JON BONSO AND KENNETH SAMONTE

AWS CERTIFIED DEVOPS ENGINEER PROFESSIONAL

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Study Guide and Cheat Sheets

CloudFormation Template for ECS, Auto Scaling and ALB

Amazon Elastic Container Service (ECS) allows you to manage and run Docker containers on clusters of EC2 instances. You can also configure your ECS to use Fargate launch type which eliminates the need to manage EC2 instances.

With CloudFormation, you can define your ECS clusters and tasks definitions to easily deploy your containers. For high availability of your Docker containers, ECS clusters are usually configured with an auto scaling group behind an application load balancer. These resources can also be declared on your CloudFormation template.

DevOps Exam Notes:

Going on to the exam, be sure to remember the syntax needed to declare your ECS cluster, Auto Scaling group, and application load balancer. The **AWS::ECS::Service** resource creates an ECS cluster and the **AWS::ECS::TaskDefinition** resource creates a task definition for your container. The **AWS::ElasticLoadBalancingV2::LoadBalance**r resource creates an application load balancer and the **AWS::AutoScaling::AutoScalingGroup** resource creates an EC2 auto scaling group.

AWS provides an example template which you can use to deploy a web application in an Amazon ECS container with auto scaling and application load balancer. Here's a snippet of the template with the core resources:

```
{
  "AWSTemplateFormatVersion":"2010-09-09",
  "Resources":{
      "ECSCluster":{
      "Type":"AWS::ECS::Cluster"

      },

……

      "taskdefinition":{
      "Type":"AWS::ECS::TaskDefinition",

      "Properties":{

……

      "ECSALB":{
      "Type":"AWS::ElasticLoadBalancingV2::LoadBalancer",
```

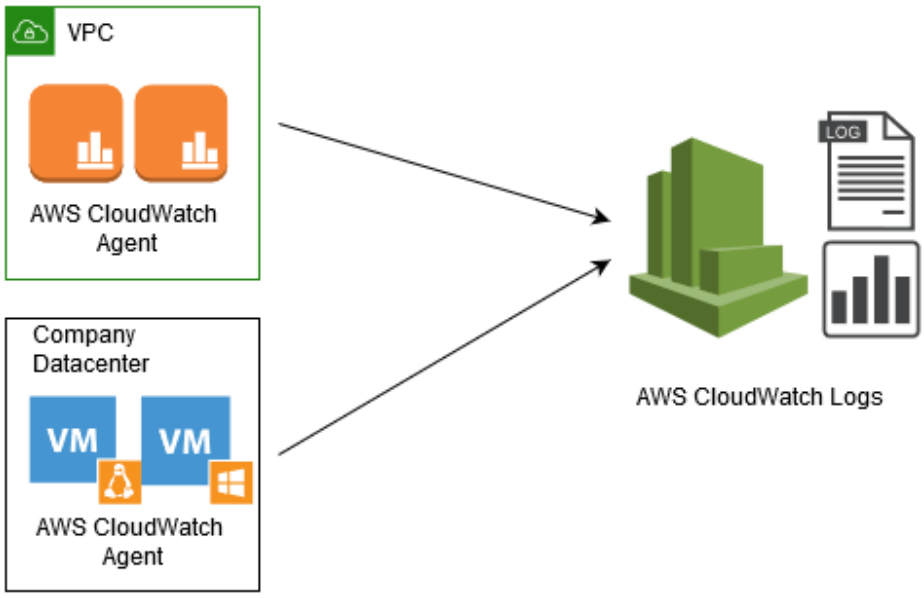
```
        "Properties":{

……

        "ECSAutoScalingGroup":{
        "Type":"AWS::AutoScaling::AutoScalingGroup",
        "Properties":{
        "VPCZoneIdentifier":{
              "Ref":"SubnetId"

        },
```

Sources:
https://docs.aws.amazon.com/AWSCloudFormation/latest/UserGuide/quickref-ecs.html
https://docs.aws.amazon.com/AWSCloudFormation/latest/UserGuide/aws-resource-ecs-service.html
https://docs.aws.amazon.com/AWSCloudFormation/latest/UserGuide/aws-properties-ecs-service-loadbalancers.html

Fetching Application Logs from Amazon EC2, ECS and On-premises Servers

Application logs are vital for monitoring, troubleshooting, and regulatory compliance of every enterprise system. Without it, your team will waste a lot of time trying to find the root cause of an issue that can be easily detected by simply checking the logs. These files often live inside the server or a container. Usually, you have to connect to the application server via SSH or RDP before you can view the logs. This manual process seems to be inefficient, especially for high-performance organizations with hybrid network architectures.

Using the Amazon CloudWatch Logs agent, you can collect system metrics and logs from your Amazon EC2 instances and on-premises application servers. Gone are the days of spending several minutes connecting to your server and manually retrieving the application logs. For Linux servers, you don't need to issue a *tail -f* command anymore since you can view the logs on the CloudWatch dashboard on your browser in near real-time. It also collects both system-level and custom metrics from your EC2 instances and on-premises servers, making your monitoring tasks a breeze.



You have to manually download and install the Amazon CloudWatch Logs agent to your EC2 instances or on-premises servers using the command line. Alternatively, you can use AWS Systems Manager to automate the installation process. For your EC2 instances, it is preferable to attach an IAM Role to allow the application to send data to CloudWatch. For your on-premises servers, you have to create a separate IAM User to integrate your server to CloudWatch. Of course, you should first establish a connection between your on-premises data center and VPC using a VPN or a Direct Connect connection. You have to use a named profile in your local server that contains the credentials of the IAM user that you created.

If you are running your containerized application in Amazon Elastic Container Service (ECS), you can view the different logs from your containers in one convenient location by integrating Amazon CloudWatch. You can configure your Docker containers' tasks to send log data to CloudWatch Logs by using the *awslogs* log driver.


```
"logConfiguration": {
    "logDriver": "awslogs",
    "options": {
        "awslogs-group": "awslogs-wordpress",
        "awslogs-region": "us-west-2",
        "awslogs-stream-prefix": "awslogs-example"
    }
```

If your ECS task is using a Fargate launch type, you can enable the *awslogs* log driver and add the required *logConfiguration* parameters to your task definition. For EC2 launch types, you have to ensure that your Amazon ECS container instances have an attached IAM role that contains *logs:CreateLogStream* and *logs:PutLogEvents* permissions. Storing the log files to Amazon CloudWatch prevents your application logs from taking up disk space on your container instances.

Sources:
https://docs.aws.amazon.com/AmazonCloudWatch/latest/logs/UseCloudWatchUnifiedAgent.html
https://docs.aws.amazon.com/AmazonECS/latest/userguide/using_awslogs.html

Amazon Elastic Container Service (ECS)

- A container management service to run, stop, and manage Docker containers on a cluster.
- ECS can be used to create a consistent deployment and build experience, manage, and scale batch and **Extract-Transform-Load** (ETL) workloads, and build sophisticated application architectures on a microservices model.

Features

- You can create ECS clusters within a new or existing VPC.
- After a cluster is up and running, you can define task definitions and services that specify which Docker container images to run across your clusters.

Components

- Containers and Images
  - Your application components must be architected to run in **containers** — containing everything that your software application needs to run: code, runtime, system tools, system libraries, etc.
  - Containers are created from a read-only template called an **image**.
- Task Components
  - **Task definitions** specify various parameters for your application. It is a text file, in JSON format, that describes one or more containers, up to a maximum of ten, that form your application.
  - Task definitions are split into separate parts:
    - Task family - the name of the task, and each family can have multiple revisions.
    - IAM task role - specifies the permissions that containers in the task should have.
    - Network mode - determines how the networking is configured for your containers.
    - Container definitions - specify which image to use, how much CPU and memory the container are allocated, and many more options.
- Tasks and Scheduling
  - A **task** is the instantiation of a task definition within a cluster. After you have created a task definition for your application, you can specify the number of tasks that will run on your cluster.
    - Each task that uses the Fargate launch type has its own isolation boundary and does not share the underlying kernel, CPU resources, memory resources, or elastic network interface with another task.
  - You can upload a new version of your application task definition, and the ECS scheduler automatically starts new containers using the updated image and stop containers running the previous version.
- Clusters
  - When you run tasks using ECS, you place them in a **cluster**, which is a logical grouping of resources.
  - Clusters can contain tasks using both the Fargate and EC2 launch types.

  - When using the Fargate launch type with tasks within your cluster, ECS manages your cluster resources.
  - Enabling managed Amazon ECS cluster auto scaling allows ECS to manage the scale-in and scale-out actions of the Auto Scaling group.
- Services
  - ECS allows you to run and maintain a specified number of instances of a task definition simultaneously in a cluster.
  - In addition to maintaining the desired count of tasks in your service, you can optionally run your service behind a load balancer.
  - There are two deployment strategies in ECS:
    - **Rolling Update**
      - This involves the service scheduler replacing the current running version of the container with the latest version.

    Blue/Green Deployment with AWS CodeDeploy
      - This deployment type allows you to verify a new deployment of a service before sending production traffic to it.
      - The service must be configured to use either an Application Load Balancer or Network Load Balancer.
- Container Agent (AWS ECS Agent)
  - The **container agent** runs on each infrastructure resource within an ECS cluster.
  - It sends information about the resource's current running tasks and resource utilization to ECS, and starts and stops tasks whenever it receives a request from ECS.
  - Container agent is only supported on Amazon EC2 instances.

AWS Fargate

- You can use Fargate with ECS to run containers without having to manage servers or clusters of EC2 instances.
- You no longer have to provision, configure, or scale clusters of virtual machines to run containers.
- Fargate only supports container images hosted on Elastic Container Registry (ECR) or Docker Hub.

Task Definitions for Fargate Launch Type

- Fargate task definitions require that the network mode is set to *awsvpc*. The *awsvpc* network mode provides each task with its own elastic network interface.
- Fargate task definitions only support the *awslogs* log driver for the log configuration. This configures your Fargate tasks to send log information to Amazon CloudWatch Logs.
- Task storage is **ephemeral**. After a Fargate task stops, the storage is deleted.

Monitoring

- You can configure your container instances to send log information to CloudWatch Logs. This enables you to view different logs from your container instances in one convenient location.
- With CloudWatch Alarms, watch a single metric over a time period that you specify, and perform one or more actions based on the value of the metric relative to a given threshold over a number of time periods.
- Share log files between accounts, monitor CloudTrail log files in real time by sending them to CloudWatch Logs.

EC2 Container Services ECS vs Lambda

Amazon EC2 Container Service (ECS)

- Amazon ECS is a highly scalable, high performance container management service that supports Docker containers and allows you to easily run applications on a managed cluster of Amazon EC2 instances. ECS eliminates the need for you to install, operate, and scale your own cluster management infrastructure.
- With ECS, deploying containerized applications is easily accomplished. This service fits well in running batch jobs or in a microservice architecture.
  You have a central repository where you can upload your Docker Images from ECS container for safekeeping called Amazon ECR.
- Applications in ECS can be written in a stateful or stateless matter.
- The Amazon ECS CLI supports Docker Compose, which allows you to simplify your local development experience as well as easily set up and run your containers on Amazon ECS.
- Since your applications still run on EC2 instances, server management is your responsibility. This gives you more granular control over your system.
- It is up to you to manage scaling and load balancing of your EC2 instances as well, unlike in AWS Lambda where functions scale automatically.
- You are charged for the costs incurred by your EC2 instances in your clusters. Most of the time, Amazon ECS costs more than using AWS Lambda since your active EC2 instances will be charged by the hour.
- One version of Amazon ECS, know as AWS Fargate, will fully manage your infrastructure so you can just focus on deploying containers. AWS Fargate has a different pricing model from the standard EC2 cluster.
- ECS will automatically recover unhealth containers to ensure that you have the desired number of containers supporting your application.

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AWS Lambda

- AWS Lambda is a function-as-a-service offering that runs your code in response to events and automatically manages the compute resources for you, since Lambda is a serverless compute service. With Lambda, you do not have to worry about managing servers, and directly focus on your application code.
- Lambda automatically scales your function to meet demands. It is noteworthy, however, that Lambda has a maximum execution duration per request of 900 seconds or 15 minutes.
- To allow your Lambda function to access other services such as Cloudwatch Logs, you would need to create an execution role that has the necessary permissions to do so.
- You can easily integrate your function with different services such as API Gateway, DynamoDB, CloudFront, etc. using the Lambda console.
- You can test your function code locally in the Lambda console before launching it into production. Currently, Lambda supports only a number of programming languages such as Java, Go, PowerShell, Node.js, C#, Python, and Ruby. ECS is not limited by programming languages since it mainly caters to Docker.
- Lambda functions must be stateless since you do not have volumes for data storage.
- You are charged based on the number of requests for your functions and the duration, the time it takes for your code to execute. To minimize costs, you can throttle the number of concurrent executions running at a time, and the execution time limit of the function.
- With Lambda@Edge, AWS Lambda can run your code across AWS locations globally in response to Amazon CloudFront events, such as requests for content to or from origin servers and viewers. This makes it easier to deliver content to end users with lower latency.