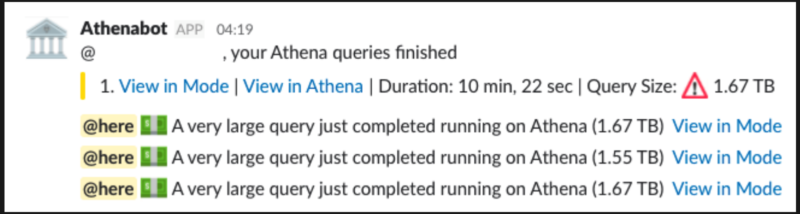
One Athena query cost what?

Data Warehouse

- S3
- Athena Queries
    - Partition
    - Compression



Athenabot APP 04:19

@ , your Athena queries finished

1. View in Mode | View in Athena | Duration: 10 min, 22 sec | Query Size: ⚠ 1.67 TB

@here 💵 A very large query just completed running on Athena (1.67 TB) View in Mode

@here 💵 A very large query just completed running on Athena (1.55 TB) View in Mode

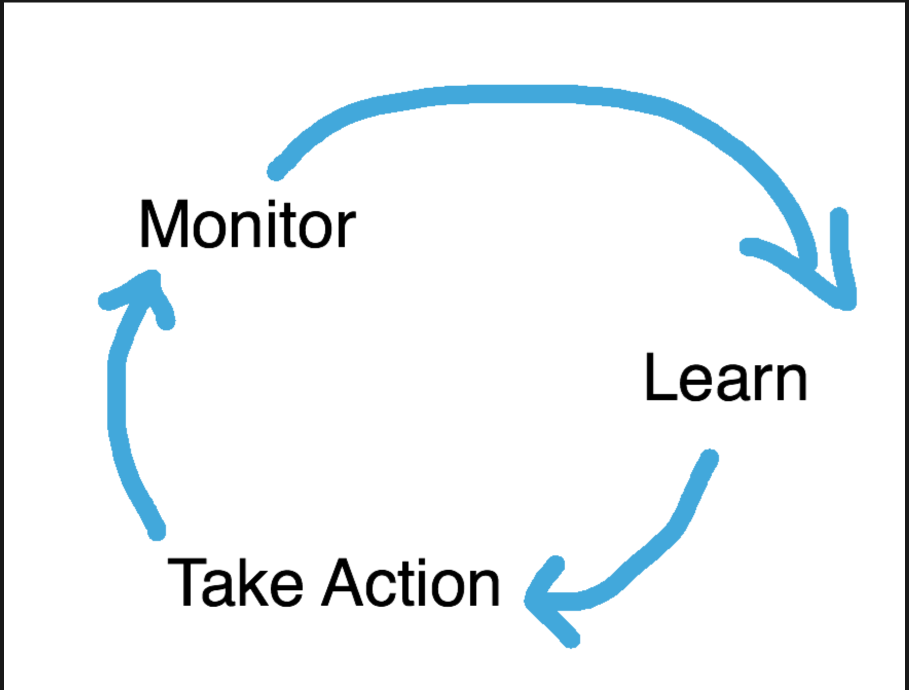
@here 💵 A very large query just completed running on Athena (1.67 TB) View in Mode

Socialize why

Empower Teams v. Punish Teams
- Big numbers can be scary

Creating a healthy system
- Monitor → Learn → Take action

High Cost of faulty information
- Alarms
- Regular checks on reporting



Results with this pipeline

Task level detail within our clusters

Queryable database of task start and stop events

Can cost our containers
- Container Y ran for 112 seconds on cluster Z
- Container Y reserves 1024 cpu and 2048 memory
- A cpu second on cluster Z cost $0.00001

The cost of container Y is $0.0001 x 114,688 cpu/seconds = $1.14

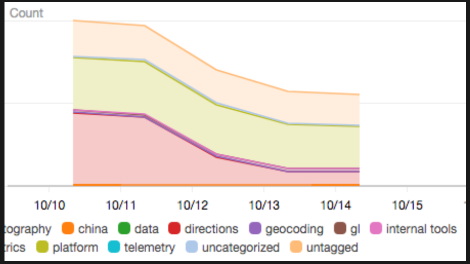
Reporting: Custom Cost Metrics

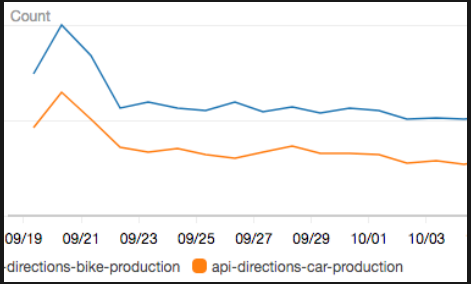
Scheduled Lambda → Athena → CloudWatch → S3

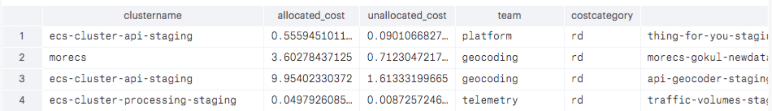
Team Cost
- Overview of what's happening in the cluster at the team level

Service Cost
- Stakeholders get feedback on application level changes and their impact

Not every detail is logged to CloudWatch





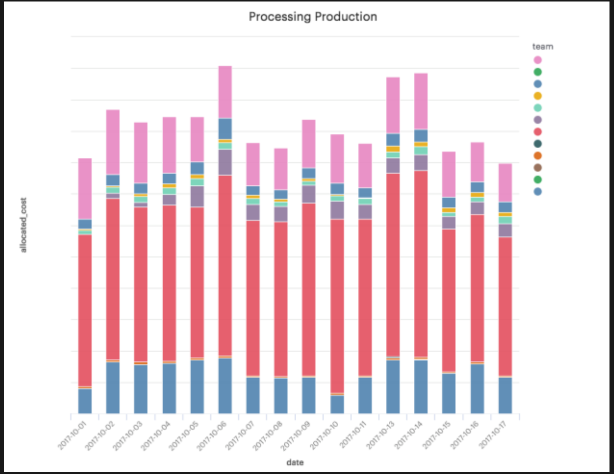


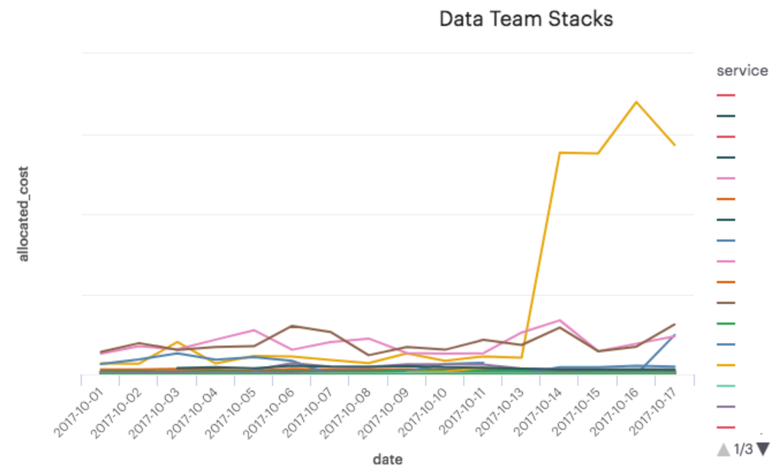
	clustername	allocated_cost	unallocated_cost	team	costcategory	
1	ecs-cluster-api-staging	0.5559451011…	0.0901066827…	platform	rd	thing-for-you-stagi
2	morecs	3.60278437125	0.7123047217…	geocoding	rd	morecs-gokul-newdat
3	ecs-cluster-api-staging	9.95402330372	1.61333199665	geocoding	rd	api-geocoder-stagin
4	ecs-cluster-processing-staging	0.0497926085…	0.0087257246…	telemetry	rd	traffic-volumes-sta

Reporting back out

Scheduled Lambda → Athena → CloudWatch → S3

Determining what to write to CloudWatch
- *Cost on the Cluster can be rolled up by task, service, team and cost category.*





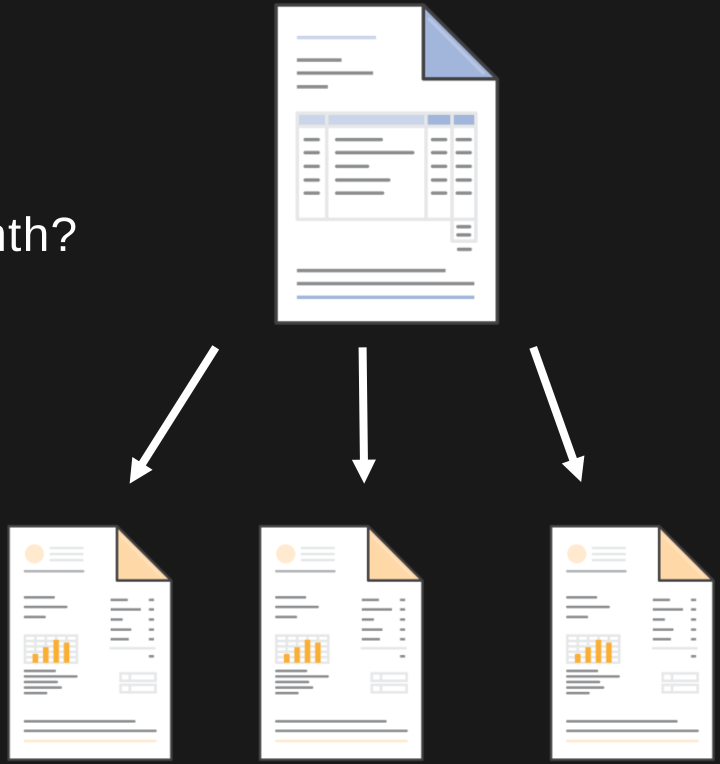
Immediate Benefits

Can answer key questions:

☑ How much did my Application cost this month?

☑ Why’s the EC2 Bill more expensive?

- Diagnose Capacity fluctuations
- Usage bill for stakeholder teams
- ECS clusters organized for engineering



Additional Benefits

Put a focus on right sizing
 - Charged by reservation not utilization

Debugging task placement problems
 - Replay task history on a box with stop and start events

Debugging Instance Events
 - Disk Utilization

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What’s Next?

- Utilization and billing tightly linked in stakeholder reporting
- Following this model with other large AWS products
- Enhanced alarming / monitoring

AWS re:Invent

aws

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What’s Next?

We’re growing!
 - https://www.mapbox.com/jobs/

We look for incredibly smart and radically pragmatic people. Our teams members have a range of cultural, ethnic, social, and economic backgrounds. We prioritize the progression, growth, and leadership of individuals from all backgrounds and strongly believe in the value of cultivating a diverse team and encourage people of all backgrounds to apply.

Thank you!