Introducing AWS Fargate

Running Containers without Infrastructure

[name] [title]

[date]

AGENDA

Motivation

Why did we build Fargate?

Working with Fargate

Construct a sample app on Fargate

Demo

MOTIVATION

At first there was

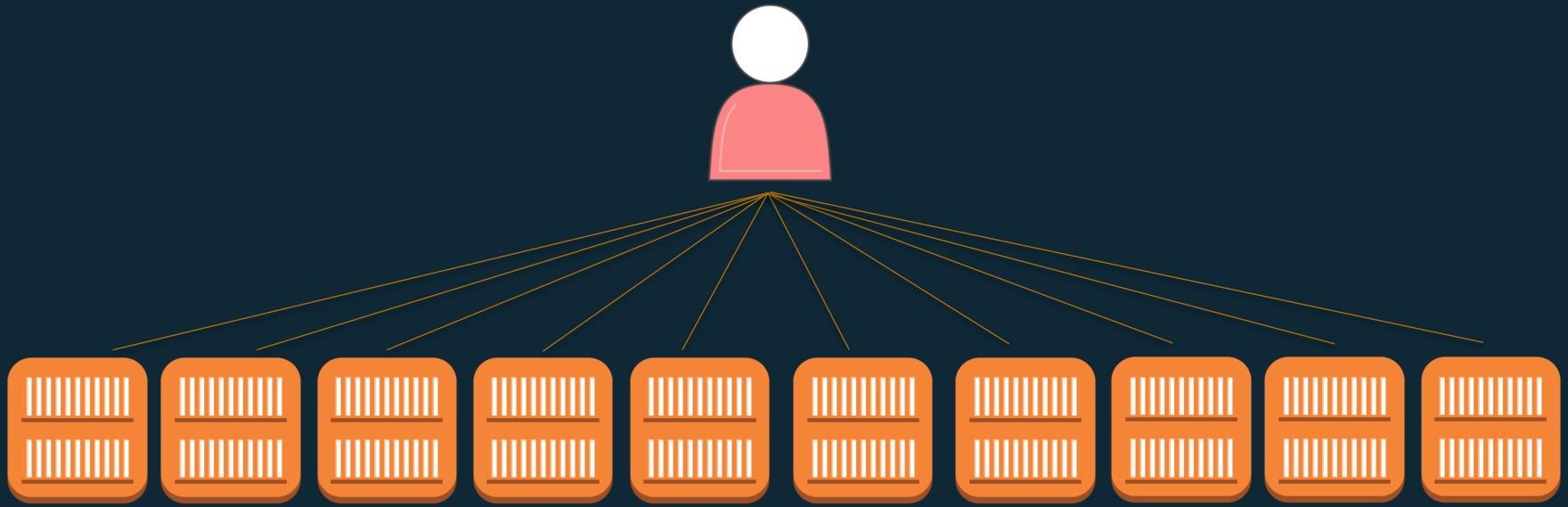
Amazon EC2

Then Docker!

Customers started containerizing applications within EC2 instances

Containers made it easy to build and scale cloud-native applications

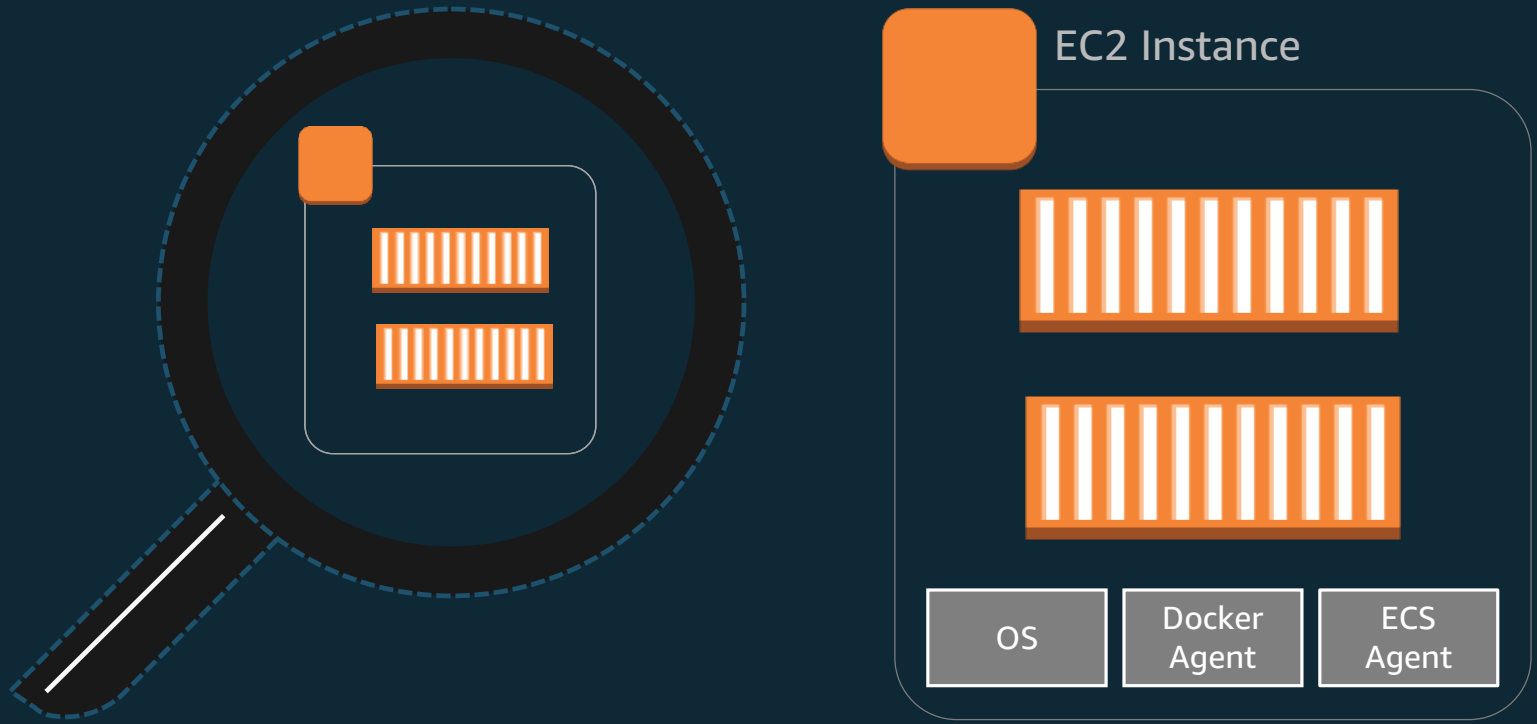
Customers needed an easier way to manage large clusters of instances and containers



AMAZON ELASTIC CONTAINER SERVICE

Cluster Management as a hosted service

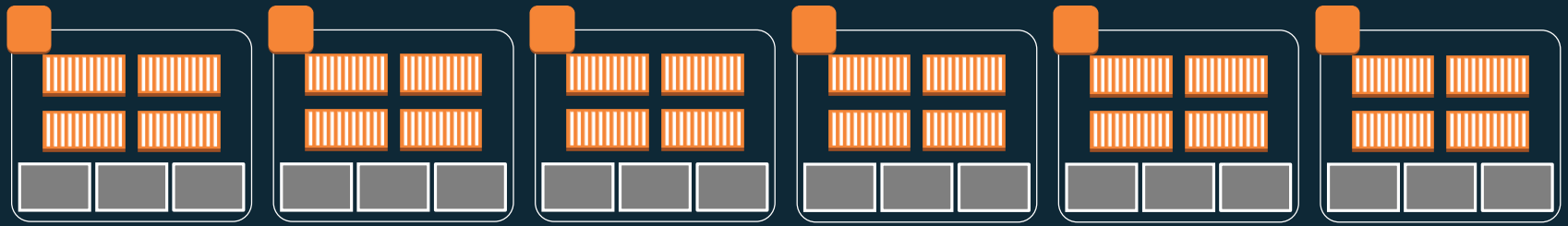
But cluster management is only half the equation…



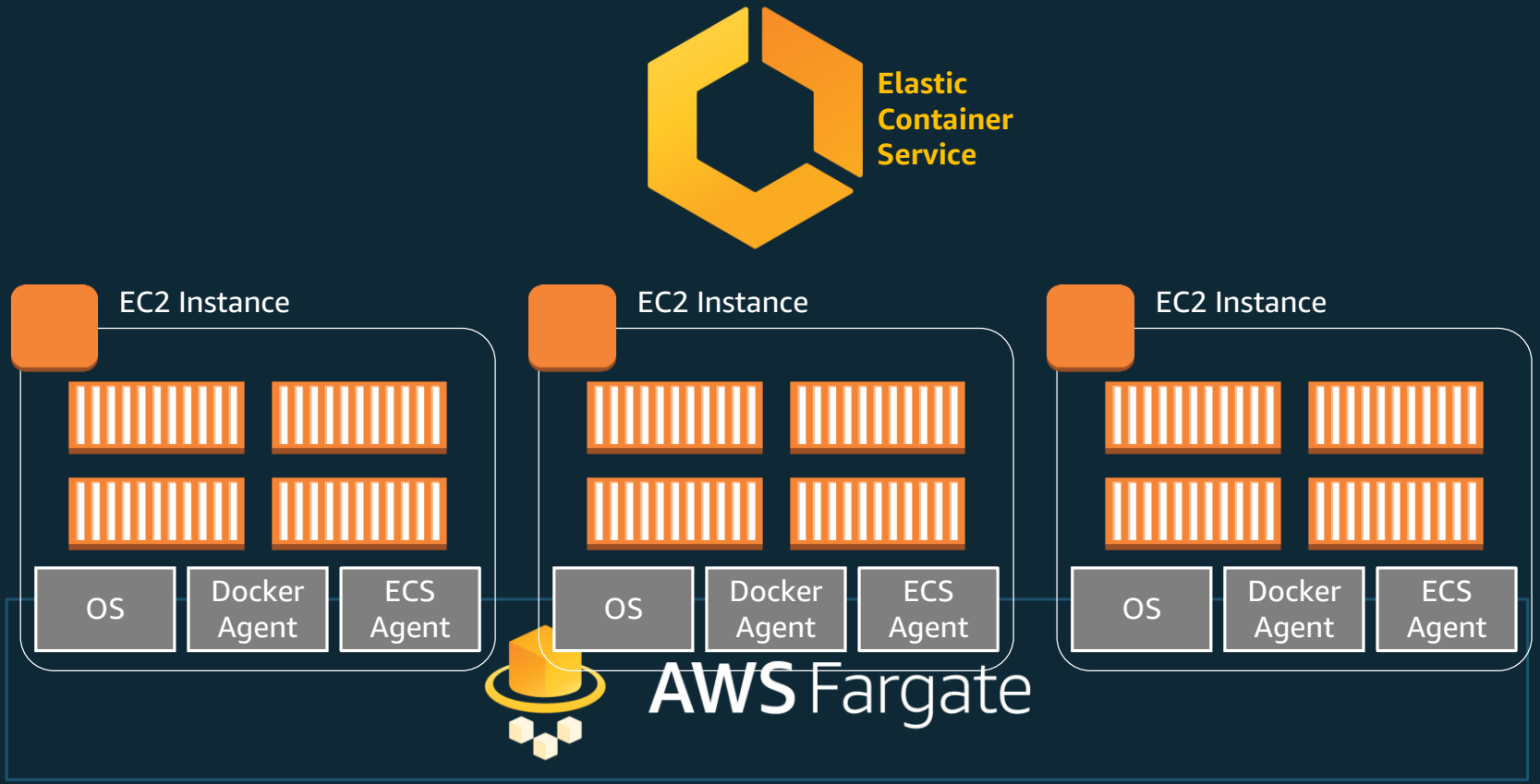
Managing instance fleets is hard work too!

Patching and Upgrading OS, agents, etc.

Scaling the instance fleet for optimal utilization



Customers wanted to run containers without having to manage EC2 instances



AWS FARGATE

Your Docker Containers

MANAGED BY AWS

No EC2 Instances to provision, scale or manage

ELASTIC

Scale up & down seamlessly. Pay only for what you use

INTEGRATED

with the AWS ecosystem: VPC Networking,
Elastic Load Balancing, IAM Permissions, Cloudwatch and more.

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AWS Container Services Landscape

MANAGEMENT

Deployment, Scheduling, Scaling & Management of containerized applications

Amazon Elastic Container Service

Preview!

Amazon Elastic Container Service for Kubernetes

HOSTING

Where the containers run

Amazon EC2

AWS Fargate

IMAGE REGISTRY

Container Image Repository

Amazon Elastic Container Registry

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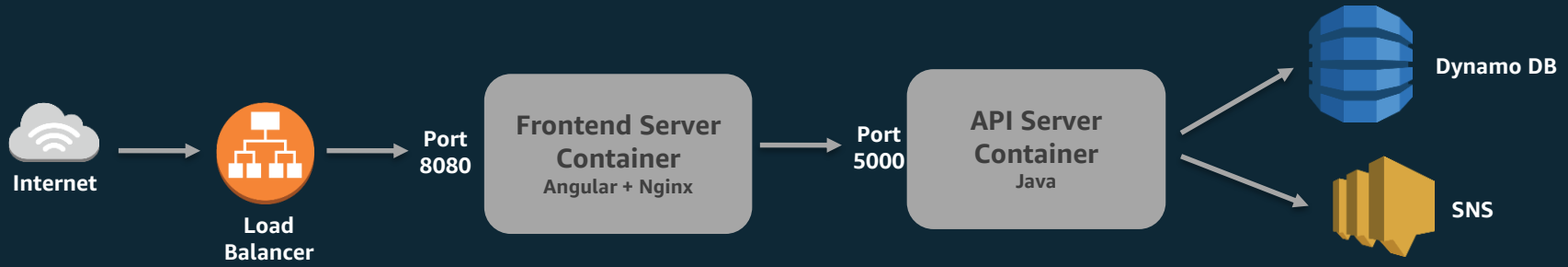
WORKING WITH FARGATE

WE WILL BUILD

- A TicTacToe game application, called Scorekeep on Fargate



- Configure it step by step : Compute, Networking, Storage, Permissions, Logging
- And run it!

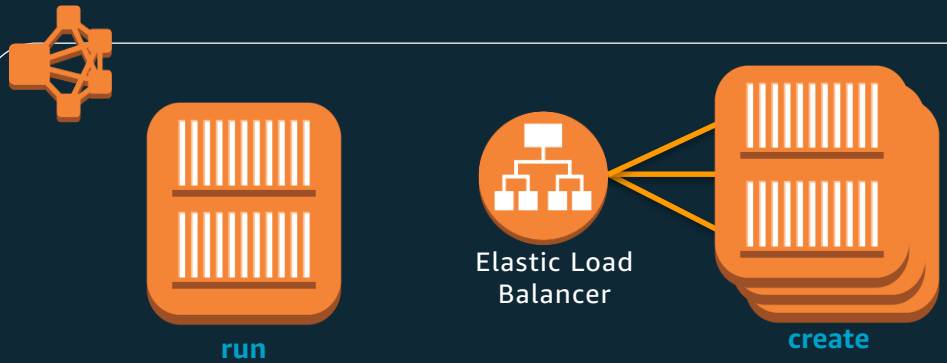
FARGATE CONSTRUCTS

CONSTRUCTS

register

Task Definition

Define application containers: Image URL, CPU & Memory requirements, etc.



run

Task

- A running instantiation of a task definition
- Use FARGATE launch type

create

Service

- Maintain n running copies
- Integrated with ELB
- Unhealthy tasks automatically replaced

create

Cluster

- Infrastructure Isolation boundary
- IAM Permissions boundary

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TASK DEFINITION

Task Definition Snippet

```
{
  "family": “scorekeep",
  "containerDefinitions": [
    {
     "name":“scorekeep-frontend",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/fe"
    },
    {
     "name":“scorekeep-api",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/api"
    }
  ]
}
```

Immutable, versioned document

Identified by family:version

Contains a list of up to 10 container definitions

All containers are co-located on the same host

Each container definition has:

- A name
- Image URL (ECR or Public Images)
- And more…stay tuned!

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REGISTRY SUPPORT

Amazon Elastic Container Registry (ECR)

Public Repositories supported

3rd Party Private Repositories (coming soon!)

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COMPUTE

CPU & MEMORY SPECIFICATION

Units

- CPU : cpu-units. 1 vCPU = 1024 cpu-units
- Memory : MB

Task Level Resources:

- Total Cpu/Memory across all containers
- Required fields
- Billing axis

Container Level Resources:

- Defines sharing of task resources among containers
- Optional fields

Task Definition Snippet

```
{
  "family": "scorekeep",
  "cpu": "1 vCpu",
  "memory": "2 gb",
  "containerDefinitions": [
    {
     "name":“scorekeep-frontend",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/fe“,
     "cpu": 256,
     "memoryReservation": 512
    },
    {
     "name":“scorekeep-api",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/api",
     "cpu": 768,
     "memoryReservation": 512
    }
  ]
}
```

Task Level Resources

Container Level Resources

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TASK CPU MEMORY CONFIGURATIONS

CPU	Memory
256 (.25 vCPU)	512MB, 1GB, 2GB
512 (.5 vCPU)	1GB, 2GB, 3GB, 4GB
1024 (1 vCPU)	2GB, 3GB, 4GB, 5GB, 6GB, 7GB, 8GB
2048 (2 vCPU)	Between 4GB and 16GB in 1GB increments
4096 (4 vCPU)	Between 8GB and 30GB in 1GB increments

50 different CPU/Memory configurations to choose from

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PRICING

Pay for what you provision

Billed for Task level CPU and Memory

Per-second billing. 1 minute minimum

NETWORKING

VPC INTEGRATION

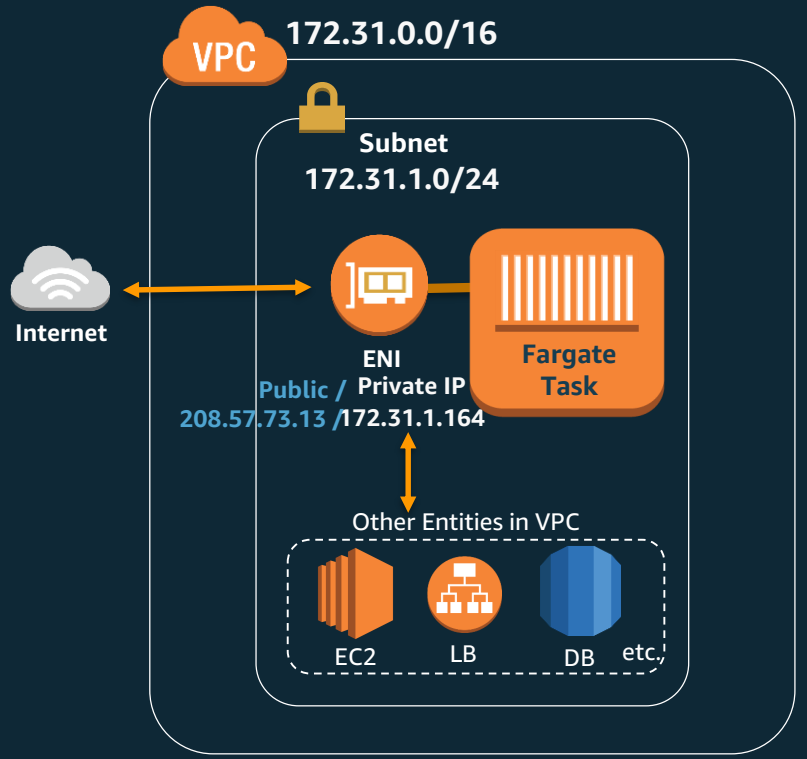
Launch your Fargate Tasks into subnets

Under the hood :

- We create an Elastic Network Interface (ENI)
- The ENI is allocated a private IP from your subnet
- The ENI is attached to your task
- Your task now has a private IP from your subnet!

You can assign public IPs to your tasks

Configure security groups to control inbound & outbound traffic



VPC CONFIGURATION

Task Definition

```
{
  "family": "scorekeep",
  "cpu": "1 vCpu",
  "memory": "2 gb",
  "networkMode": "awsvpc",
  "containerDefinitions": [
    {
     "name":“scorekeep-frontend",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/fe",
     "cpu": 256,
     "memoryReservation": 512
    },
    {
     "name":“scorekeep-api",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/api",
     "cpu": 768,
     "memoryReservation": 512
    }
  ]
}
```

Enables ENI creation & attachment to Task

Run Task

```
$ aws ecs run-task ...
    -- task-definition scorekeep:1
    -- network-configuration
         “awsvpcConfiguration = {
            subnets=[subnet1-id, subnet2-id],
            securityGroups=[sg-id]
         }”
```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INTERNET ACCESS

The Task ENI is used for all inbound & outbound network traffic to and from your task

It is also used for:

- Image Pull (from ECR or a public repository)
- Pushing logs to Cloudwatch

These endpoints need to be reachable via your task ENI

Two common modes of setup:

- Private with no inbound internet traffic, but allows outbound internet access
- Public task with both inbound and outbound internet access

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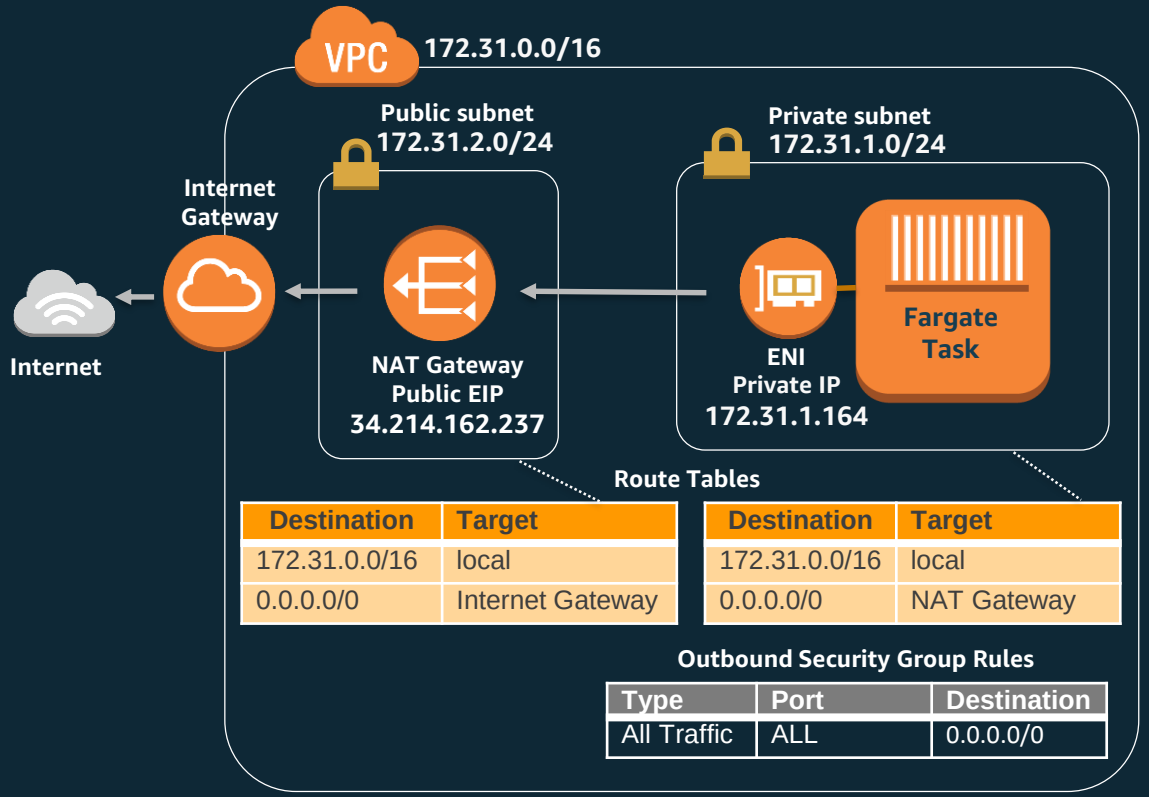
PRIVATE TASK SETUP



Attach Internet Gateway to VPC

Setup a Public Subnet with
- Route to Internet Gateway
- NAT Gateway

Setup Private Subnet with
- Fargate Task
- Route to NAT Gateway

Security Group to allow outbound traffic

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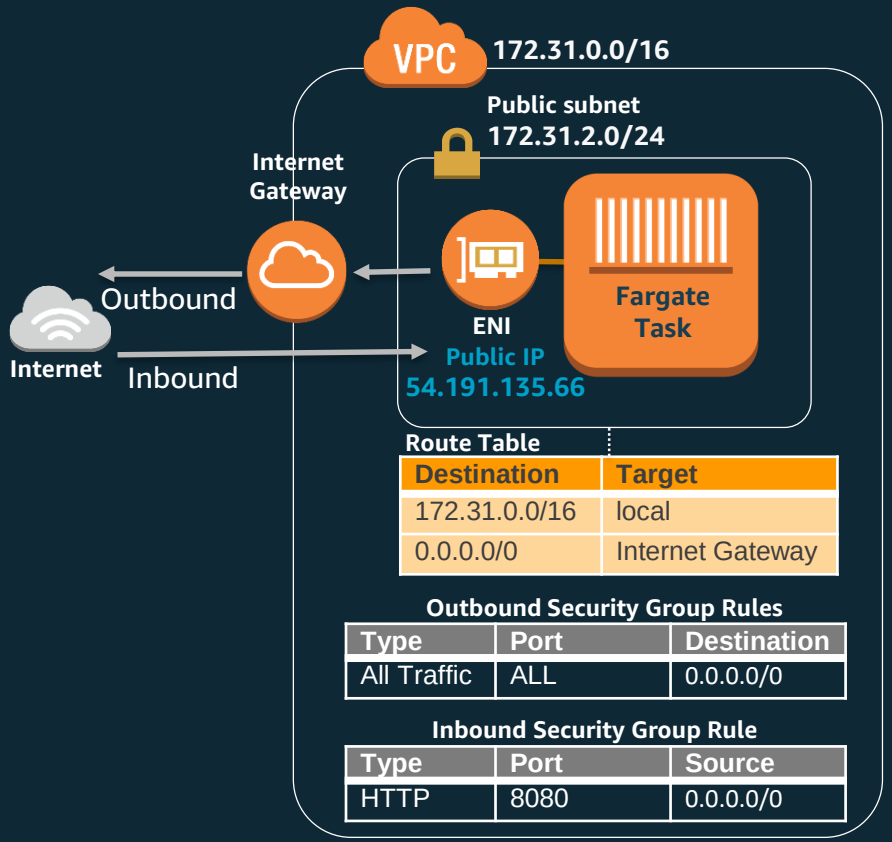
PUBLIC TASK SETUP



Route Table

Destination	Target
172.31.0.0/16	local
0.0.0.0/0	Internet Gateway

Outbound Security Group Rules

Type	Port	Destination
All Traffic	ALL	0.0.0.0/0

Inbound Security Group Rule

Type	Port	Source
HTTP	8080	0.0.0.0/0

Run Task

```
$ aws ecs run-task ...
    -- network-configuration
          "awsvpcConfiguration = {
               subnets=[public-subnet],
               securityGroups=[sg-id],
               assignPublicIp=ENABLED
          }"
```

Launch the task into a Public subnet

Give it a public IP address

Security Group to allow the expected inbound traffic

aws

ELB CONFIGURATION

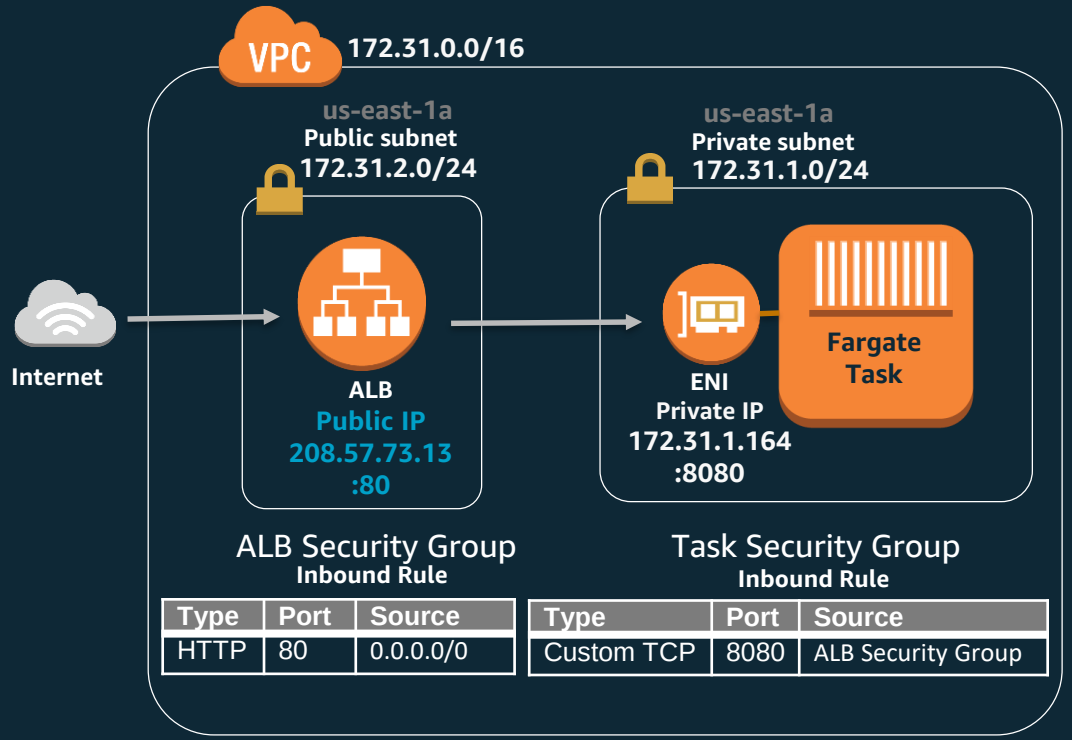
Task Definition

```
{
  "family": "scorekeep",
  "cpu": "1 vCpu",
  "memory": "2 gb",
  "networkMode": “awsvpc“,
  "containerDefinitions": [
    {
     "name":“scorekeep-frontend",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/fe",
     "cpu": 256,
     "memoryReservation": 512,
      "portMappings": [
           { "containerPort": 8080 }
      ]
    },
    {
     "name":“scorekeep-api",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/api",
     "cpu": 768,
     "memoryReservation": 512,
      "portMappings": [
           { "containerPort": 5000 }
      ]
    }
  ]
}
```

Create Service

```
$ aws ecs create-service ...
    -- task-definition scorekeep:1
    -- network-configuration
         “awsvpcConfiguration = {
             subnets=[subnet-id],
             securityGroups=[sg-id]
          }”
     -- load-balancers
        “[
          {
            "targetGroupArn": “<insert arn>",
            "containerName":  “scorekeep-frontend",
            "containerPort":  8080
          }
        ]”
```

INTERNET FACING ELB VPC SETUP



Task in private subnet with private IP

ALB in public subnet with public IP

Make sure the AZs of the two subnets match

ALB security group to allow inbound traffic from internet

Task security group to allow inbound traffic from the ALB's security group

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STORAGE

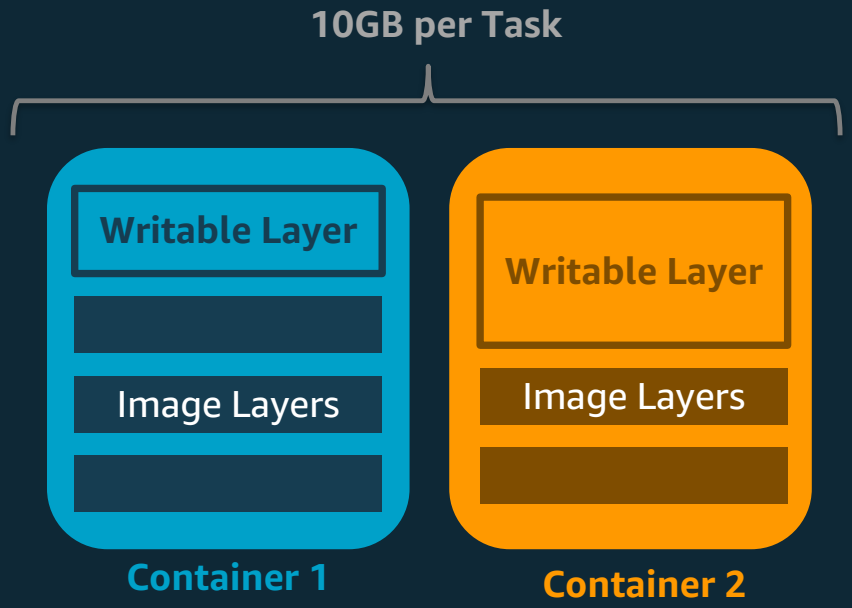
DISK STORAGE

EBS backed Ephemeral storage provided in the form of:

- Writable Layer Storage
- Volume Storage

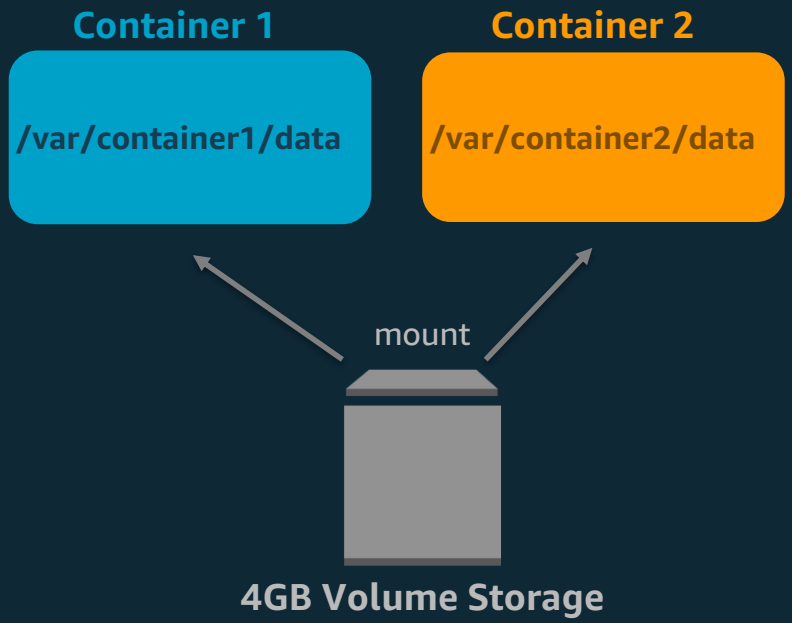
LAYER STORAGE

- Docker images are composed of layers
  The topmost layer is the “writable” layer to capture file changes made by the running container
- 10GB Layer storage available per task, across all containers, including image layers
- Writes are not visible across containers
- Ephemeral. Storage is not available after the task stops.



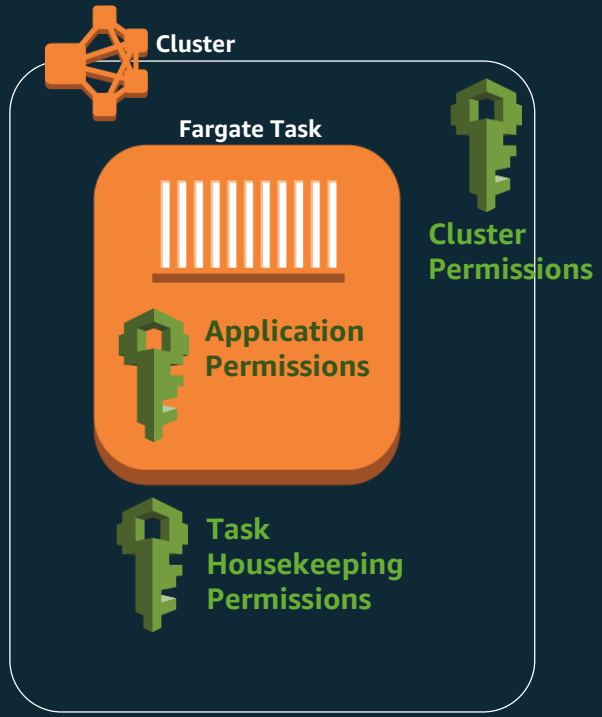
VOLUME STORAGE

- Need writes to be visible across containers?
- Fargate provides 4GB volume space per task
- Configure via volume mounts in task definition
  - Can mount at different containerPaths
  - Do not specify host sourcePath
- Remember this is also ephemeral, i.e. not available after the task stops



IAM PERMISSIONS

PERMISSION TIERS



Cluster Permissions:

Control who can launch/describe tasks in your cluster

Application Permissions:

Allows your application containers to access AWS resources securely

Housekeeping Permissions:

Allows us to perform housekeeping activities around your task:

- ECR Image Pull
- Cloudwatch logs pushing
- ENI creation
- Register/Deregister targets into ELB

CLUSTER PERMISSIONS

You can tailor IAM policies for fine grained access control to your clusters
Attach these policies to IAM Users and/or Roles as necessary

Some example policies:

```
{
  "Effect": "Allow",
  "Action": [ "ecs:RunTask" ],
  "Condition": {
    "ArnEquals": {"ecs:cluster":"<cluster-arn>"}
  },
  "Resource": [ "<task_def_family>:*" ]
}
```

Example 1: Allow RunTask in a specific cluster with a specific task definition only

```
{
  "Effect": "Allow",
  "Action": [ "ecs:ListTasks",
              "ecs:DescribeTasks" ],
  "Condition": {
    "ArnEquals": {"ecs:cluster":"<cluster-arn>"}
  },
  "Resource": "*"
}
```

Example 2: Read-only access to tasks in a specific cluster

And many more!

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APPLICATION PERMISSIONS

Do your application containers access other AWS resources? Need to get credentials down to the task?Use a Task Role

Create an IAM Role with the requisite permissions that your application needs. In our scorekeep example, DDB & SNS permissions.

Establish a trust relationship with ecs-tasks.amazonaws.com on that role. This lets us assume the role and wire the credentials down to your task.

Add the role arn to your task definition and you're done!

We issue and rotate temporary credentials

AWS CLI/SDK calls from within your application will automatically use the Task Role credentials

Task Definition

```
{
  "family": "scorekeep",
  "cpu": "1 vCpu",
  "memory": "2 gb",
  "networkMode": "awsvpc",
  "taskRoleArn": "arn:aws...role/scorekeepRole",
  "containerDefinitions": [
    {
     "name":"scorekeep-frontend",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/fe",
     "cpu": 256,
     "memoryReservation": 512,
     "portMappings": [
         { "containerPort": 8080 }
     ]
    },
    {
     "name":"scorekeep-api",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/api",
     "cpu": 768,
     "memoryReservation": 512,
     "portMappings": [
         { "containerPort": 5000 }
     ]
    }
  ]
}
```


aws

HOUSEKEEPING PERMISSIONS

- We need certain permissions in your account to bootstrap your task and keep it running.

- Execution Role gives us permissions for:
    - ECR Image Pull
    - Pushing Cloudwatch logs

- ECS Service Linked Role gives us permissions for:
    - ENI Management
    - ELB Target Registration/Deregistration

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EXECUTION ROLE

- Using an ECR Image or Cloudwatch Logs?
  Give us permissions via an Execution Role

- Create an IAM Role and add Read Permissions to ECR
  - ecr:GetAuthorizationToken & ecr:BatchGetImage
  - Or use AmazonEC2ContainerRegistryReadOnly managed policy

- Add Write Permissions to CloudWatchLogs
  - logs:CreateLogStream & logs:PutLogEvents
  - Or use CloudWatchLogsFullAccess managed policy

- Establish trust relationship with ecs-tasks.amazonaws.com.
  This lets us assume the role

- Add the execution role arn into your task definition

Task Definition

```
{
  "family": "scorekeep",
  "cpu": "1 vCpu",
  "memory": "2 gb",
  "networkMode": “awsvpc“,
  “taskRoleArn": “arn:aws...role/scorekeepRole“,
  “executionRoleArn":
          “arn:aws...role/scorekeepExecutionRole“,
  "containerDefinitions": [
    {
     "name":“scorekeep-frontend",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/fe",
     "cpu": 256,
     "memoryReservation": 512,
     "portMappings": [
         { "containerPort": 8080 }
     ]
    },
    {
     "name":“scorekeep-api",
     "image":"xxx.dkr.ecr.us-east-1.amazonaws.com/api",
     "cpu": 768,
     "memoryReservation": 512,
     "portMappings": [
         { "containerPort": 5000 }
     ]
    }
  ]
}
```


aws

ECS SERVICE LINKED ROLE

- A service-linked role is a unique type of IAM role that is linked directly to an AWS service, in this case ECS
- It is automatically created in your account at first cluster creation
- It has a predefined policy, that is immutable. In this case, ENI & ELB permissions.
- You don’t have to explicitly pass this role in the task definition or any API call.
  Just know about it in case you stumble upon it in the IAM console

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VISIBILITY & MONITORING

CLOUDWATCH LOGS CONFIGURATION

- Use the awslogs driver to send stdout from your application to Cloudwatch logs
- Create a log group in Cloudwatch
- Configure the log driver in your task definition
- Remember to add permissions via the Task Execution Role

```
{
  "family": "scorekeep",
  ...
  "containerDefinitions": [
     {
      "name":“scorekeep-frontend",
        ...
       "logConfiguration": {
           "logDriver": "awslogs",
            "options": {
                   "awslogs-group": "scorekeep",
                   "awslogs-region": “us-east-1",
                   "awslogs-stream-prefix": "scorekeep/frontend“}}
    },
    {
      "name":“scorekeep-api",
        ...
       "logConfiguration": {
           "logDriver": "awslogs",
            "options": {
                   "awslogs-group": "scorekeep",
                   "awslogs-region": “us-east-1",
                   "awslogs-stream-prefix": "scorekeep/api"}}
    }
]}
```

Task Definition

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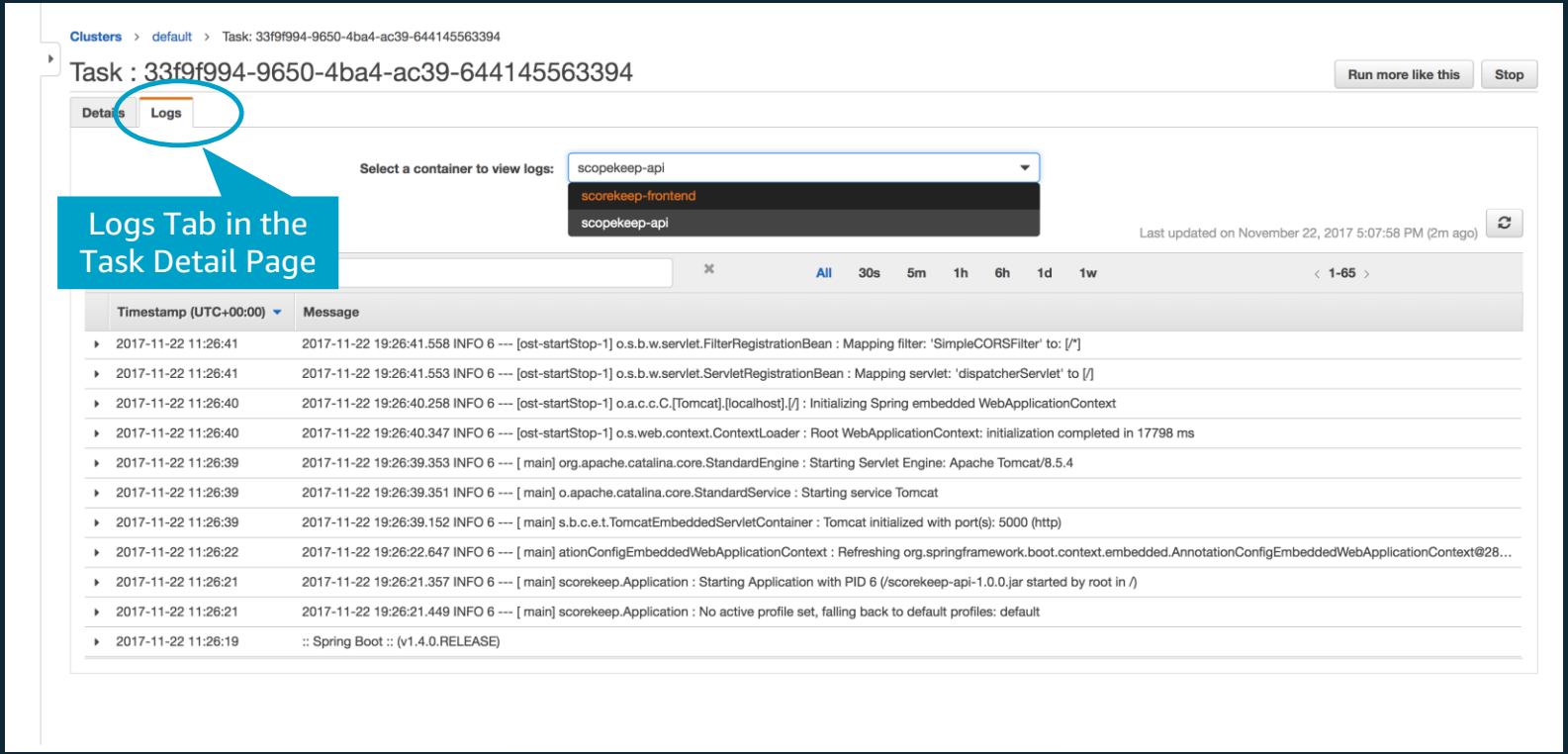
CLOUDWATCH LOGS

View logs in the ECS or Cloudwatch Console



OTHER VISIBILITY TOOLS

CloudWatch events on task state changes

Service CPU/Memory utilization metrics available in CloudWatch

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DEMO

FINAL SCOREKEEP TASK DEFINITION

```
{
  "family": "scorekeep",
  "cpu": "1 vCpu",
  "memory": "2 gb",
  "networkMode":"awsvpc",
  "taskRoleArn": "arn:aws:…",
  "executionRoleArn": “arn:…”,
  "requiresCompatibilities": [
     "FARGATE"
  ],
  "containerDefinitions": […]
}
```

Task Definition

```
{
  "name": "scorekeep-frontend",
  "image":“xxx.dkr.ecr…frontend",
  "cpu": 256,
  "memoryReservation": 512,
  "portMappings" : [
     { "containerPort": 8080 }
   ],
   "logConfiguration": {
      "logDriver": "awslogs",
      "options": {
        "awslogs-group": "scorekeep",
        "awslogs-region": "us-east-1",
         "awslogs-stream-prefix":
                  "scorekeep/frontend"
    }
  }
}
```

scorekeep-frontend
Container Definition

```
{
  "name": "scorekeep-api",
  "image":“xxx.dkr.ecr…api",
  "cpu": 768,
  "memoryReservation": 512,
  "portMappings" : [
     { "containerPort": 5000 }
   ],
   "logConfiguration": {
      "logDriver": "awslogs",
      "options": {
        "awslogs-group": "scorekeep",
        "awslogs-region": "us-east-1",
        "awslogs-stream-prefix":
                  "scorekeep/api”
    }
  },
  "environment": […] #env var
}
```

scorekeep-api
Container Definition

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LET'S RUN IT!

Register Task Definition

```
$ aws ecs register-task-definition --cli-input-json file:///scorekeep-task-definition.json
```

Create Cluster

```
$ aws ecs create-cluster --cluster-name FargateDemoCluster
```

Run Task

```
$ aws ecs run-task
    --cluster FargateDemoCluster --task-definition scorekeep:1
    --launch-type FARGATE --count 1
    --network-configuration "awsvpcConfiguration={subnets=[subnet-xxx], securityGroups=[sg-xxx]}"
```

Create Service

```
$ aws ecs create-service --service-name ScorekeepService
    --cluster FargateDemoCluster --task-definition scorekeep:1
    --launch-type FARGATE –desired-count 5
    --network-configuration "awsvpcConfiguration={subnets=[subnet-xxx], securityGroups=[sg-xxx]}“
    --load-balancer “[{"targetGroupArn":“arn:aws:xxx",
                      "containerName":“scorekeep-frontend",
                      "containerPort":8080}]”
```


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Find the Fargate Scorekeep project on GitHub at

https://github.com/awslabs/eb-java-scorekeep/tree/fargate

TAKE AWAYS

TAKE AWAYS

- Fargate is a new launch type within ECS to run containers without having to manage EC2 instances

- If you're debating between EC2 v/s Fargate mode, start architecting with Fargate.
  It forces good design practice by keeping your application containers truly independent of the underlying host.

- If you think you must have access to the underlying host, think again.
  - There are some good reasons : special instance type needs, EC2 dedicated instances, utilizing EC2 reserved instances
  - And tell us about your use case, we want to support it on Fargate!

- Start using Fargate today!
  - Fargate works with most Docker container images
  - You can run existing task definitions on Fargate with only minor modifications.

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THANK YOU!

Learn more at aws.amazon.com/fargate