



PUBLIC SECTOR
SUMMIT ONLINE

CI/CD at scale: Best practices with AWS DevOps services

Loh Yiang Meng
Solutions Architect
Amazon Web Services

Agenda

- What is DevOps?
- Pipeline automation
- Safe deployments
- Repeatable infrastructure changes
- CI/CD at Electrify Asia
- Demo

What is DevOps?

DevOps =

What is DevOps?

DevOps = Culture + Practices + Tools

What is DevOps?

DevOps = Culture + Practices + Tools

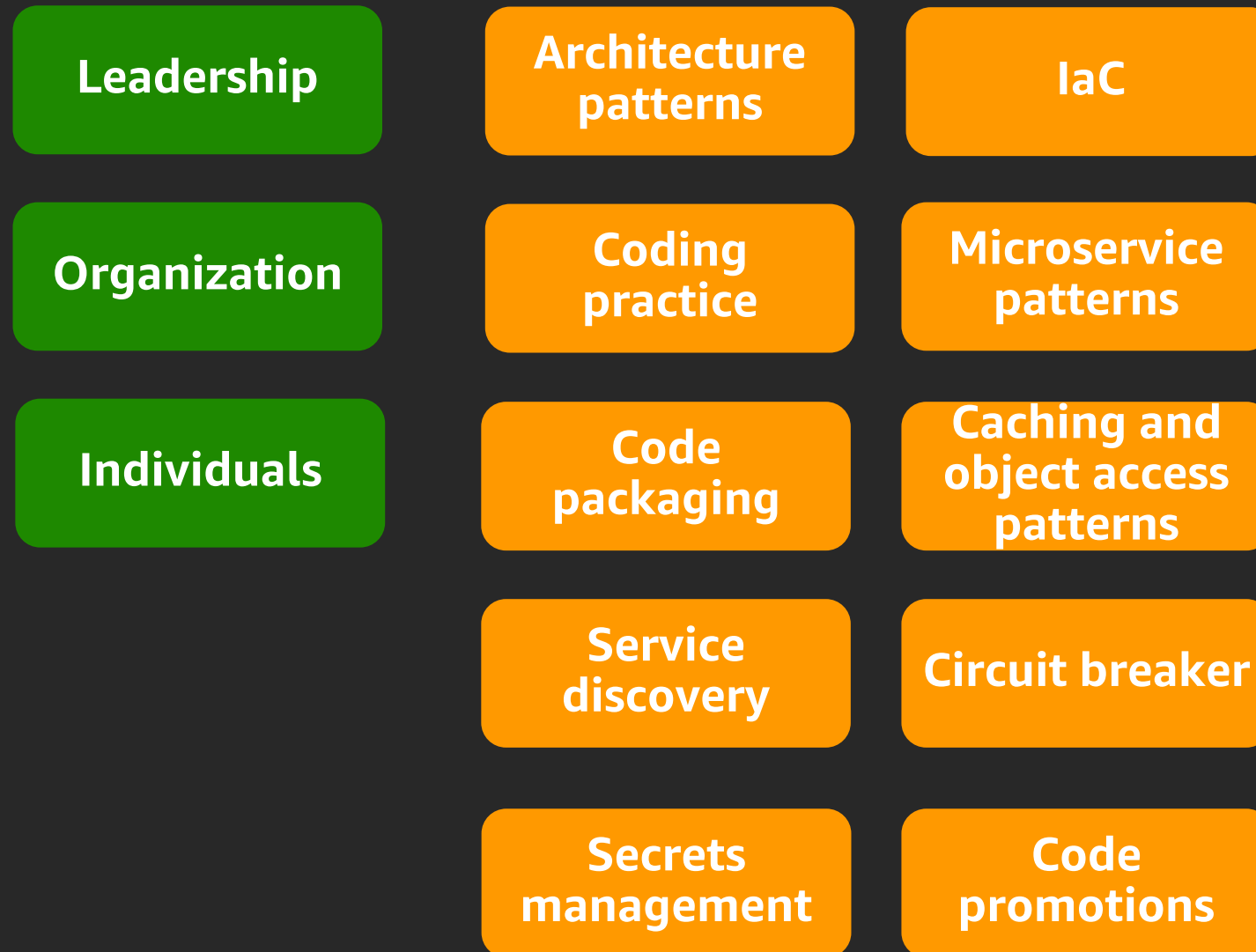
Leadership

Organization

Individuals

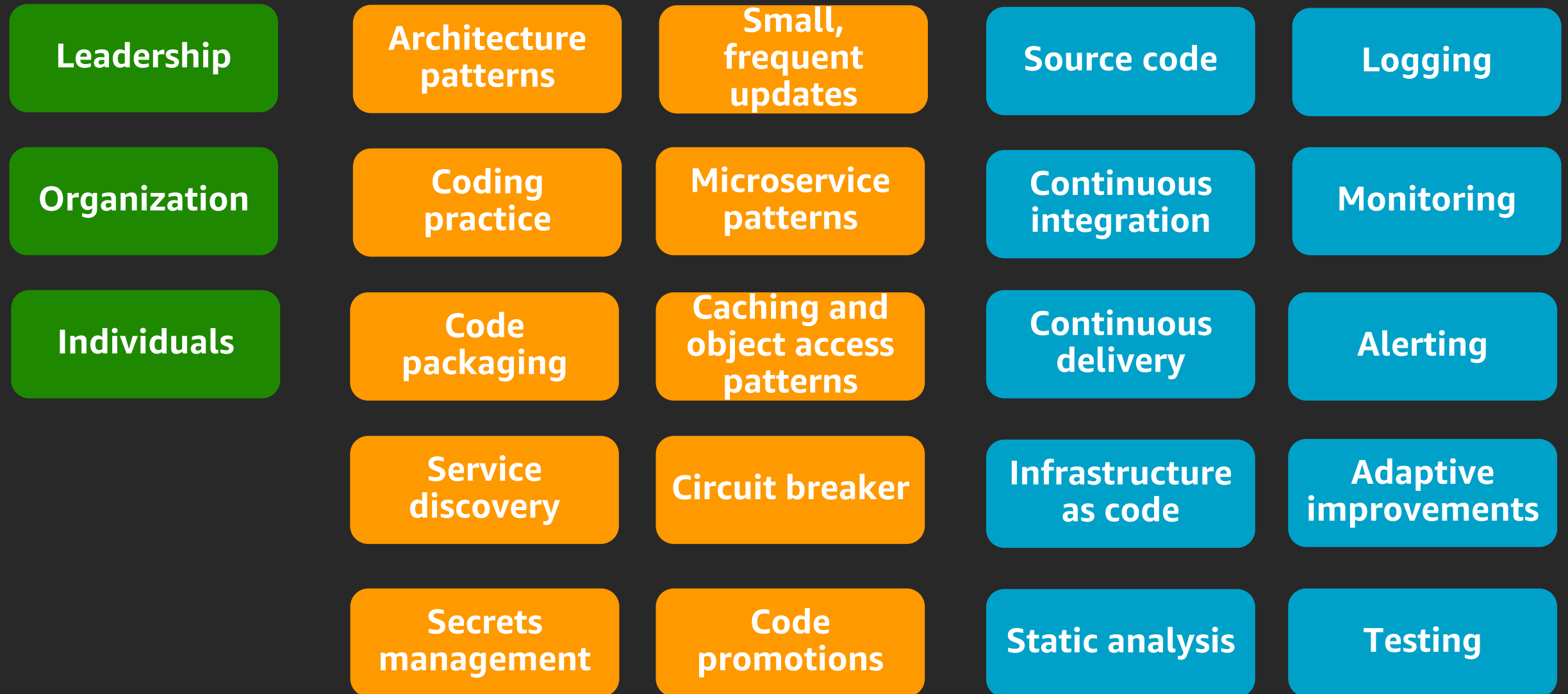
What is DevOps?

DevOps = Culture + Practices + Tools

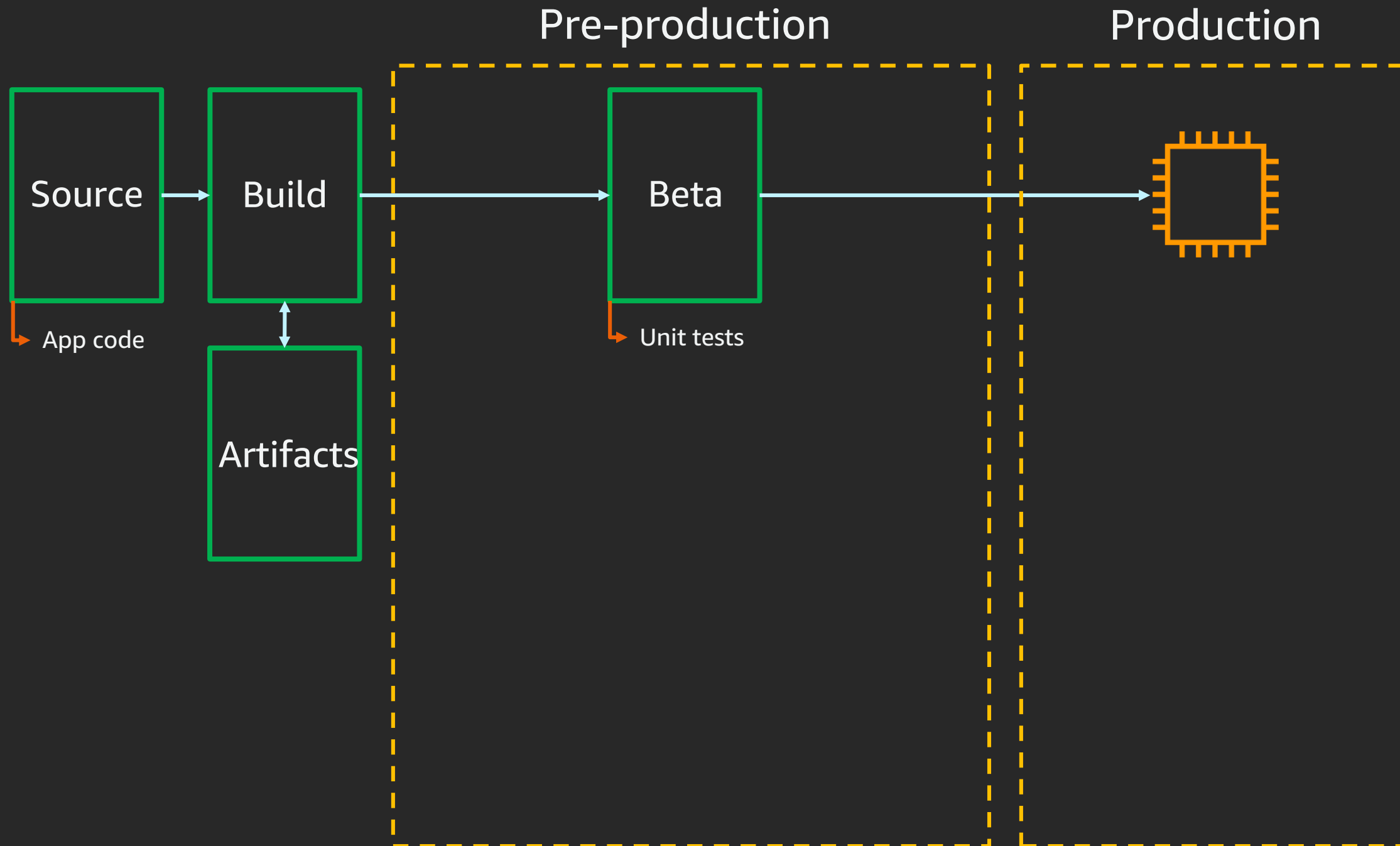


What is DevOps?

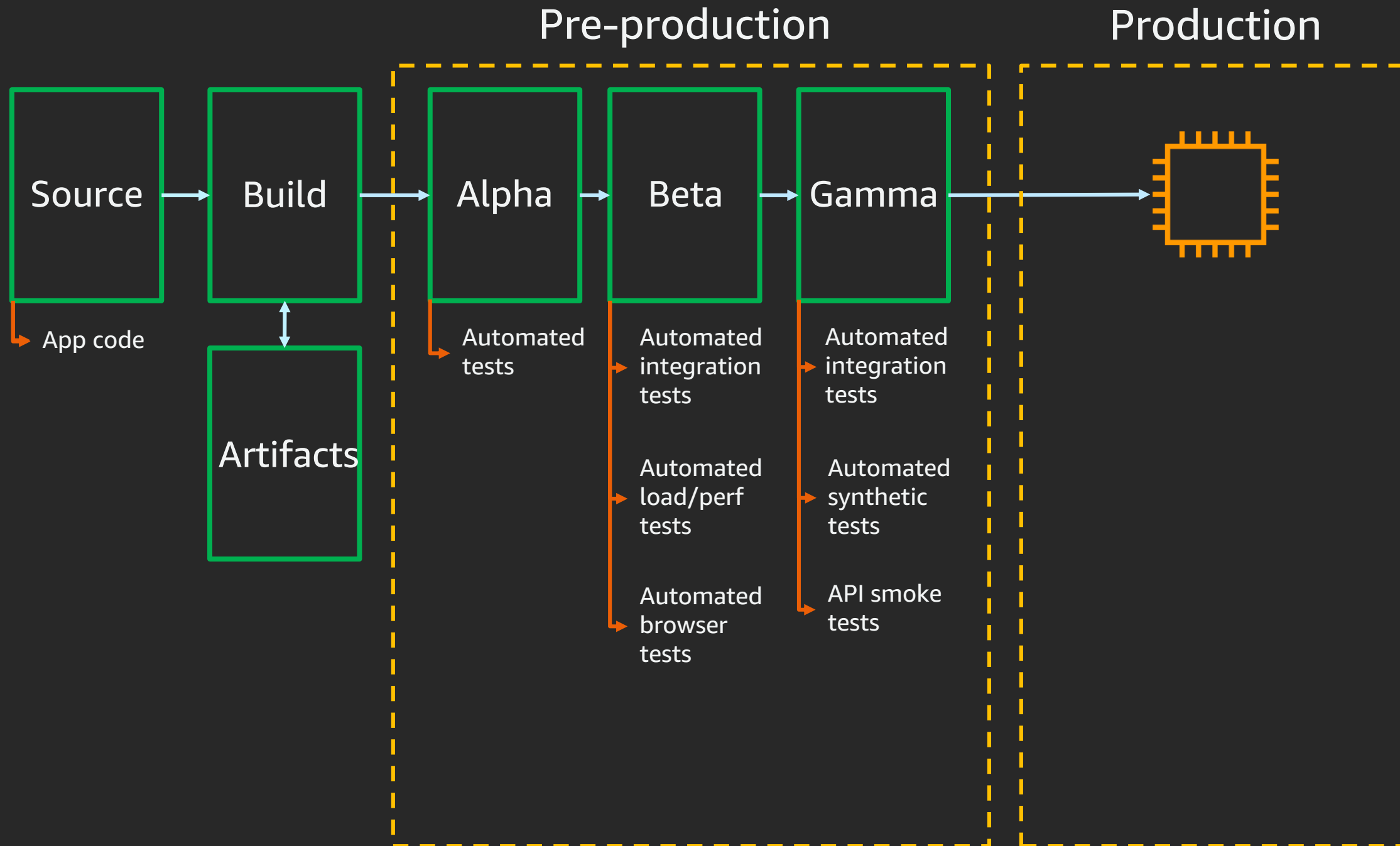
DevOps = Culture + Practices + Tools



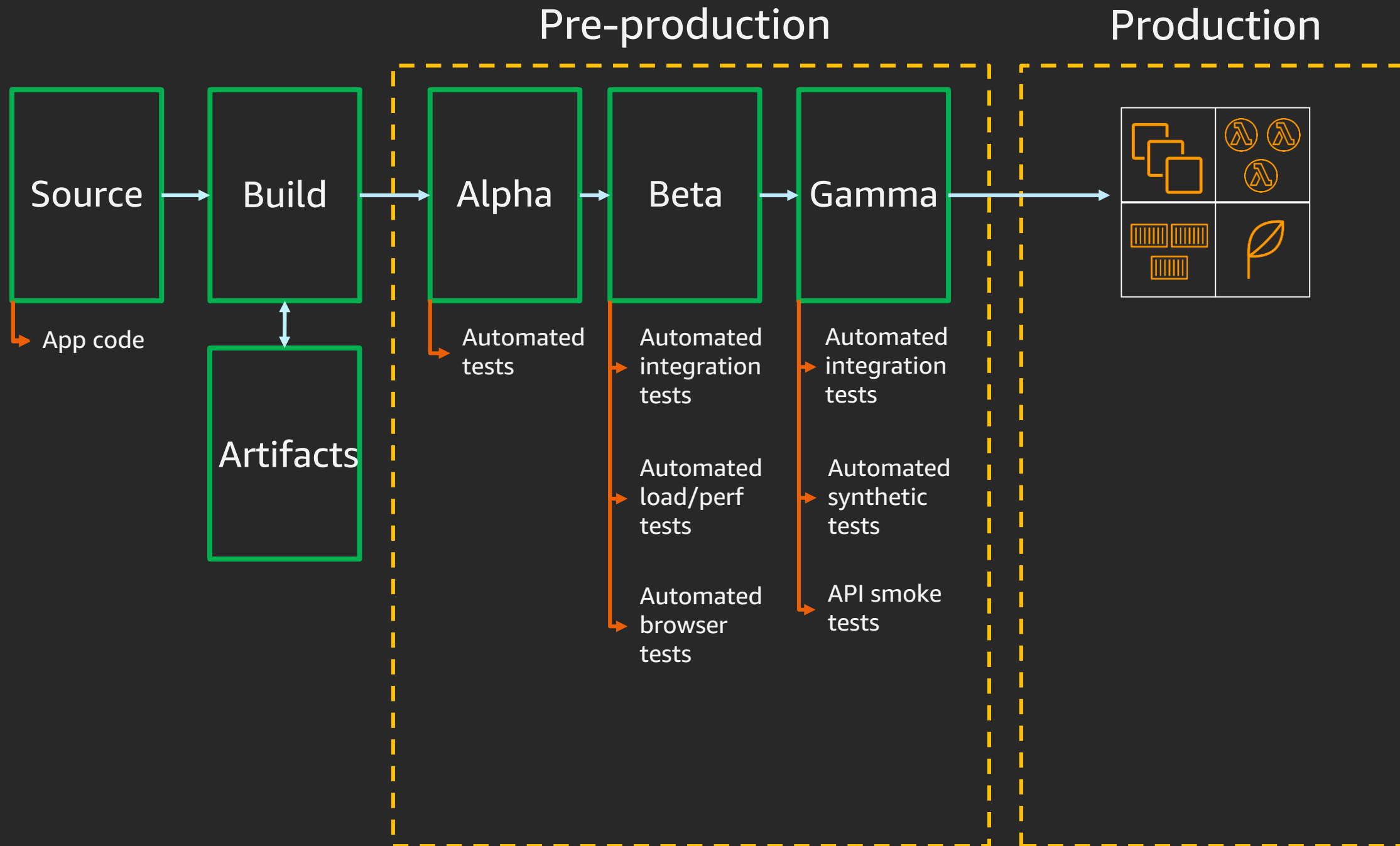
What is DevOps at scale?



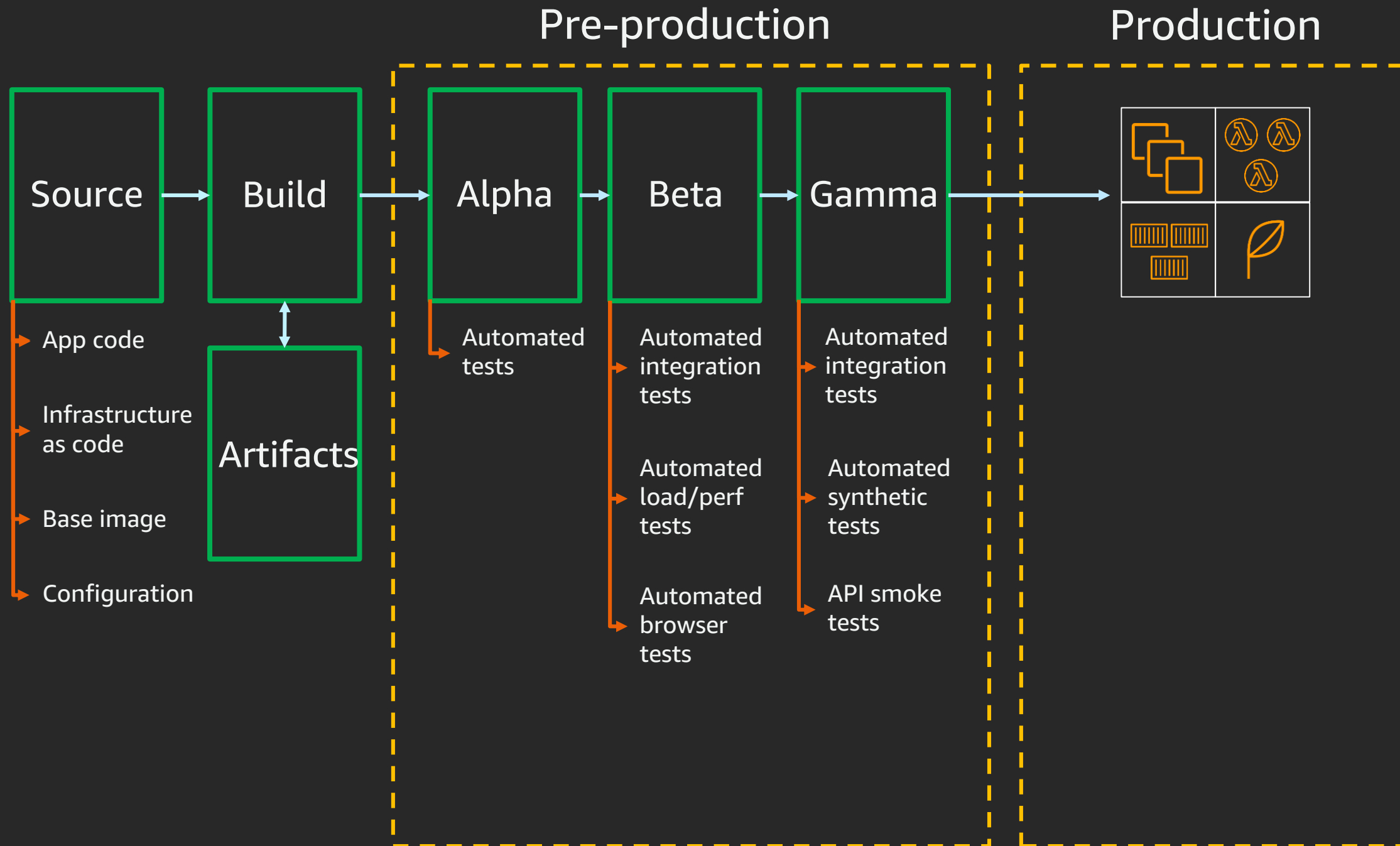
What is DevOps at scale?



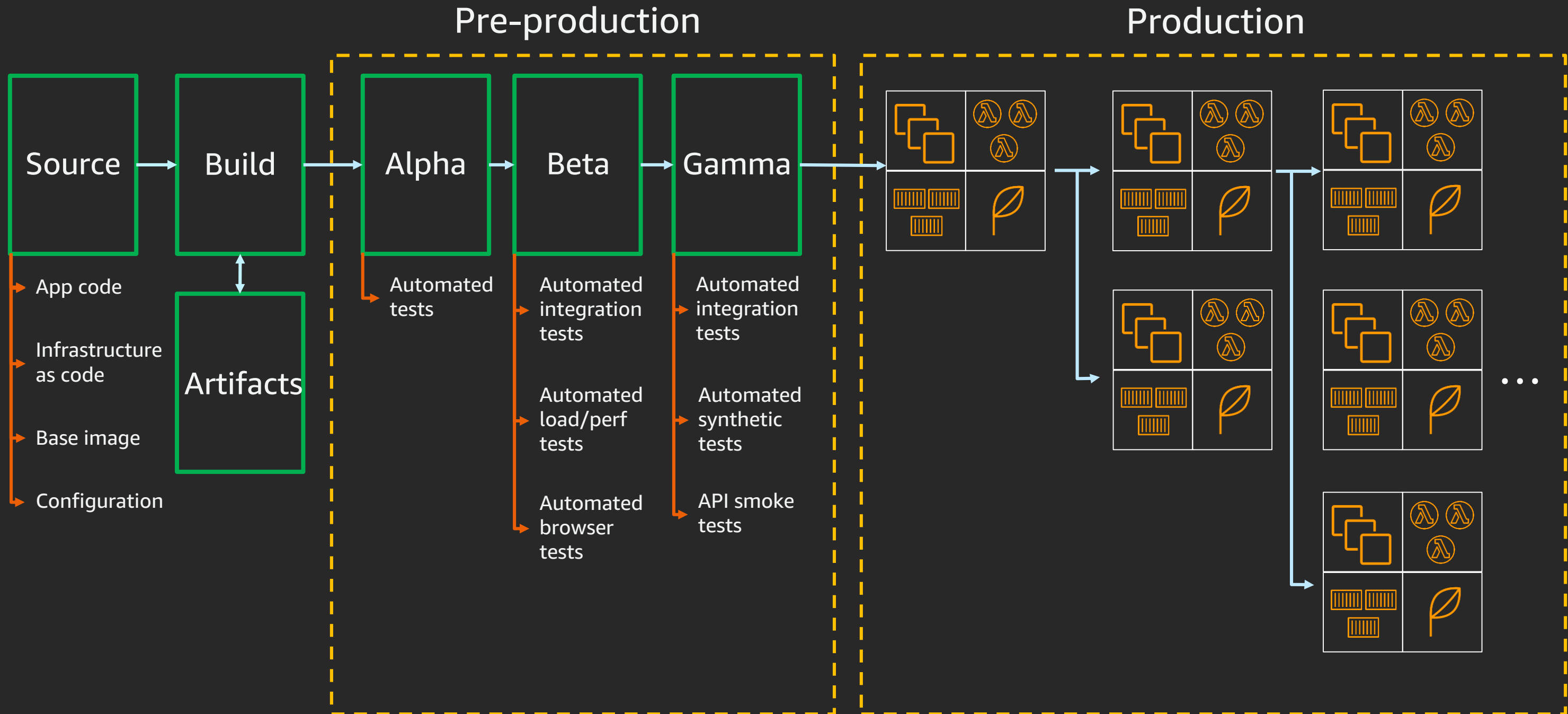
What is DevOps at scale?



What is DevOps at scale?



What is DevOps at scale?



Best practices for CI/CD

1

Pipeline
automation

2

Safe
deployments

3

Repeatable
infrastructure
changes

Best practices for CI/CD

1

Pipeline
automation

2

Safe
deployments

3

Repeatable
infrastructure
changes

Release process stages



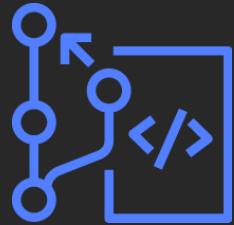
- Check in source code such, as .java files
- Peer review new code

- Compile code
- Unit tests
- Style checkers
- Create container images and deployment packages

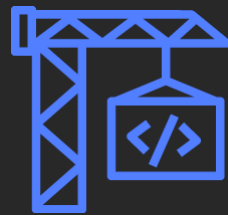
- Integration tests with other systems
- Load testing
- UI tests
- Security testing

- Deploy to production environments
- Monitor code in production in order to quickly detect errors

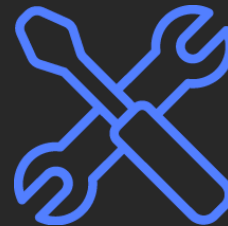
AWS code services



AWS CodeCommit



AWS CodeBuild



AWS CodeBuild
+ third-party
tooling



AWS CodeDeploy



AWS CodePipeline

AWS CodePipeline



- Managed continuous delivery service
- Model and visualize release process
- Automated pipeline trigger on code change
- Integrates with third-party tools

AWS CodePipeline: Supported sources

Via branch

AWS CodeCommit

GitHub

★ Bitbucket

Via object/folder

Amazon S3

Via Docker image

Amazon ECR

AWS CodePipeline: Supported triggers

Automatically kick off release

Amazon EventBridge

- Scheduled (nightly release)
- AWS Health events (AWS Fargate platform retirement)

Available in Amazon EventBridge console, API, SDK, CLI, and AWS CloudFormation

Webhooks

- Docker Hub
- Quay
- Artifactory

Available in AWS CodePipeline API, SDK, CLI, and AWS CloudFormation

AWS CodePipeline: Supported deployment targets

Amazon EC2

AWS CodeDeploy

AWS Elastic Beanstalk

AWS OpsWorks Stacks

Containers

AWS CodeDeploy

Amazon ECS

AWS Fargate

Serverless

AWS CodeDeploy

AWS CloudFormation
(AWS SAM)

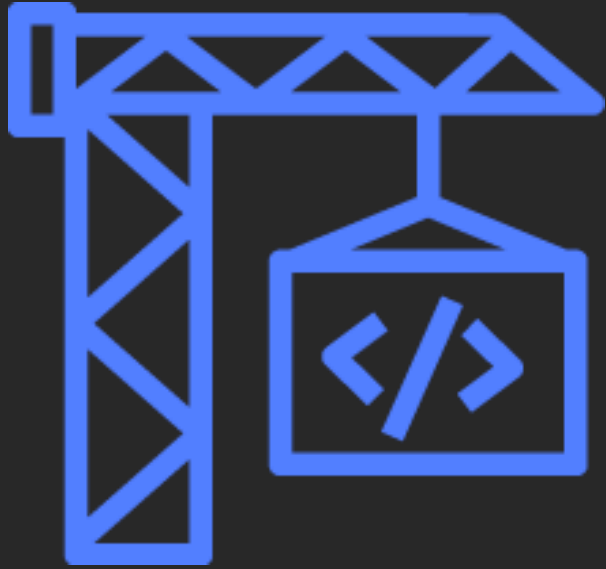
AWS Lambda

Continuous integration goals



1. Automatically kick off a new build when new code is checked in
2. Build and test code in a consistent, repeatable environment
3. Continually have an artifact ready for deployment
4. Continually close feedback loop when build fails

AWS CodeBuild



- Fully managed build service
- Isolated build containers for consistent, immutable environment
- Docker and AWS CLI out of box
- Ability to customize build environment

AWS CodeBuild

```
version: 0.2
```

```
env:
```

```
  variables:
```

```
    JAVA_HOME: "/usr/lib/jvm/java-8-openjdk-amd64"
```

```
phases:
```

```
  install:
```

```
    runtime-versions:
```

```
      java: corretto8
```

```
  build:
```

```
    commands:
```

```
      - echo Build started on `date`  
      - mvn install
```

```
  post_build:
```

```
    commands:
```

```
      - echo Test started on `date`  
      - mvn surefire-report:report
```

```
reports:
```

```
  SurefireReports:
```

```
    files:
```

```
      - '**/*'
```

```
    base-directory: 'target/surefire-reports'
```

```
artifacts:
```

```
  type: zip
```

```
  files:
```

```
    - target/messageUtil-1.0.jar
```

```
  discard-paths: yes
```

} Variables to be used by phases of build

} Execute build command

} Execute unit tests

} Create and store build artifacts in Amazon S3

AWS CodeBuild

```
version: 0.2

env:
  variables:
    JAVA_HOME: "/usr/lib/jvm/java-8-openjdk-amd64"
phases:
  install:
    runtime-versions:
      java: corretto8
  build:
    commands:
      - echo Build started on `date`
      - mvn install
  post_build:
    commands:
      - echo Test started on `date`
      - mvn surefire-report:report
reports:
  SurefireReports:
    files:
      - '**/*'
    base-directory: 'target/surefire-reports'
artifacts:
  type: zip
  files:
    - target/messageUtil-1.0.jar
discard-paths: yes
```

- ★
 - v0.1 – each build cmd in separate shell
 - v0.2 – each build cmd in same shell
- Variables to be used by phases of build
- Execute build command
- Execute unit tests
- Create and store build artifacts in Amazon S3

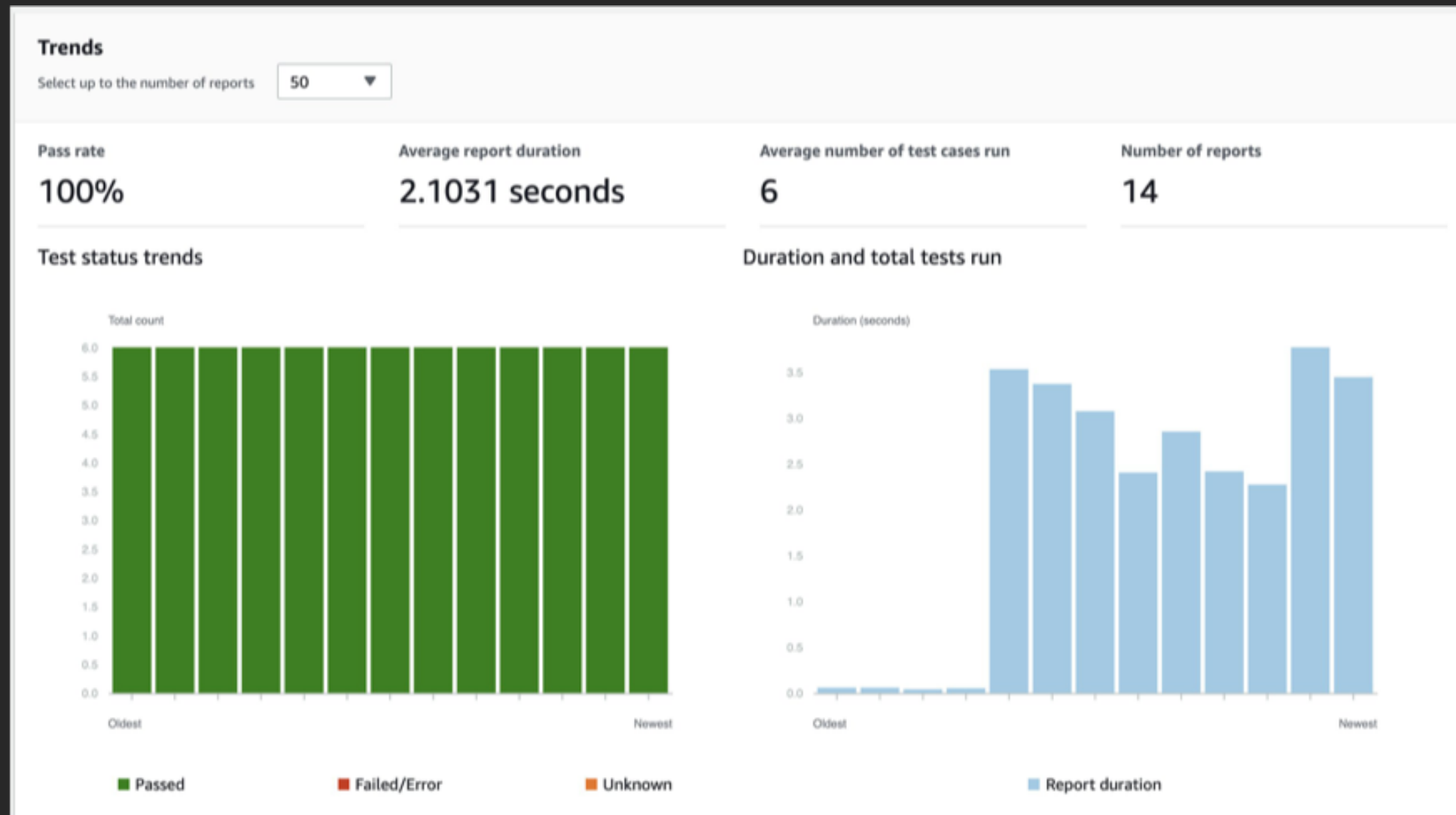
AWS CodeBuild

```
version: 0.2

env:
  variables:
    JAVA_HOME: "/usr/lib/jvm/java-8-openjdk-amd64"
phases:
  install:
    runtime-versions:
      java: corretto8
  build:
    commands:
      - echo Build started on `date`
      - mvn install
  post_build:
    commands:
      - echo Test started on `date`
      - mvn surefire-report:report
reports:
  SurefireReports:
    files:
      - '**/*'
    base-directory: 'target/surefire-reports'
artifacts:
  type: zip
  files:
    - target/messageUtil-1.0.jar
discard-paths: yes
```

- ★ v0.1 – each build cmd in separate shell
- v0.2 – each build cmd in same shell
- Variables to be used by phases of build
- Execute build command
- Execute unit tests
- ★ Reports output location
- Create and store build artifacts in Amazon S3

AWS CodeBuild



See breakdown of individual unit tests, status of the tests, duration, and messages from the tests

Best practices for CI/CD

1

Pipeline
automation

2

Safe
deployments

3

Repeatable
infrastructure
changes

Continuous deployment goals



1. Automatically deploy new changes to staging environments for testing
2. Deploy to production safely without impacting customers
3. Deliver to customers faster: Increase deployment frequency and reduce change lead time and change failure rate

AWS CodeDeploy



- Automates code deployments
- Handles complexity of application updates
- Avoid downtime during deployment
- Roll back automatically upon failure
- Limit “blast radius” with traffic control

AWS CodeDeploy: Amazon EC2 deployments

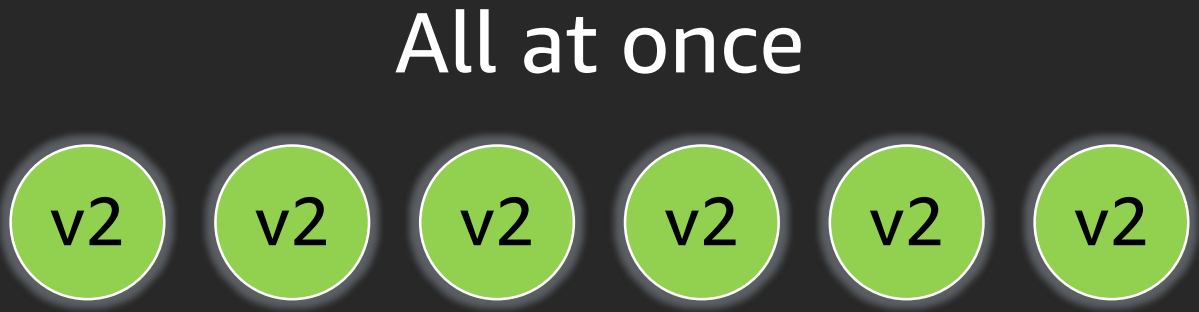
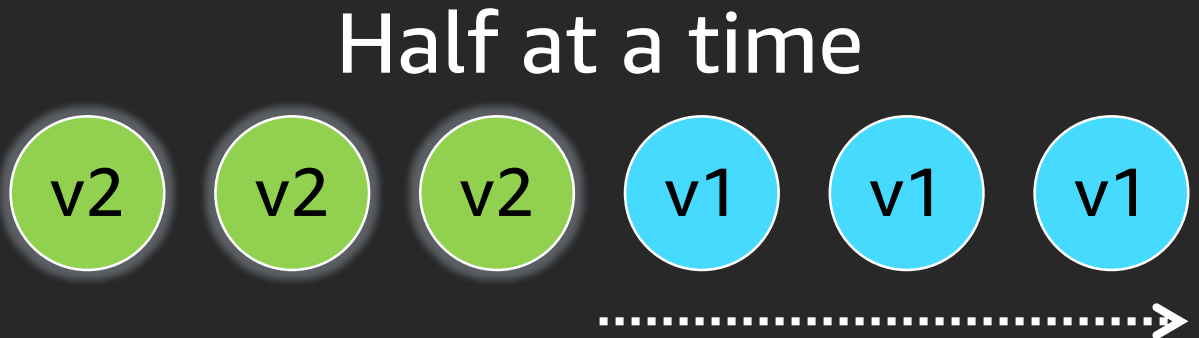
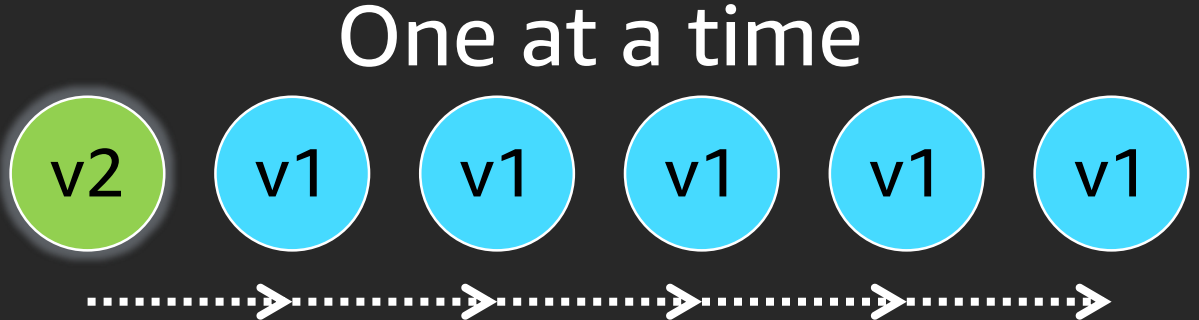
```
version: 0.0
os: linux
files:
  - source: /
    destination: /var/www/html
permissions:
  - object: /var/www/html
    pattern: "*.html"
    owner: root
    group: root
    mode: 755
hooks:
  ApplicationStop:
    - location: scripts/deregister_from_elb.sh
  BeforeInstall:
    - location: scripts/install_dependencies.sh
  ApplicationStart:
    - location: scripts/start_httpd.sh
  validateService:
    - location: scripts/test_site.sh
    - location: scripts/register_with_elb.sh
```

- Send application files to one directory and configuration files to another

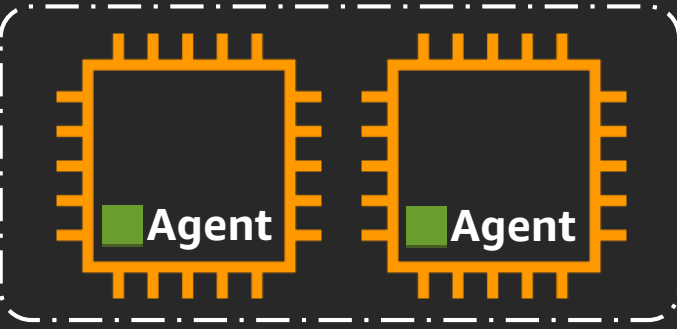
- Set specific permissions on specific directories & files

- Remove/add instance to Elastic Load Balancing
- Install dependency packages
- Start web server
- Confirm successful deploy

Choose deployment speed and group

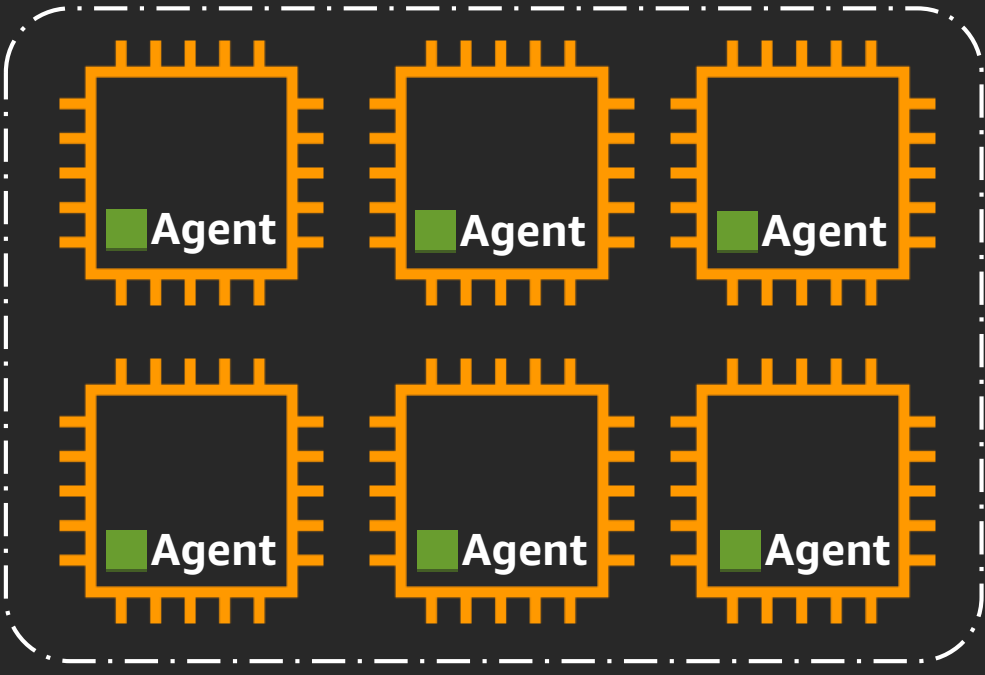


Dev deployment group

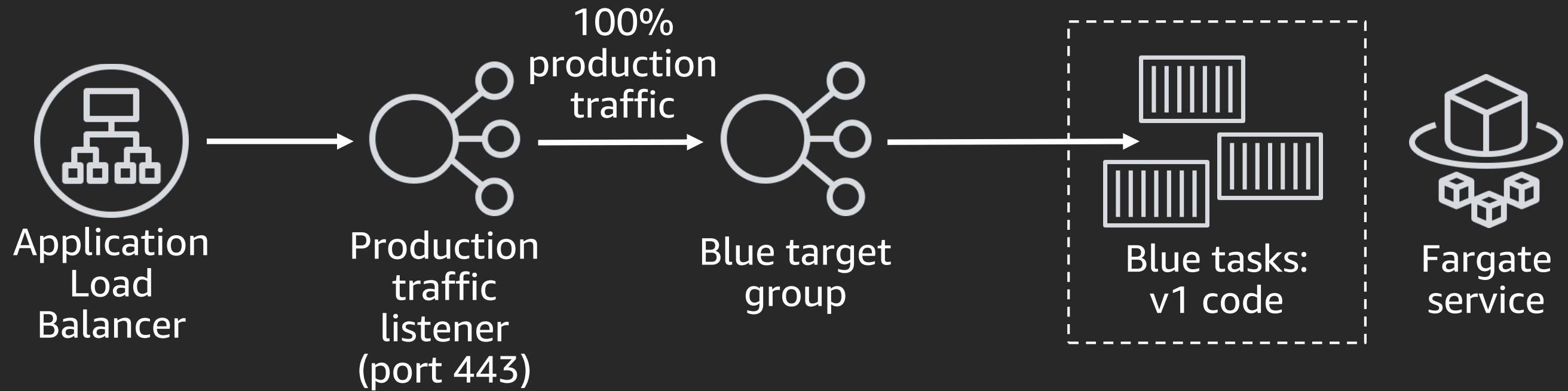


Or

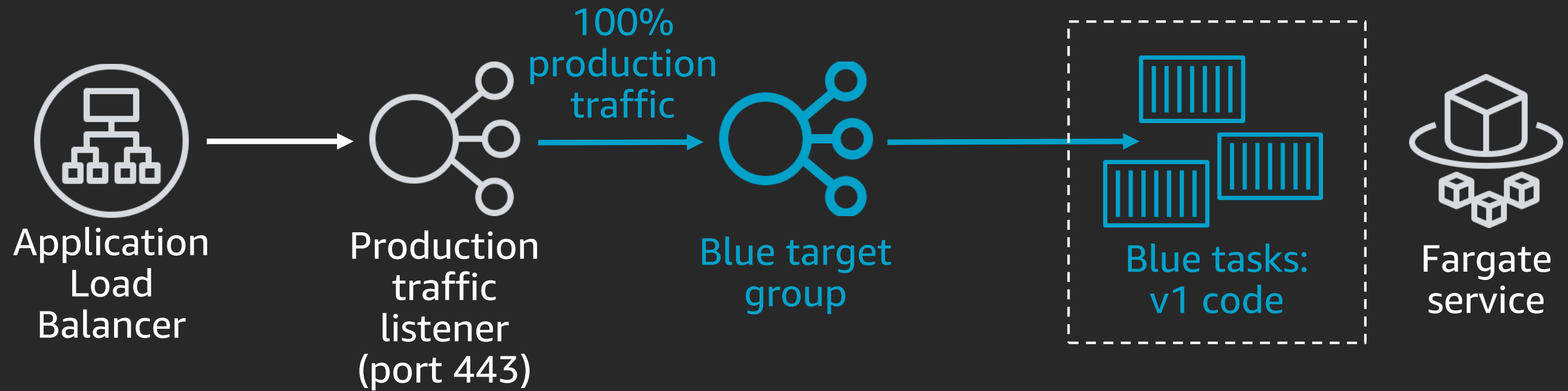
Prod deployment group



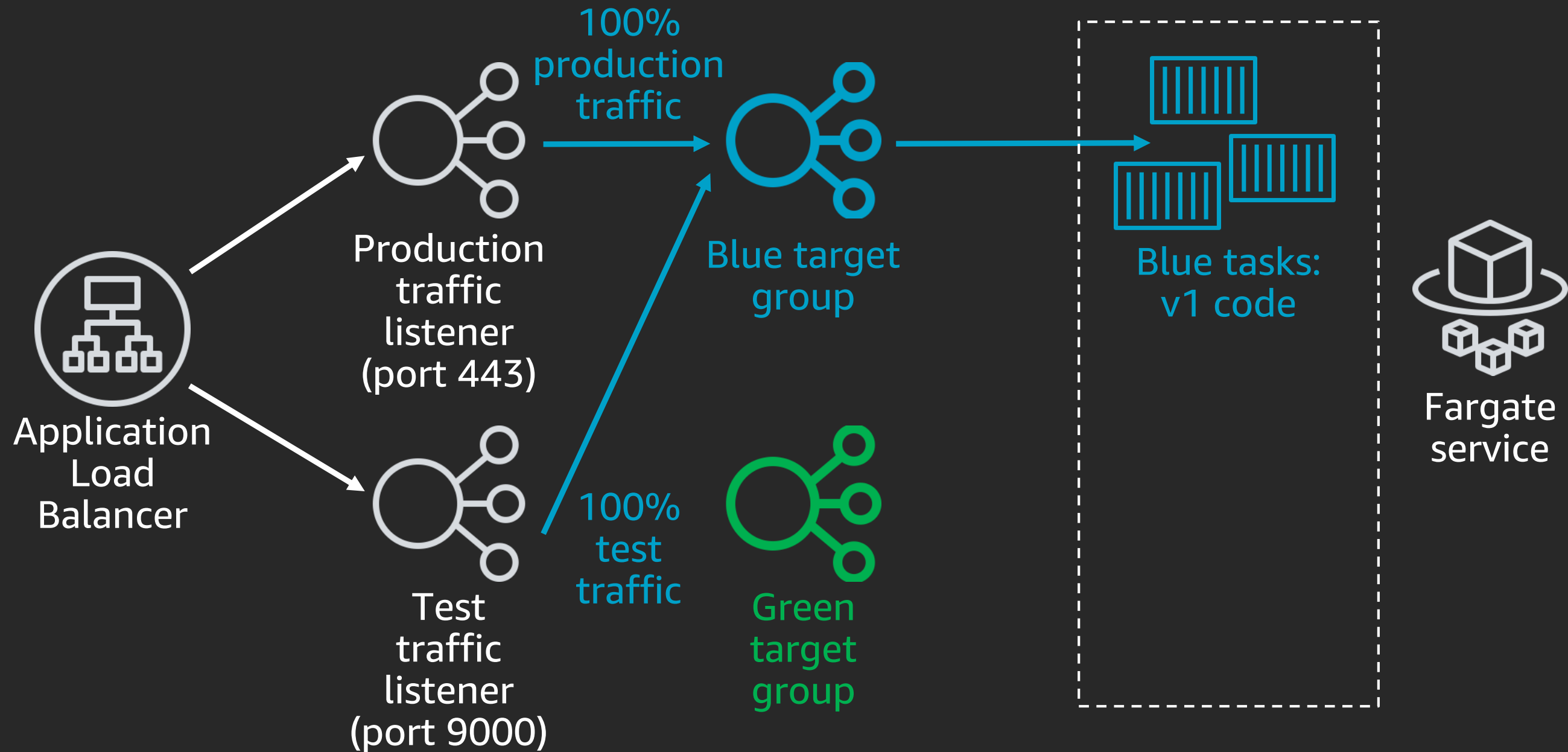
CodeDeploy: Amazon ECS blue/green deployment



CodeDeploy: Amazon ECS blue/green deployment

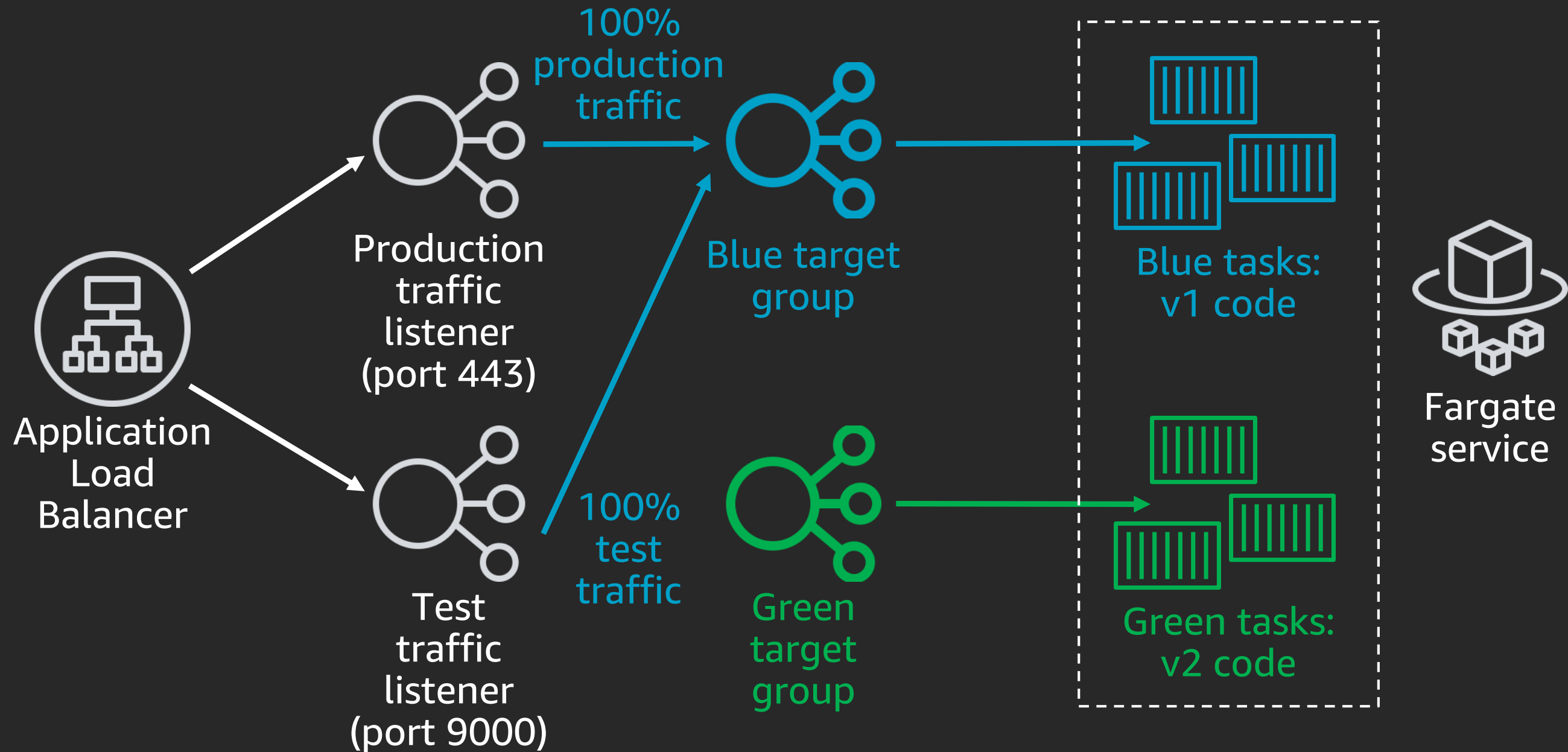


CodeDeploy: Amazon ECS blue/green deployment



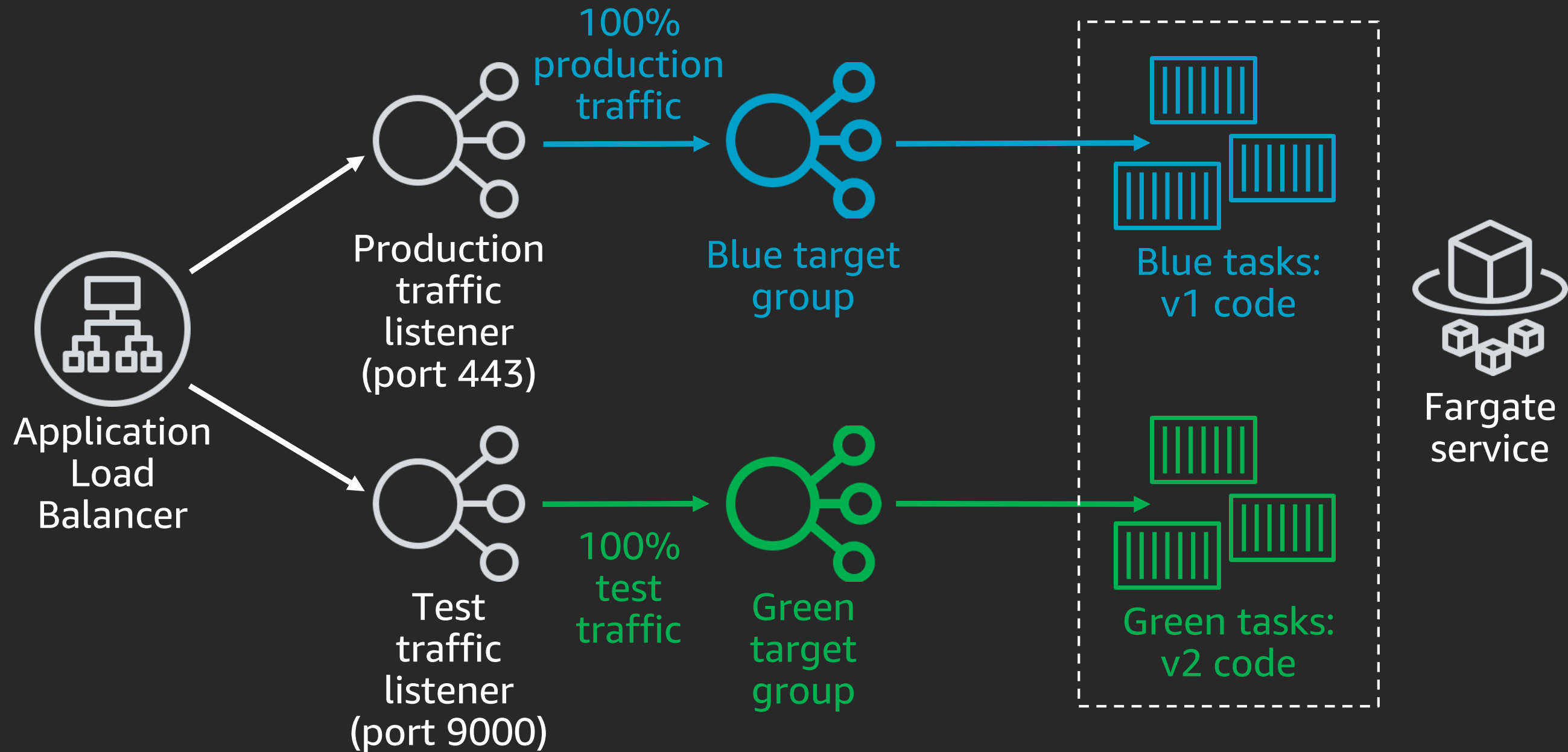
CodeDeploy: Amazon ECS blue/green deployment

Provision green tasks



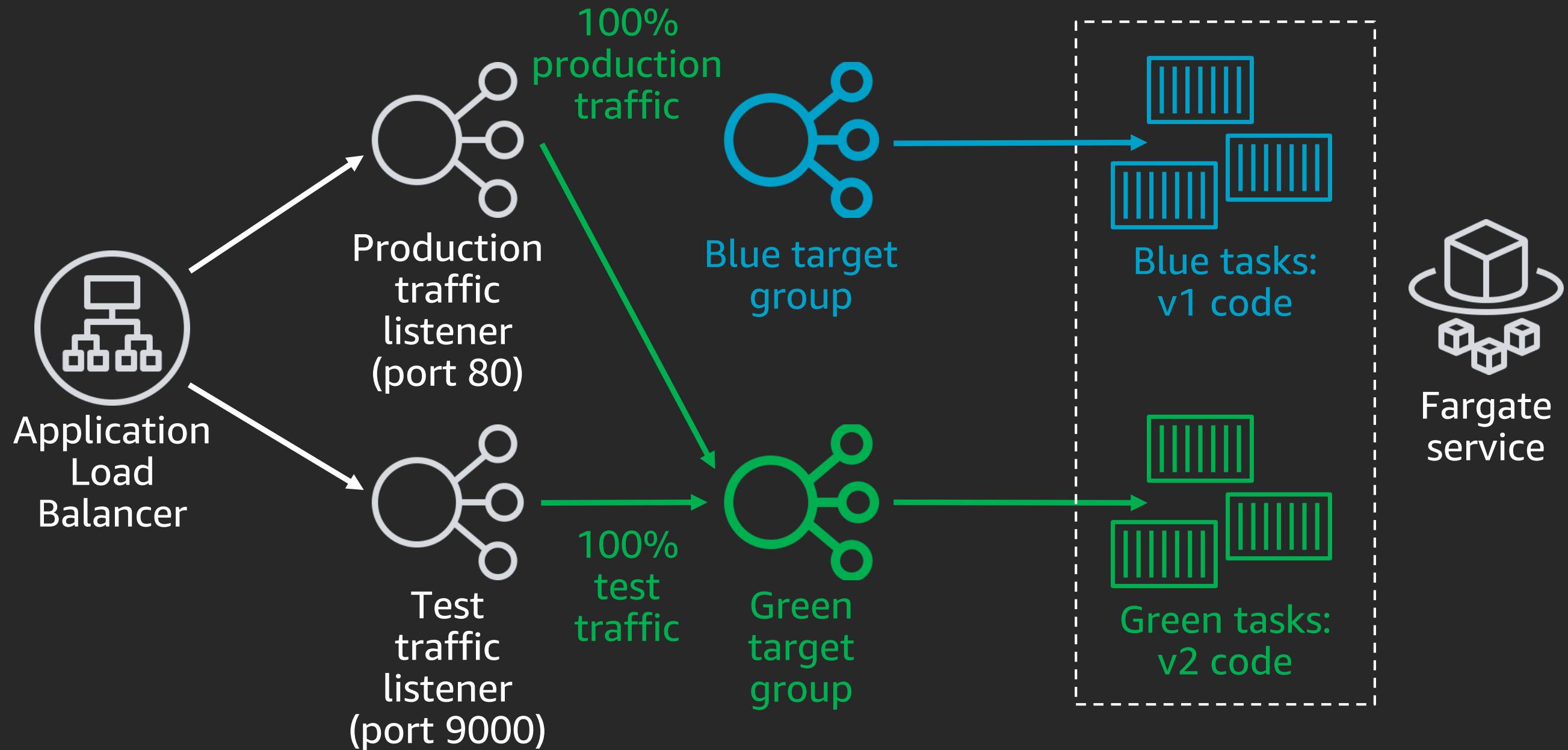
CodeDeploy: Amazon ECS blue/green deployment

Shift test traffic to green; run validation tests against test endpoint



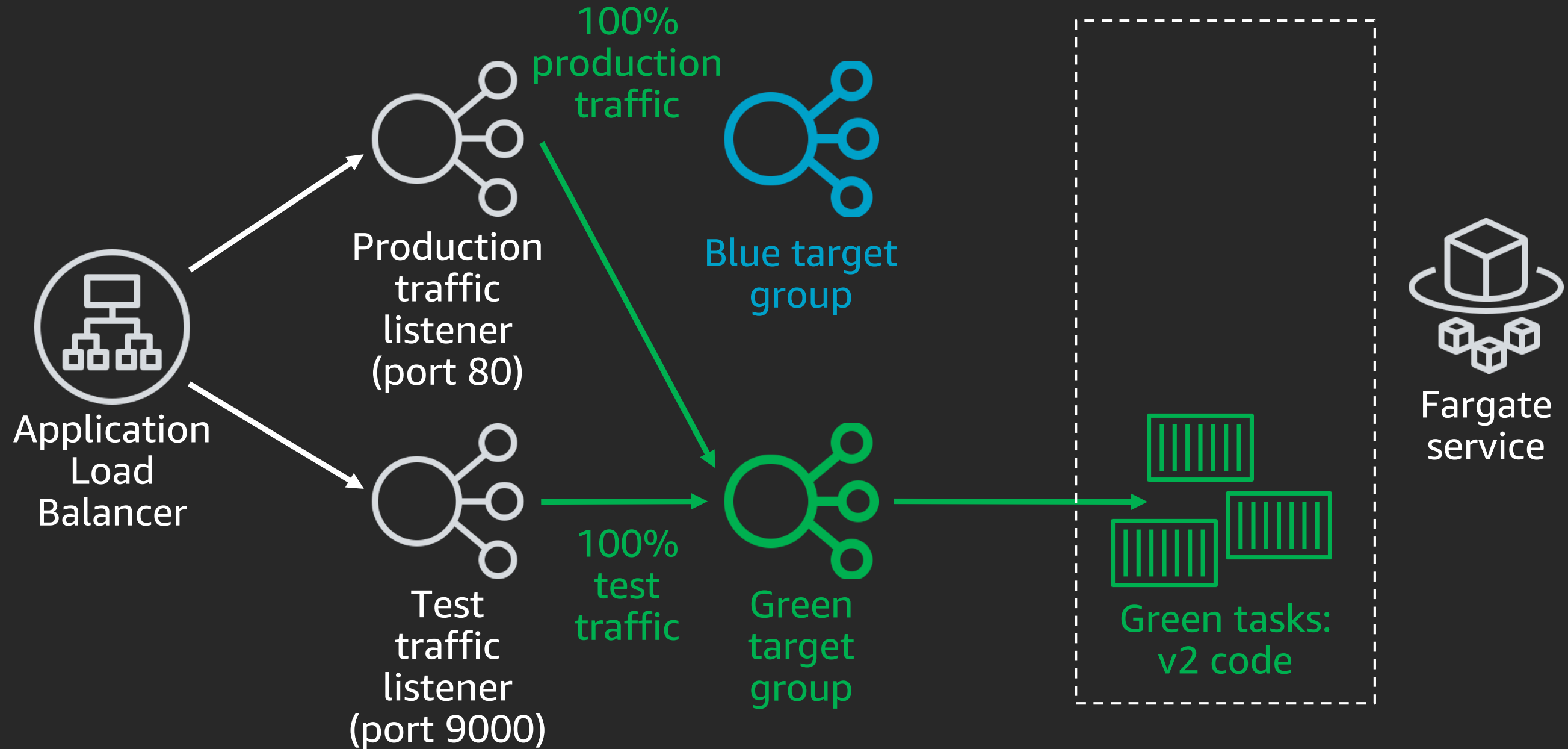
CodeDeploy: Amazon ECS blue/green deployment

Shift production traffic to green; roll back in case of alarm

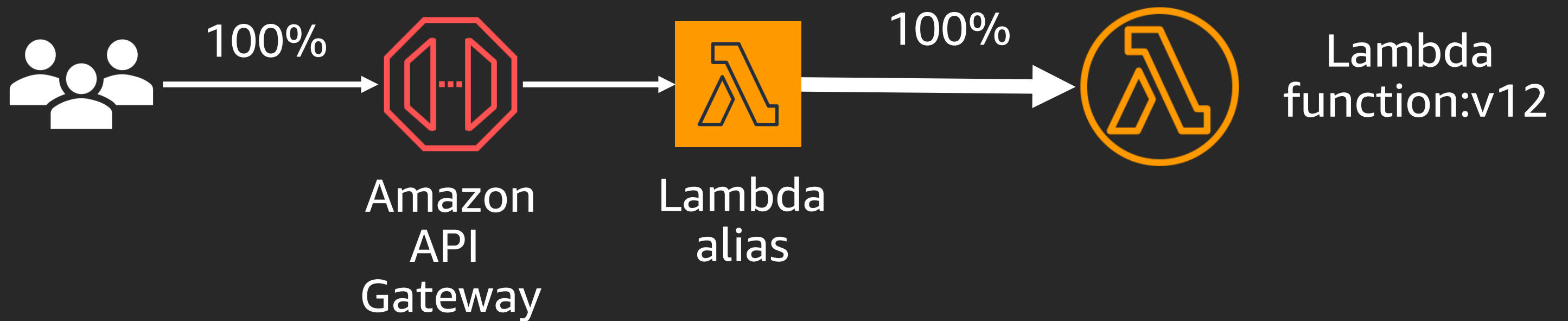


CodeDeploy: Amazon ECS blue/green deployment

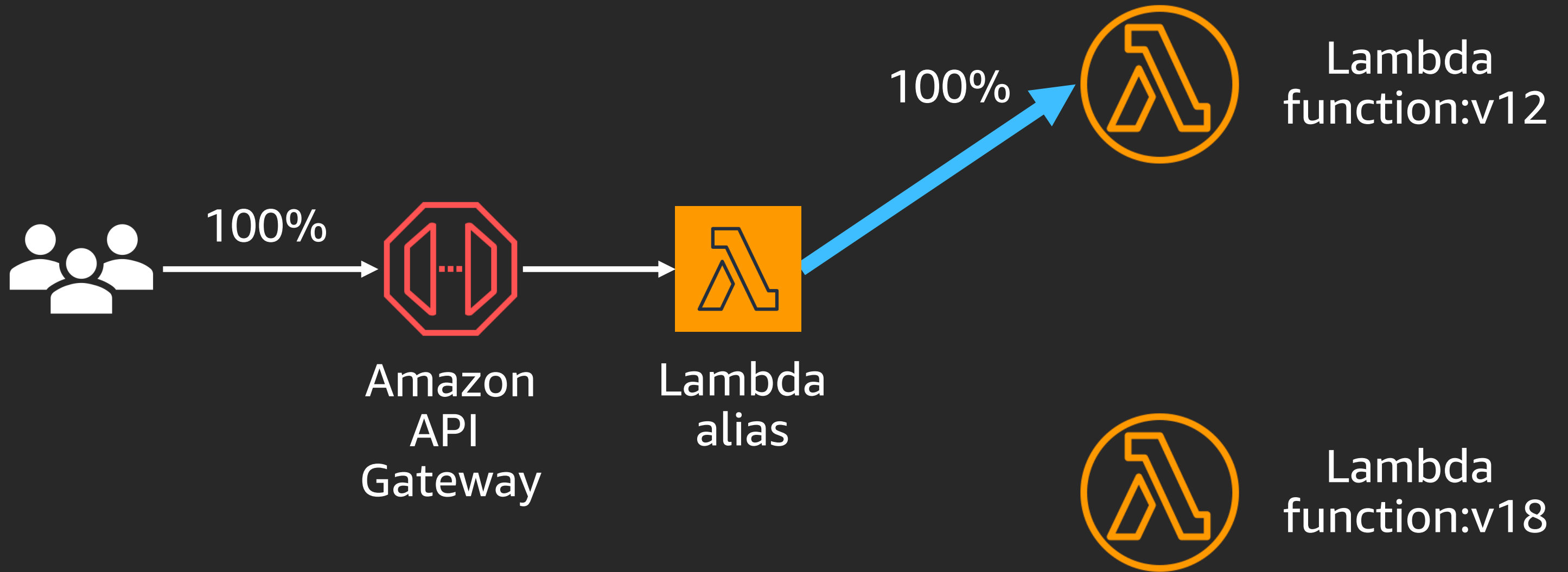
Drain blue tasks



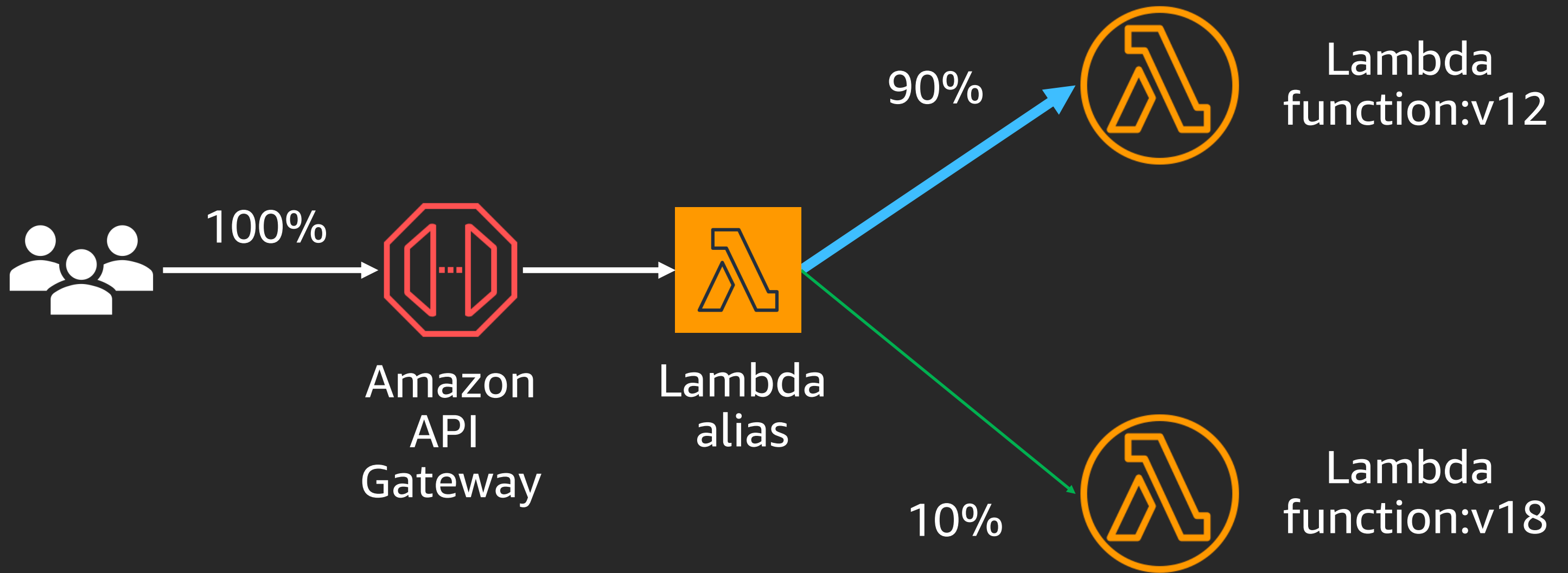
AWS CodeDeploy: Lambda deployments



AWS CodeDeploy: Lambda deployments

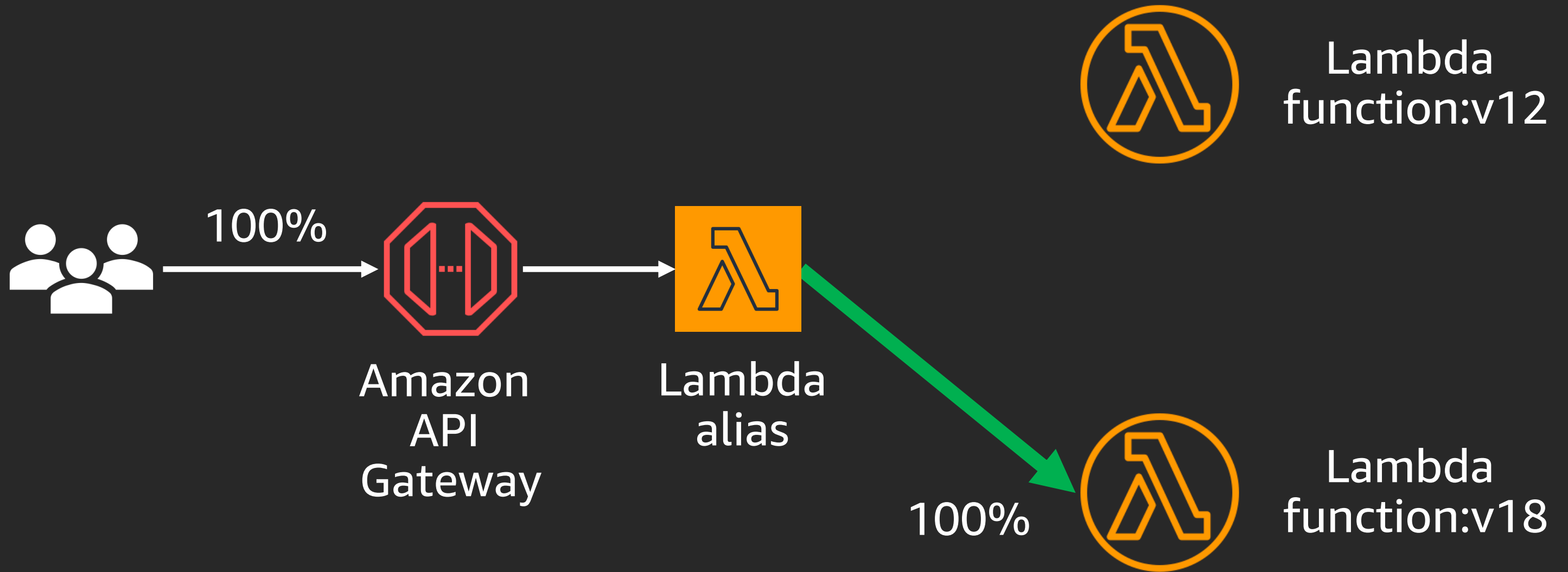


AWS CodeDeploy: Lambda deployments



Canary: "shift 10% of traffic for 10 mins., then shift the rest"

AWS CodeDeploy: Lambda deployments



Canary: "shift 10% of traffic for 10 mins., then shift the rest"

Best practices for CI/CD

1

Pipeline
automation

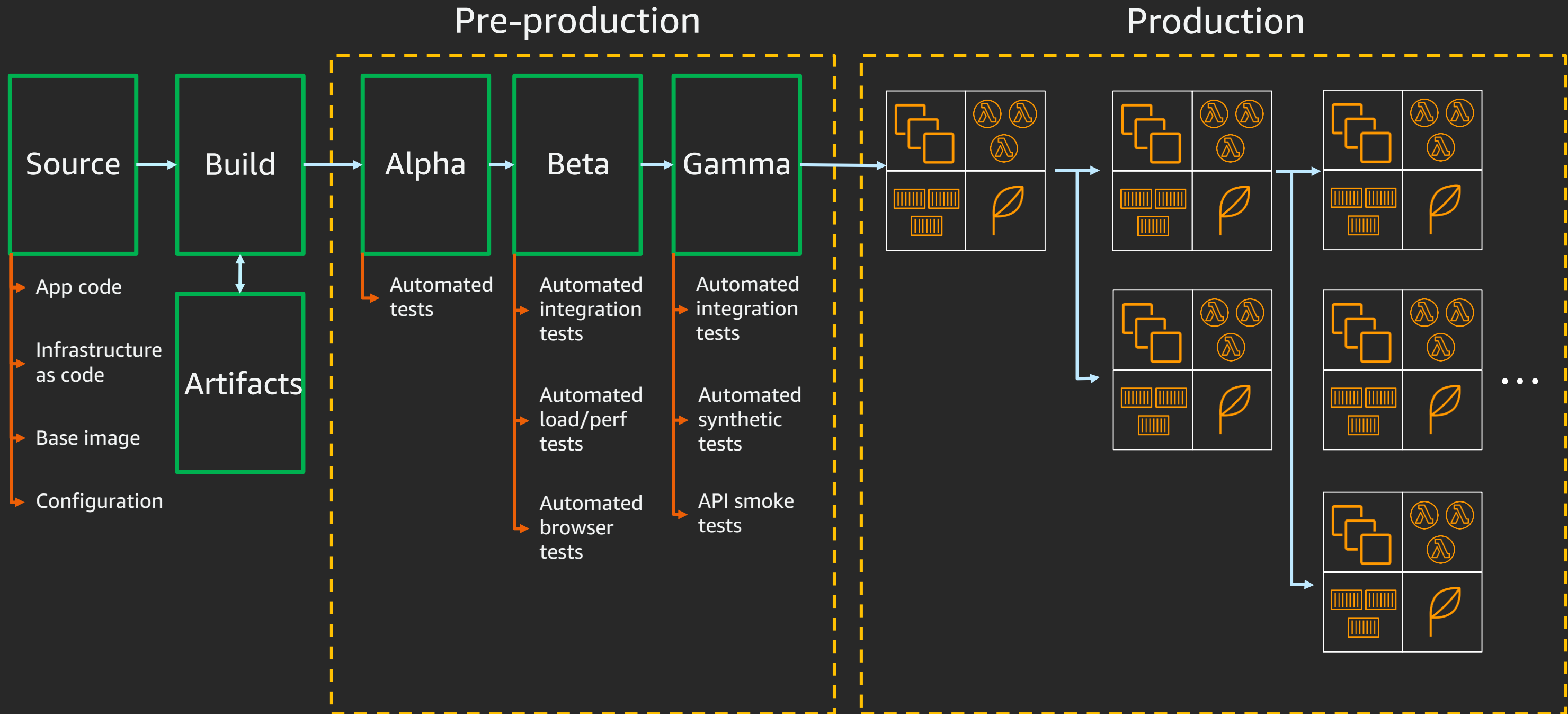
2

Safe
deployments

3

Repeatable
infrastructure
changes

What is DevOps at scale?



Infrastructure as code goals



1. Make infrastructure changes repeatable and predictable
2. Release infrastructure changes using the same tools as code changes
3. Replicate production environment in a staging environment to enable continuous testing

AWS Cloud Development Kit (AWS CDK)



- Open-source framework to define cloud infrastructure in Typescript, Python, Java, and .NET
- Provisions resources with AWS CloudFormation
- Supports all AWS CloudFormation resource types
- Provides library of higher-level resource types that have AWS best practices built in by default

AWS CDK template

```
import ec2 = require('@aws-cdk/aws-ec2');
import ecs = require('@aws-cdk/aws-ecs');
import cdk = require('@aws-cdk/cdk');

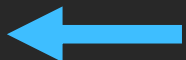
class BonjourFargate extends cdk.Stack {
  constructor(parent: cdk.App, name: string, props?: cdk.StackProps) {
    super(parent, name, props);

    const vpc = new ec2.VpcNetwork(this, 'MyVpc', { maxAZs: 2 });
    const cluster = new ecs.Cluster(this, 'Cluster', { vpc });

    new ecs.LoadBalancedFargateService(
      this, "FargateService", {
        cluster,
        image: ecs.DockerHub.image("amazon/amazon-ecs-sample"),
      });
  }
}

const app = new cdk.App();
new BonjourFargate(app, 'Bonjour');
app.run();
```

High-level virtual private cloud (VPC) class includes VPC, subnets, security groups, internet gateway, NAT gateways, and route tables



AWS CDK template

```
import ec2 = require('@aws-cdk/aws-ec2');
import ecs = require('@aws-cdk/aws-ecs');
import cdk = require('@aws-cdk/cdk');

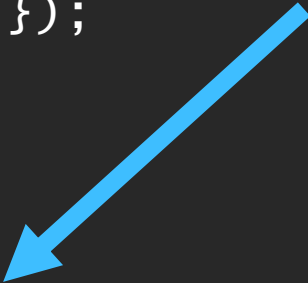
class BonjourFargate extends cdk.Stack {
  constructor(parent: cdk.App, name: string, props?: cdk.StackProps) {
    super(parent, name, props);

    const vpc = new ec2.VpcNetwork(this, 'MyVpc', { maxAZs: 2 });
    const cluster = new ecs.Cluster(this, 'Cluster', { vpc });

    new ecs.LoadBalancedFargateService(
      this, "FargateService", {
        cluster,
        image: ecs.DockerHub.image("amazon/amazon-ecs-sample"),
      });
  }
}

const app = new cdk.App();
new BonjourFargate(app, 'Bonjour');
app.run();
```

High-level Fargate class includes Amazon ECS service, Amazon ECS task definition, Application Load Balancer, listener rule, target group, and, optionally, Amazon Route 53 alias record



AWS CDK template

```
import ec2 = require('@aws-cdk/aws-ec2');
import ecs = require('@aws-cdk/aws-ecs');
import cdk = require('@aws-cdk/cdk');

class BonjourFargate extends cdk.Stack {
  constructor(parent: cdk.App, name: string, props?: cdk.StackProps) {
    super(parent, name, props);

    const vpc = new ec2.VpcNetwork(this, 'MyVpc', { maxAZs: 2 });
    const cluster = new ecs.Cluster(this, 'Cluster', { vpc });

    new ecs.LoadBalancedFargateService(
      this, "FargateService", {
        cluster,
        image: ecs.DockerHub.image("amazon/amazon-ecs-sample"),
      });
  }
}

const app = new cdk.App();
new BonjourFargate(app, 'Bonjour');
app.run();
```

22 lines of
TypeScript code
generate over
400 lines of AWS
CloudFormation
syntax

CI/CD at Electrify Asia

Electrify Asia

- Energy technology company
- Build sustainable energy ecosystems through development of transactive energy platforms
- Democratized access to clean energy across Asia-Pacific



Challenges we had

- Lacking a standard CI/CD platform
- More manual human interact workload for deployments
- Highly vulnerable security issues and trouble with keeping the secrets
- Trouble managing the infrastructure
- Hard to isolate the bottlenecks of the application/services, so there is no proper observability

Our AWS Stack

Compute



Amazon EC2 Amazon EKS Amazon ECR Lambda

Storage



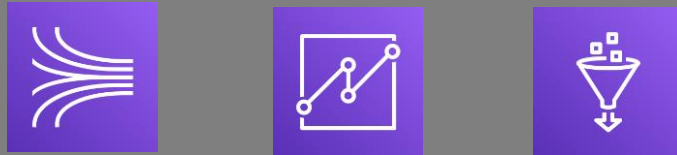
Amazon EBS Amazon EFS Amazon S3 Amazon S3 Glacier AWS Backup

Database



Amazon Aurora Amazon ElastiCache Amazon Redshift Amazon DynamoDB

Analytics



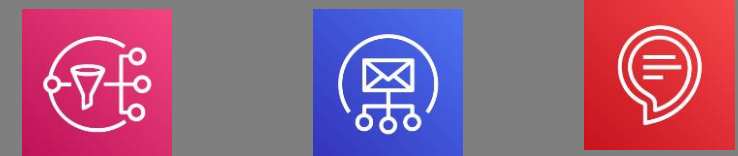
Amazon Kinesis Amazon QuickSight AWS Glue

Developer tools



AWS CodePipeline AWS CodeBuild AWS CodeCommit AWS CodeDeploy

Customer engagement and other



Amazon SNS Amazon SES Amazon Alexa

Security, identity & compliance



AWS Certificate Manager AWS WAF IAM AWS Secrets Manager AWS KMS

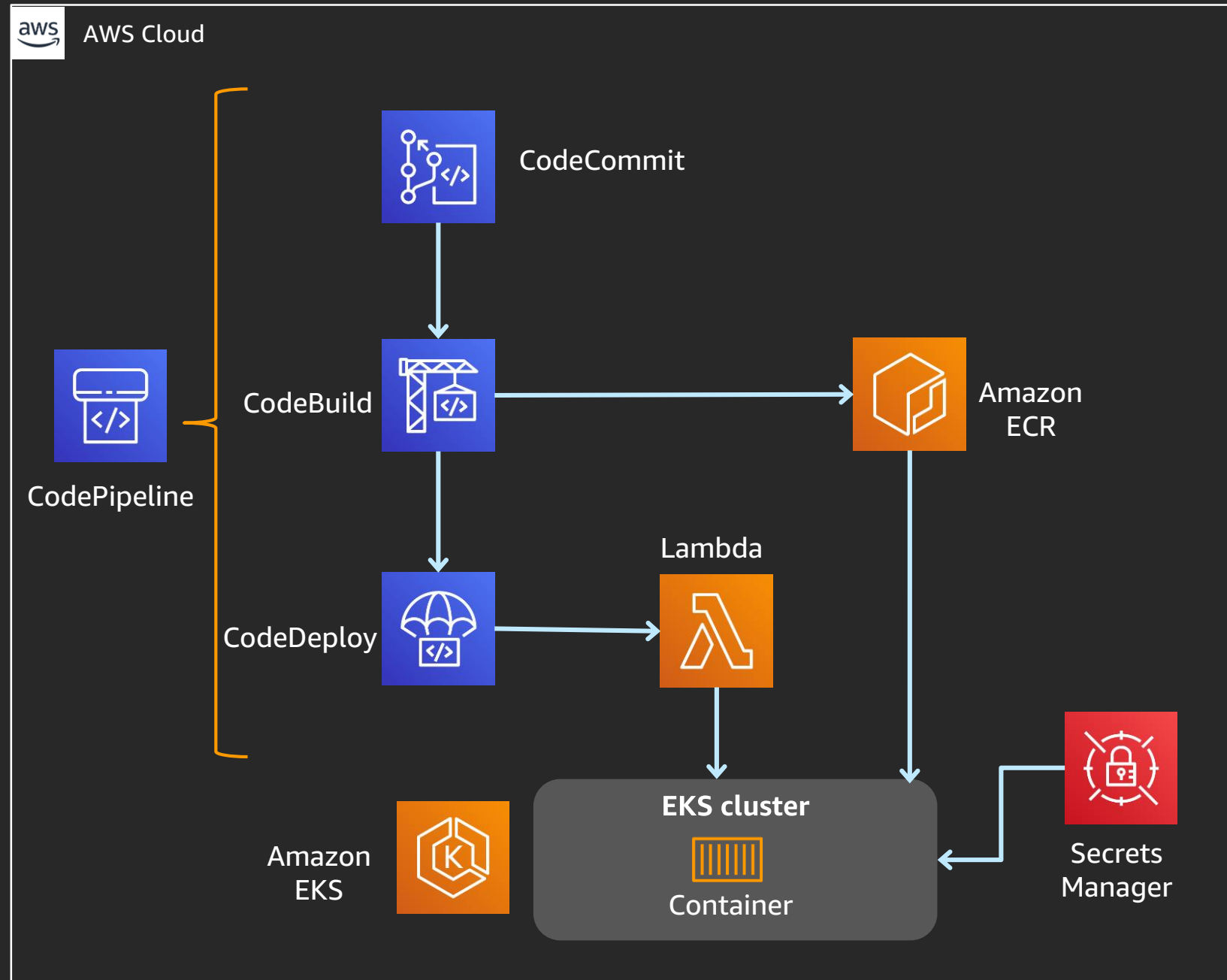
Management & governance



AWS Trusted Advisor AWS CloudTrail AWS Organizations AWS CloudFormation AWS Systems Manager Amazon CloudWatch AWS Auto Scaling

“We know that we have to deploy things faster and break things over and over again. To make that process streamlined, we came up with this solution.”

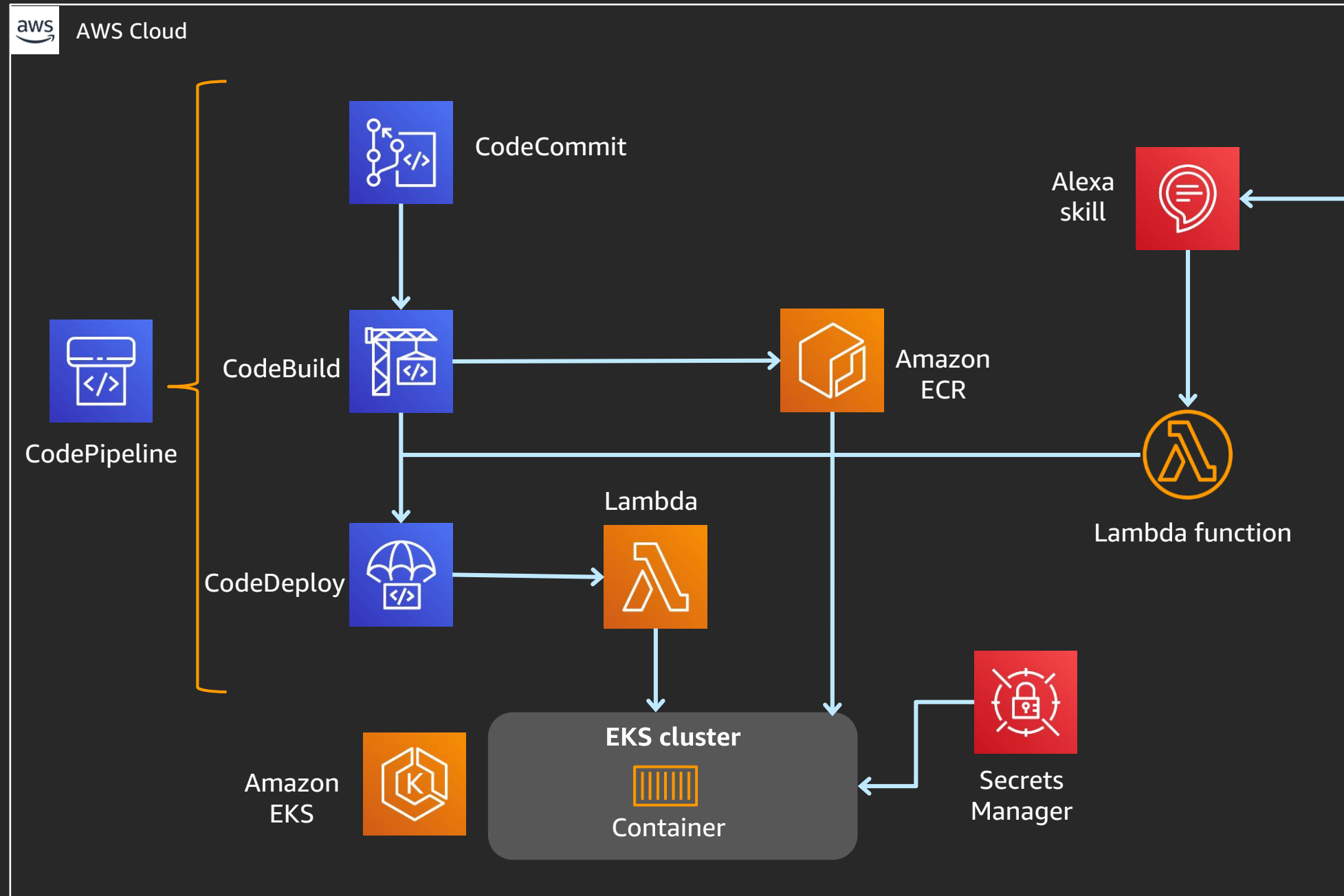
DevOps pipeline



- Saved time and costs
- Everything is automated
- Used Secrets Manager to store the secure configs
- Container Insights and CloudWatch provided observability

“... and we made it more interesting by integrating Alexa with AWS CodePipeline.”

DevOps pipeline v2

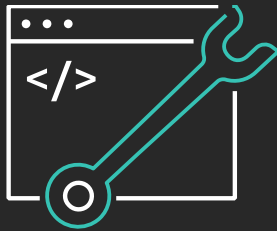


Alexa to trigger the deployments quickly and easily

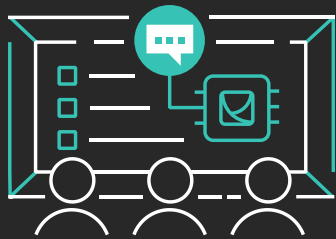
Demo

Learn to build modern applications on AWS

Resources created by the experts at AWS to help you build and validate developer skills



Enable rapid innovation by developing your skills in designing, building, and managing modern applications



Learn to modernize your applications with free digital training and classroom offerings, including Architecting on AWS, Developing on AWS, and DevOps Engineering on AWS



Validate expertise with the AWS Certified DevOps—Professional or AWS Certified Developer—Associate exams

Visit the developer learning path at aws.amazon.com/training/path-developing

Thank you!

Loh Yiang Meng