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CI/CD for Containers: A way forward for your DevOps Pipeline

KJ Pittl
ISV Solutions Architect,
Amazon Web Services

Agenda

- ~~What is DevOps,~~ what are the challenges at scale?
- ~~modernise your application, build containers, container registry,~~
- ~~What's this ECS/EKS on EC2 or Fargate~~
- Pipeline Automation
- Safe Deployments
- Repeatable infrastructure changes

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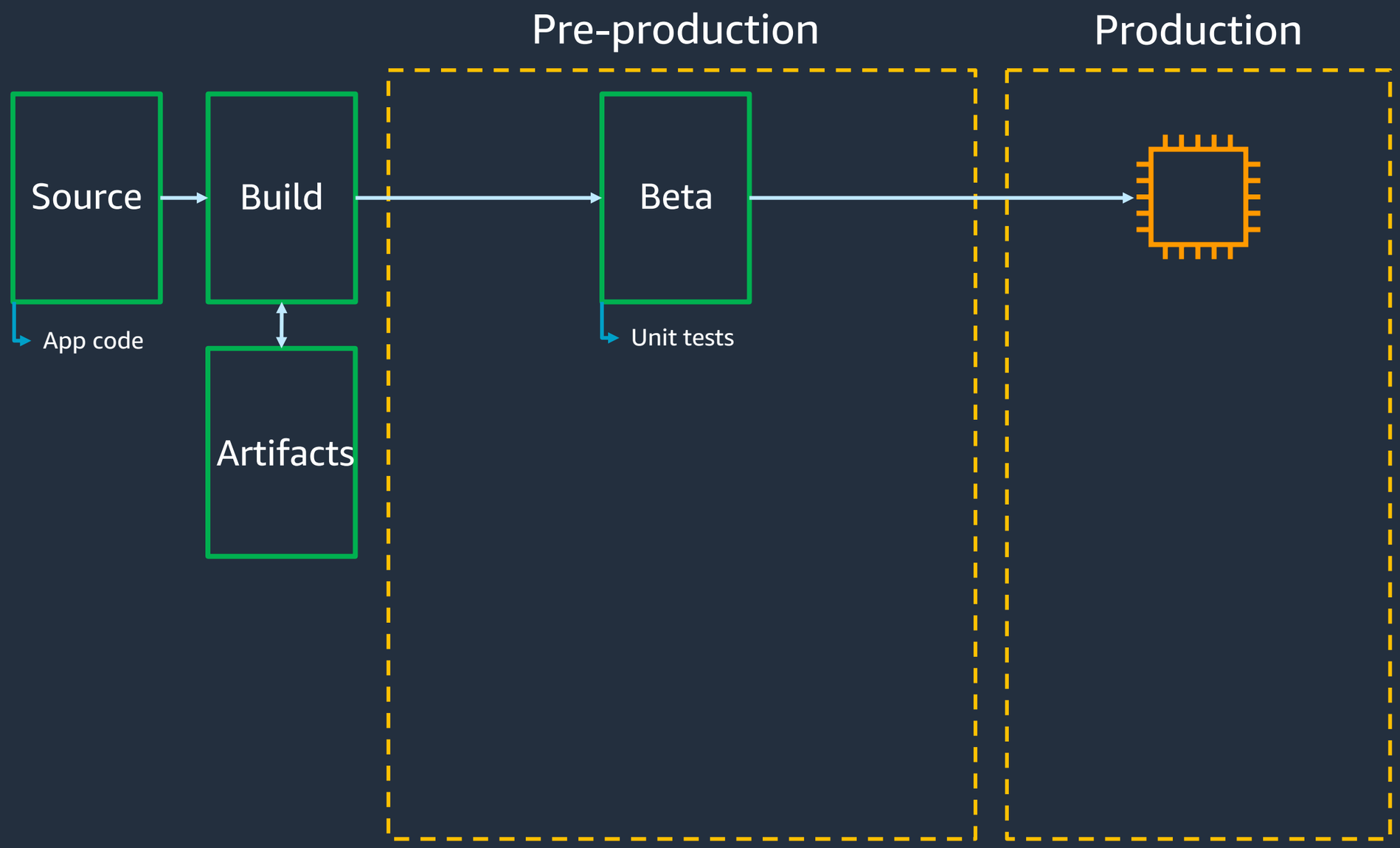
What is DevOps at scale?



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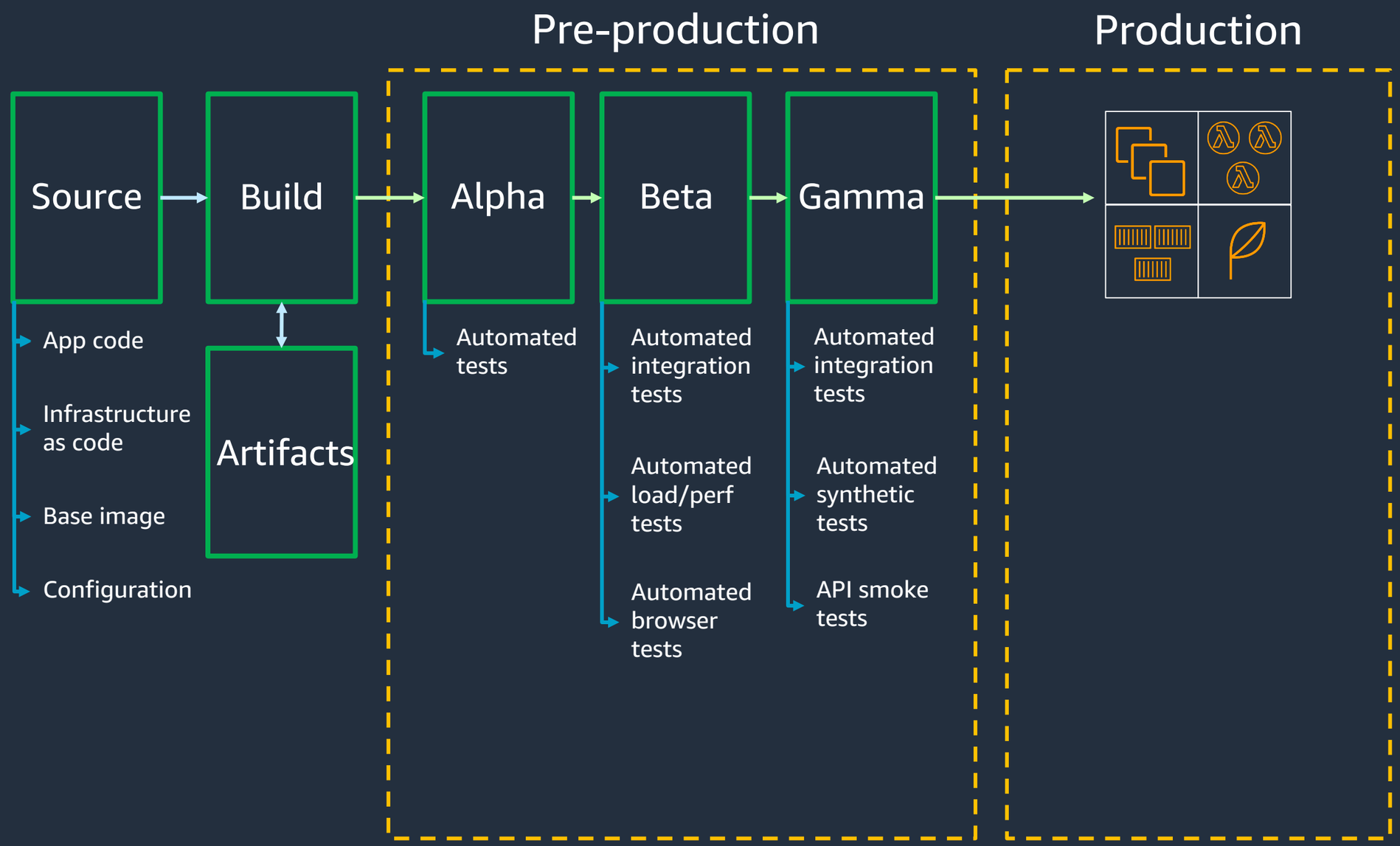

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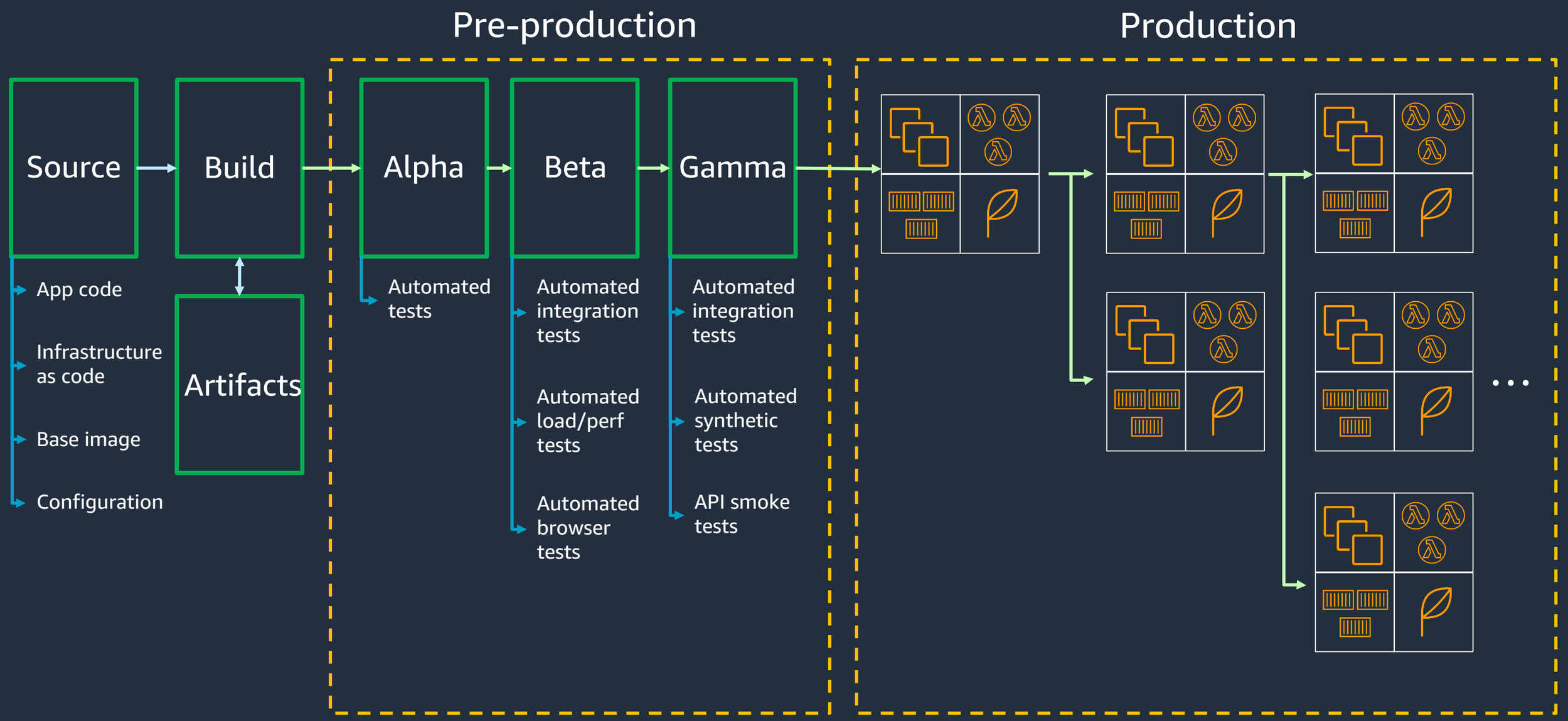
What is DevOps at scale?



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Best practices for CI/CD

1

Pipeline Automation

2

Safe Deployments

3

Repeatable infrastructure changes

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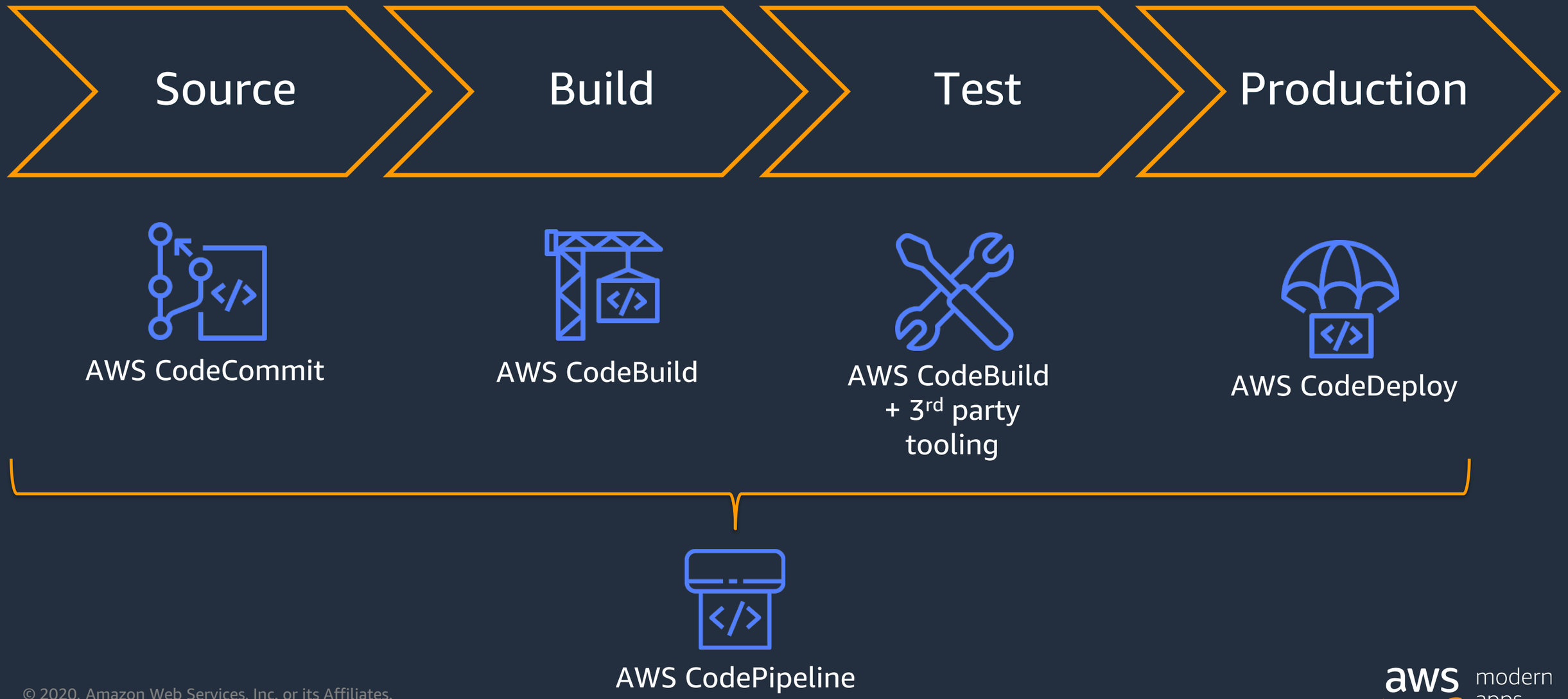
AWS Code services



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AWS CodePipeline

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

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AWS CodePipeline: Supported sources

Via branch

AWS CodeCommit

GitHub

★ Bitbucket

Via object/folder

Amazon Simple Storage Service (Amazon S3)

Via Docker image

Amazon Elastic Container Registry (Amazon ECR)

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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 (SAM)

AWS Lambda

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AWS CodePipeline: Supported triggers

Automatically kick off release

Amazon EventBridge / Cloudwatch Events

- 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

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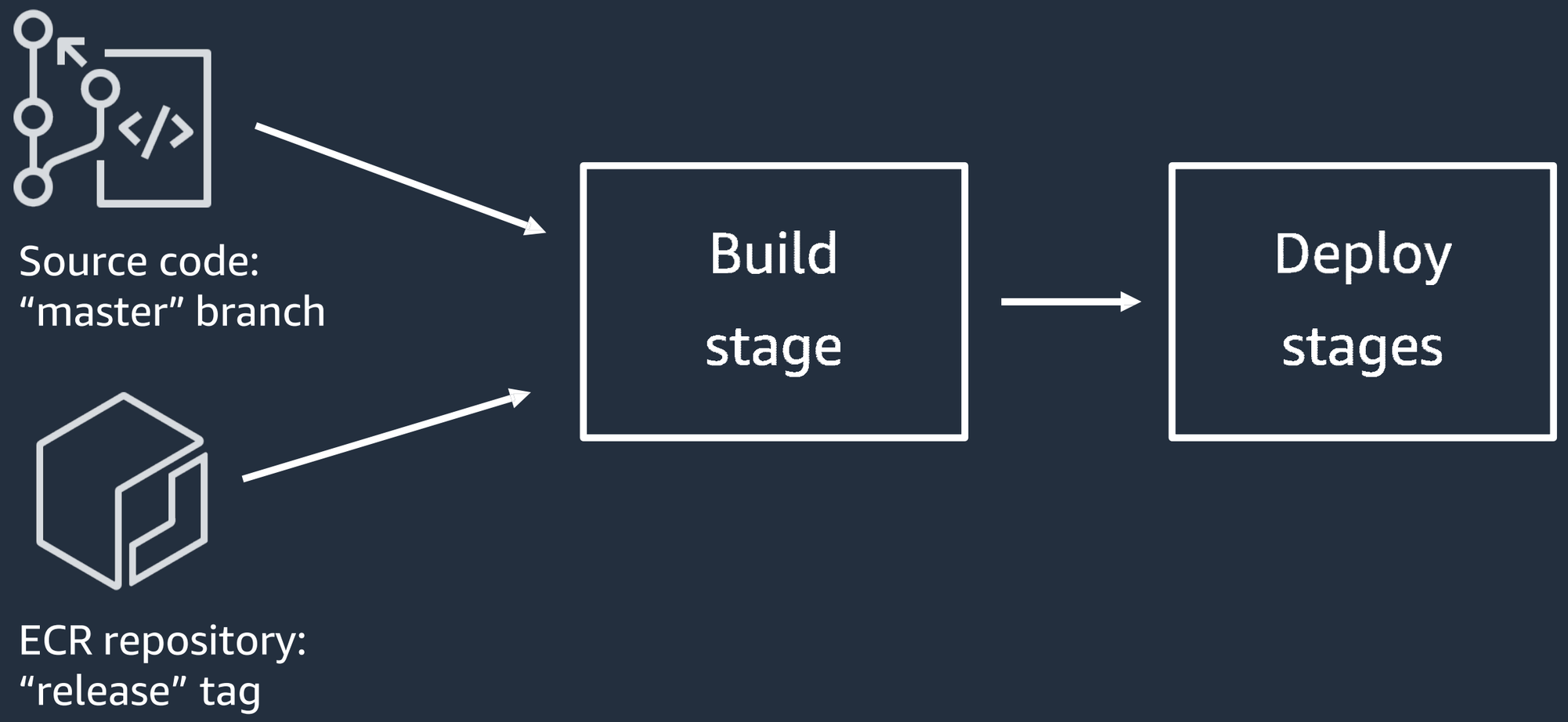
AWS CodePipeline: ECR source action



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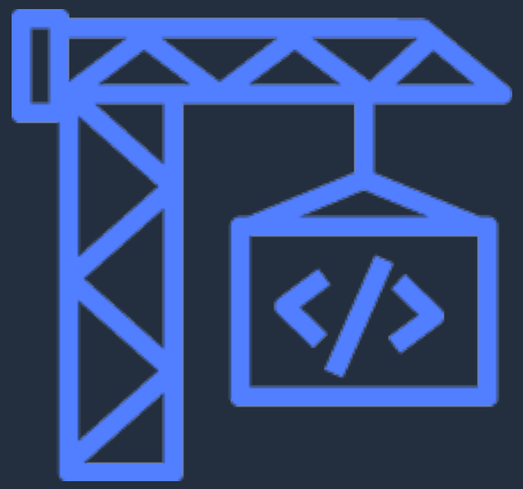
AWS CodeBuild



- 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: Docker buildspec

```
version: 0.2

phases:
  build:
    commands:
      - $(aws ecr get-login --no-include-email)
      - docker build -t $IMAGE_REPO_NAME:$IMAGE_TAG .
      - docker tag $IMAGE_REPO_NAME:$IMAGE_TAG $ECR_REPO:$IMAGE_TAG
      - docker push $ECR_REPO:$IMAGE_TAG
```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AWS CodeBuild: EKS buildspec

```
version: 0.2
phases:
  install:
    commands:
      - curl -sS -o aws-iam-authenticator https://amazon-eks.s3-us-west-2.amazonaws.com/1.10.3/2018-07-26/bin/linux/amd64/aws-iam-authenticator
      - curl -sS -o kubectl https://amazon-eks.s3-us-west-2.amazonaws.com/1.10.3/2018-07-26/bin/linux/amd64/kubectl
      - chmod +x ./kubectl ./aws-iam-authenticator
      - export PATH=$PWD/:$PATH
  -   apt-get update && apt-get -y install jq python3-pip python3-dev && pip3 install --upgrade
  awscli  pre_build:
      commands:
        - TAG="$REPOSITORY_NAME.$REPOSITORY_BRANCH.$ENVIRONMENT_NAME.$(date +%Y-%m-%d.%H.%M.%S).$(echo $CODEBUILD_RESOLVED_SOURCE_VERSION |
          head -c  8)"
        - sed -i 's@CONTAINER_IMAGE@'"$REPOSITORY_URI:$TAG"'@' hello-k8s.yml
        - $(aws ecr get-login --no-include-email)
  -     export KUBECONFIG=$HOME/.kube/config
  build:
    commands:
      - docker build --tag $REPOSITORY_URI:$TAG .

  post_build:
    commands:
      - docker push $REPOSITORY_URI:$TAG
      - CREDENTIALS=$(aws sts assume-role --role-arn $EKS_KUBECTL_ROLE_ARN --role-session-name codebuild-kubectl --duration-seconds 900)
      - export AWS_ACCESS_KEY_ID="$(echo ${CREDENTIALS} | jq -r '.Credentials.AccessKeyId')"
      - export AWS_SECRET_ACCESS_KEY="$(echo ${CREDENTIALS} | jq -r '.Credentials.SecretAccessKey')"
      - export AWS_SESSION_TOKEN="$(echo ${CREDENTIALS} | jq -r '.Credentials.SessionToken')"
      - export AWS_EXPIRATION=$(echo ${CREDENTIALS} | jq -r '.Credentials.Expiration')
      - aws eks update-kubeconfig --name $EKS_CLUSTER_NAME
      - kubectl apply -f hello-k8s.yml
-     printf '[{"name":"hello-k8s","imageUri":"%s"}]' $REPOSITORY_URI:$TAG >
build.json  artifacts:
  files: build.json
```


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AWS CodeBuild: Lambda buildspec

```
version: 0.2
phases:
  build:
    commands:
      - npm ci
      - npm test
      - >
          aws cloudformation package
            --template-file template.yml
             --output-template template-output.yml
             --s3_bucket $BUCKET
artifacts:
  type: zip
  files:
    - template-output.yml
```


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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

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AWS CodeDeploy: Amazon EC2 deployments

```yaml
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

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CodeDeploy-ECS appspec

```
version: 1.0
Resources:
    - TargetService:
        Type: AWS::ECS::Service
        Properties:
            - TaskDefinition: "my_task_definition:8"
              LoadBalancerInfos:
                    - ContainerName: "SampleApp"
                      ContainerPort: 80
Hooks:
    - BeforeInstall: "LambdaFunctionToExecuteAnythingBeforeNewRevisionInstalltion"
    - AfterInstall: "LambdaFunctionToExecuteAnythingAfterNewRevisionInstallation"
    - AfterAllowTestTraffic: "LambdaFunctionToValidateAfterTestTrafficShift"
    - BeforeAllowTraffic: "LambdaFunctionToValidateBeforeTrafficShift"
    - AfterAllowTraffic: "LambdaFunctionToValidateAfterTrafficShift"
```


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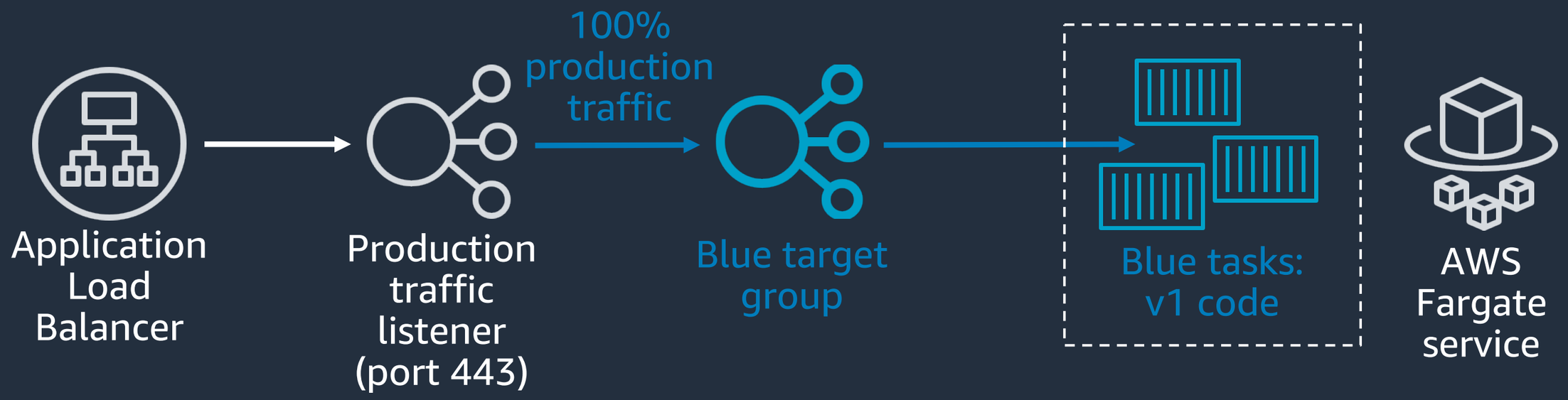
CodeDeploy: Amazon ECS blue/green deployment



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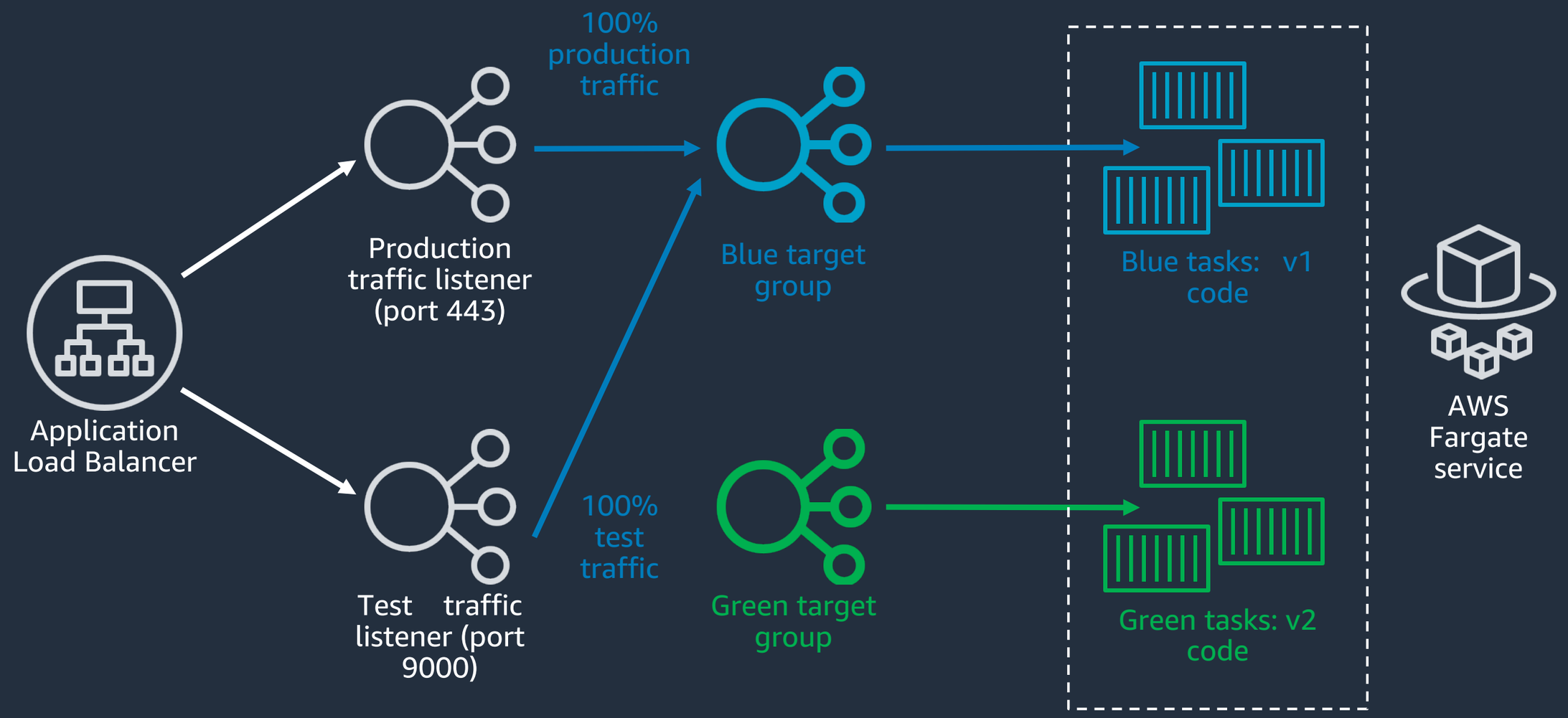
CodeDeploy: Amazon ECS blue/green deployment

Provision green tasks



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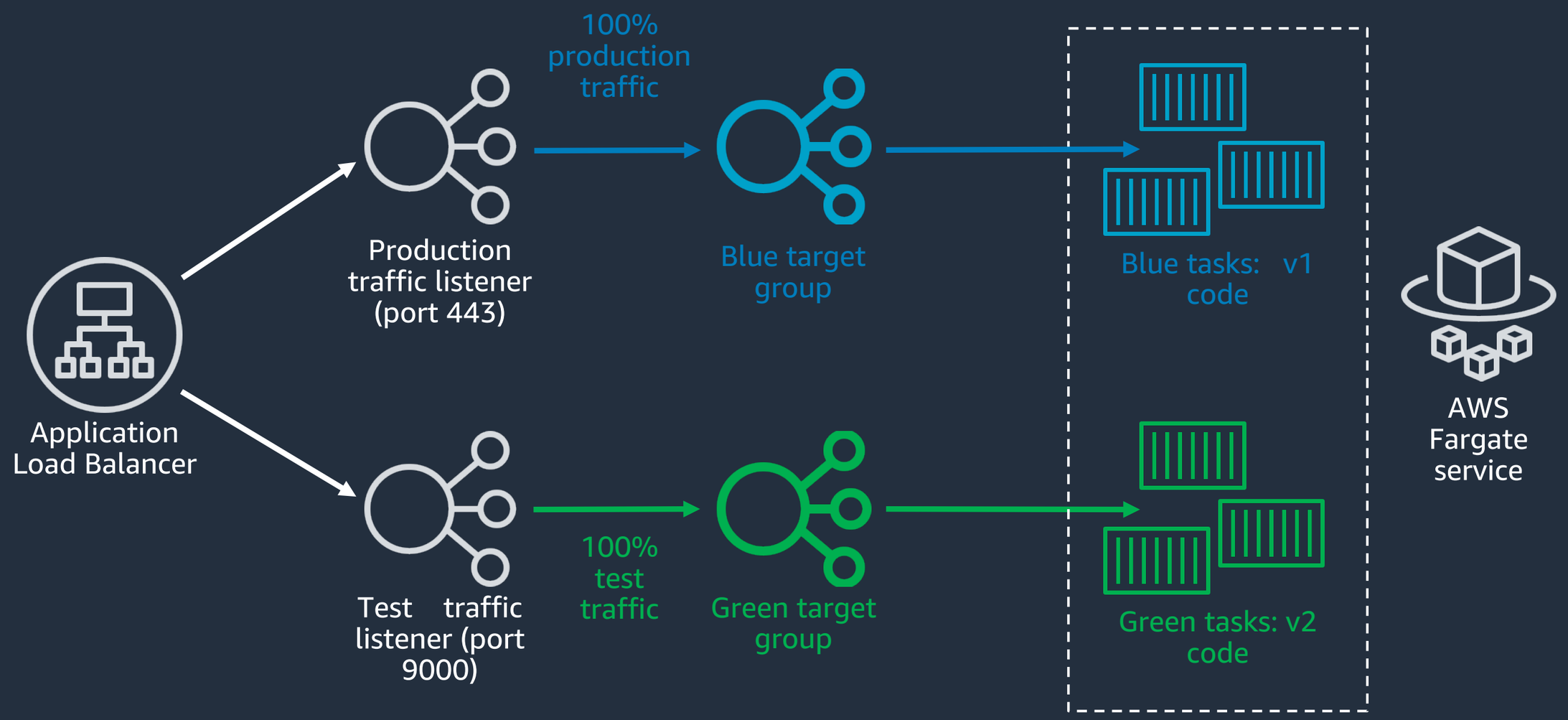
CodeDeploy: Amazon ECS blue/green deployment

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



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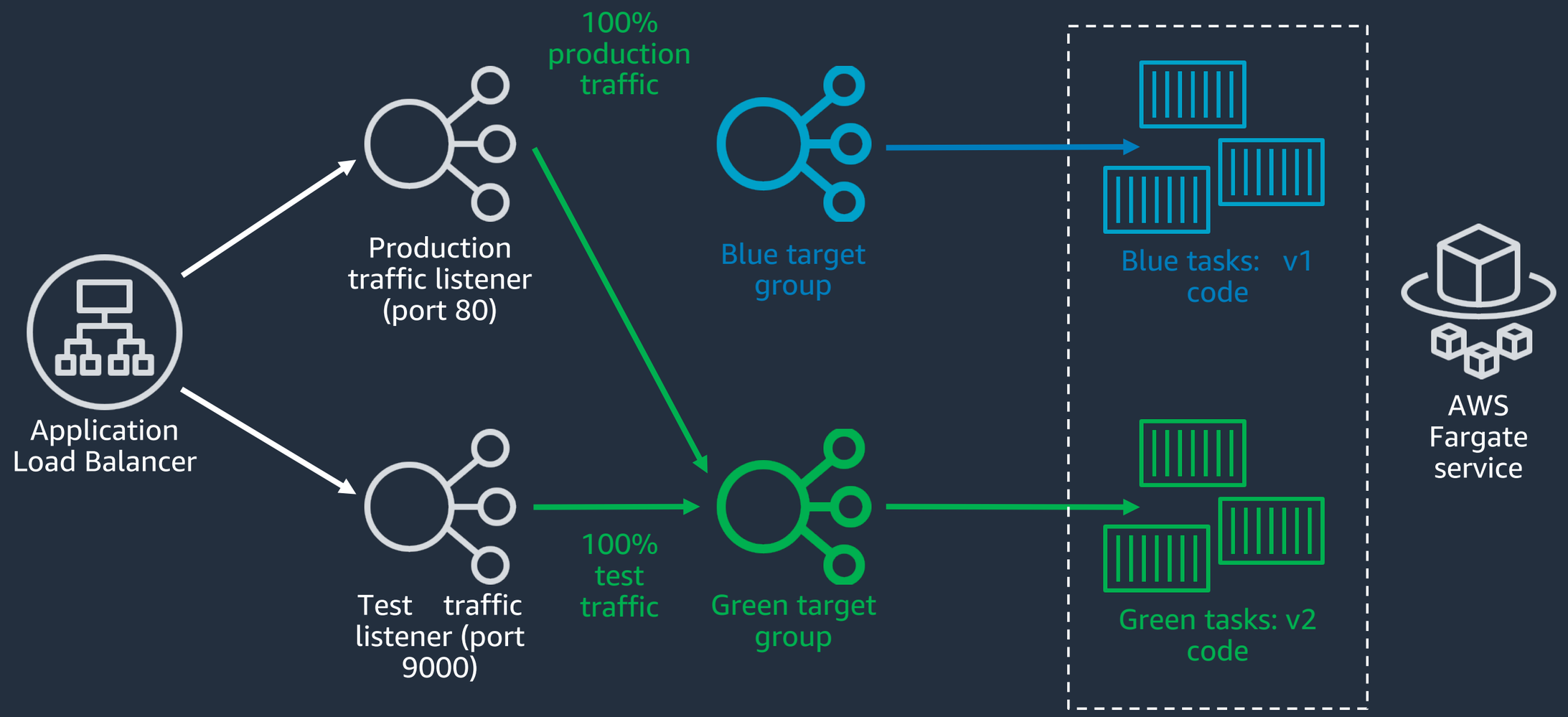
CodeDeploy: Amazon ECS blue/green deployment

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



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Container image tagging for deployments

- Docker tags are resolved when each container starts, not just during deployments
- Deploying “latest” or “prod” can result in untested code in production after a scale-out event
- Use unique “immutable” tags for deployments

CodeDeploy-Lambda deployments

Enable in your serverless application template

```
Resources:
  GetFunction:
    Type: AWS::Serverless::Function
    Properties:
      DeploymentPreference:
        Type: Canary10Percent10Minutes
        Alarms:
          - !Ref ErrorsAlarm
        Hooks:
          PreTraffic: !Ref PreTrafficHook
```


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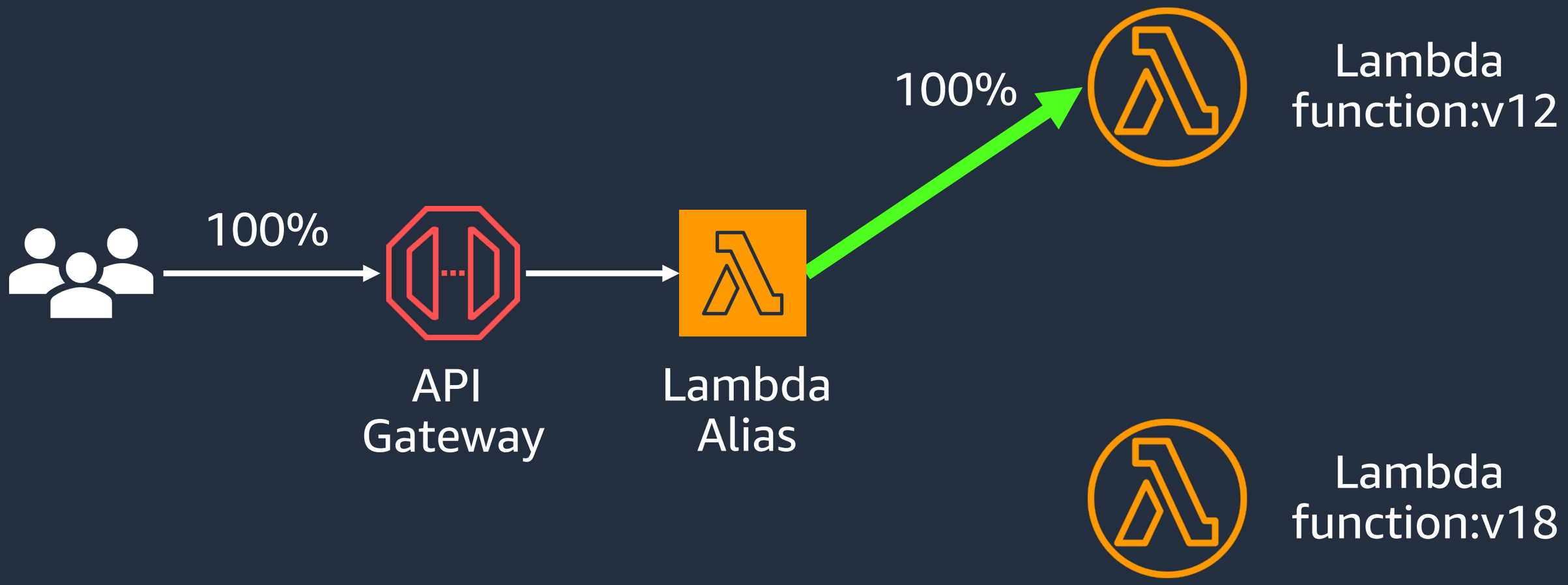
AWS CodeDeploy: AWS Lambda deployments



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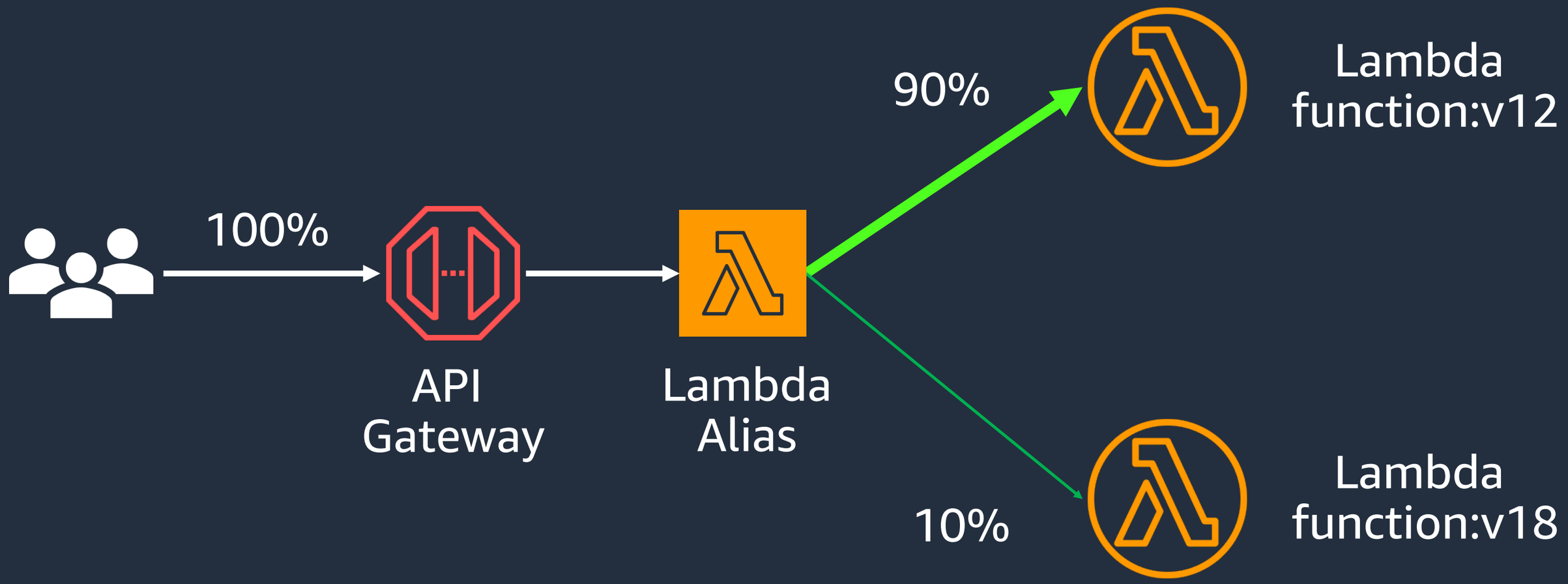
AWS CodeDeploy: AWS Lambda deployments



Canary: “shift 10% of traffic for 10 mins, then shift the rest”

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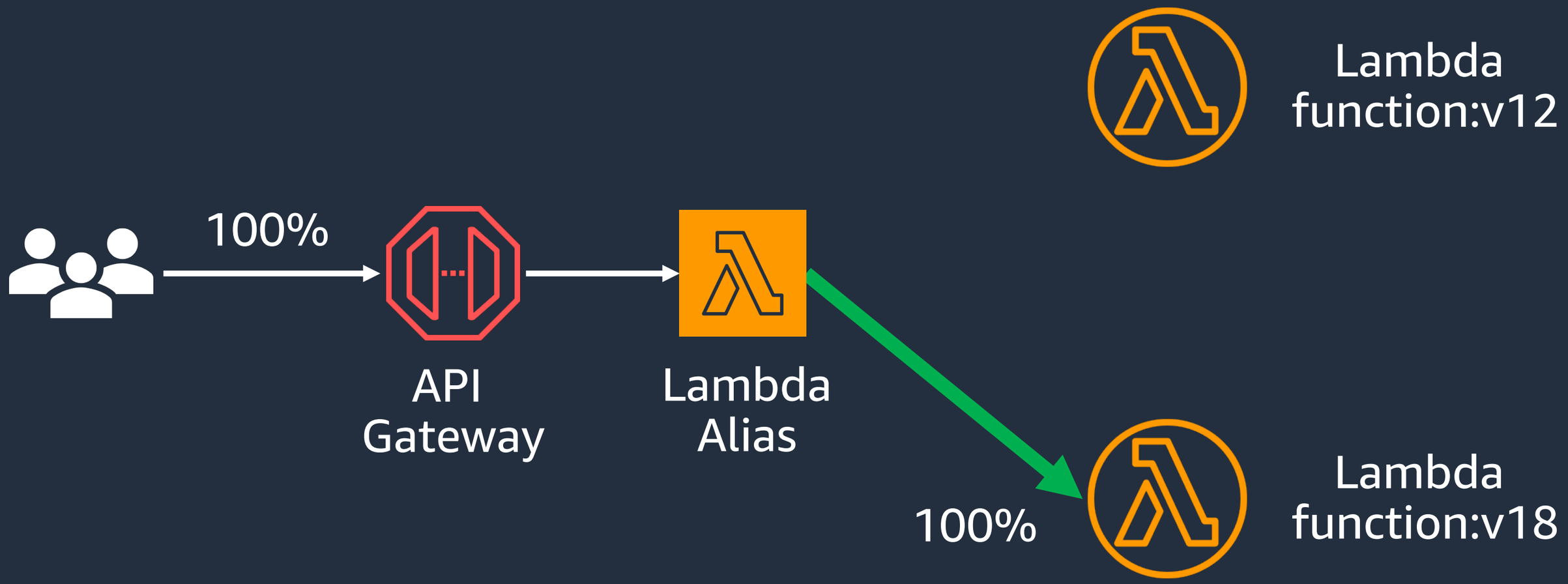
AWS CodeDeploy: AWS Lambda deployments



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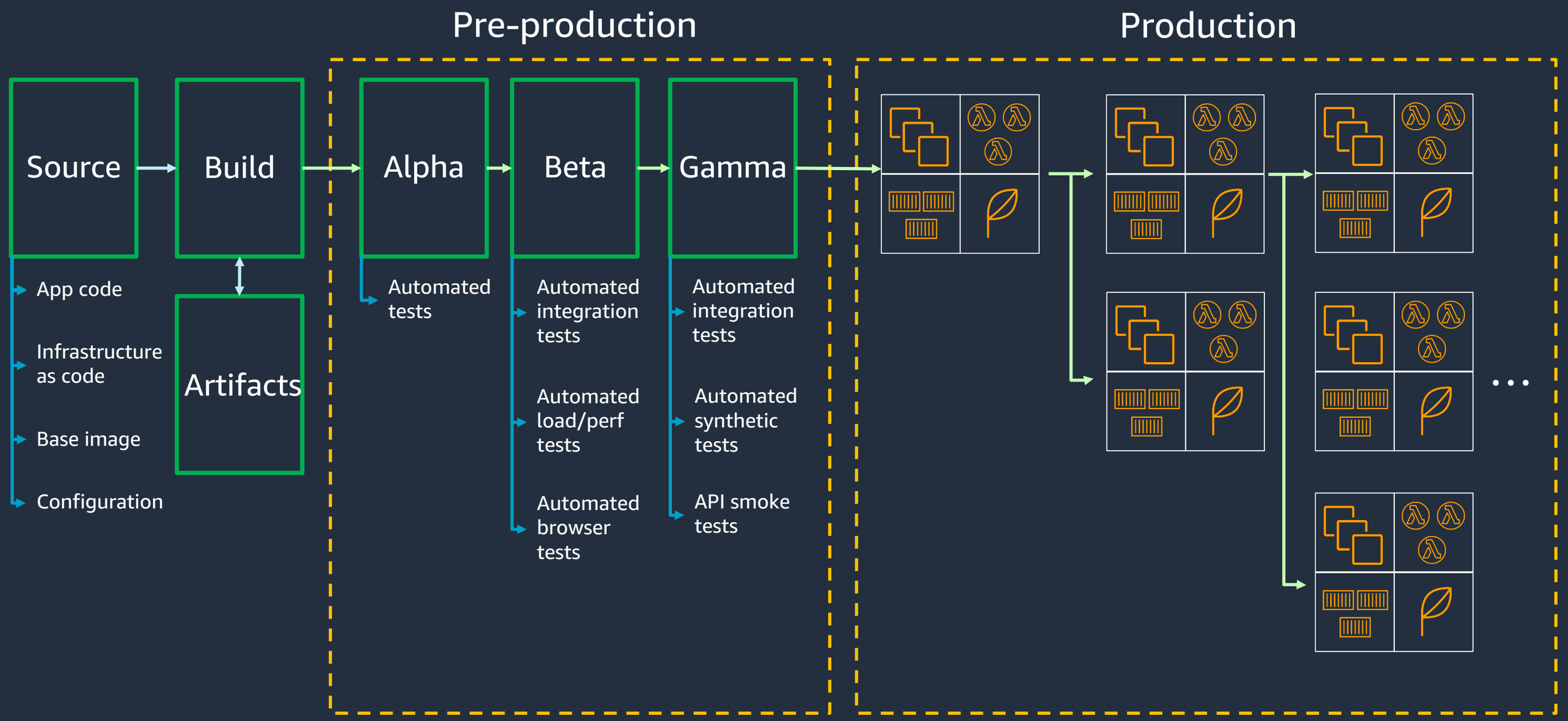

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AWS Cloud Development Kit (AWS CDK)

- Open-source framework to define cloud infrastructure in Typescript, Python, Java & .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

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

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CDK pipelines: Construct

```
export class MyMicroservicePipeline extends cdk.Construct {
    constructor(parent: cdk.Construct, name: string, props: MyMicroservicePipelineProps) {
        super(parent, name);

        const pipeline = new codepipeline.Pipeline(this, 'Pipeline', {
            pipelineName: props.serviceName,
        });

        const githubAccessToken = new cdk.SecretParameter(this, 'GitHubToken',
            { ssmParameter: 'GitHubToken' });
        new codepipeline.GitHubSourceAction(this, 'GitHubSource', {
            stage: pipeline.addStage('Source'),
            owner: 'myorg',
            repo: props.serviceName,
            oauthToken: githubAccessToken.value
        });
…
```


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CDK pipelines: Stack

```
import cdk = require('@aws-cdk/cdk');
import { MyMicroservicePipeline } from './pipeline';

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

        new MyMicroservicePipeline(this, 'Pipeline1', { 'serviceName': 'Microservice1' });
        new MyMicroservicePipeline(this, 'Pipeline2', { 'serviceName': 'Microservice2' });
        new MyMicroservicePipeline(this, 'Pipeline3', { 'serviceName': 'Microservice3' });
        new MyMicroservicePipeline(this, 'Pipeline4', { 'serviceName': 'Microservice4' });
    }
}
const app = new cdk.App();
new MyMicroservicePipelinesStack(app, 'MyMicroservicePipelines');
app.run();
```


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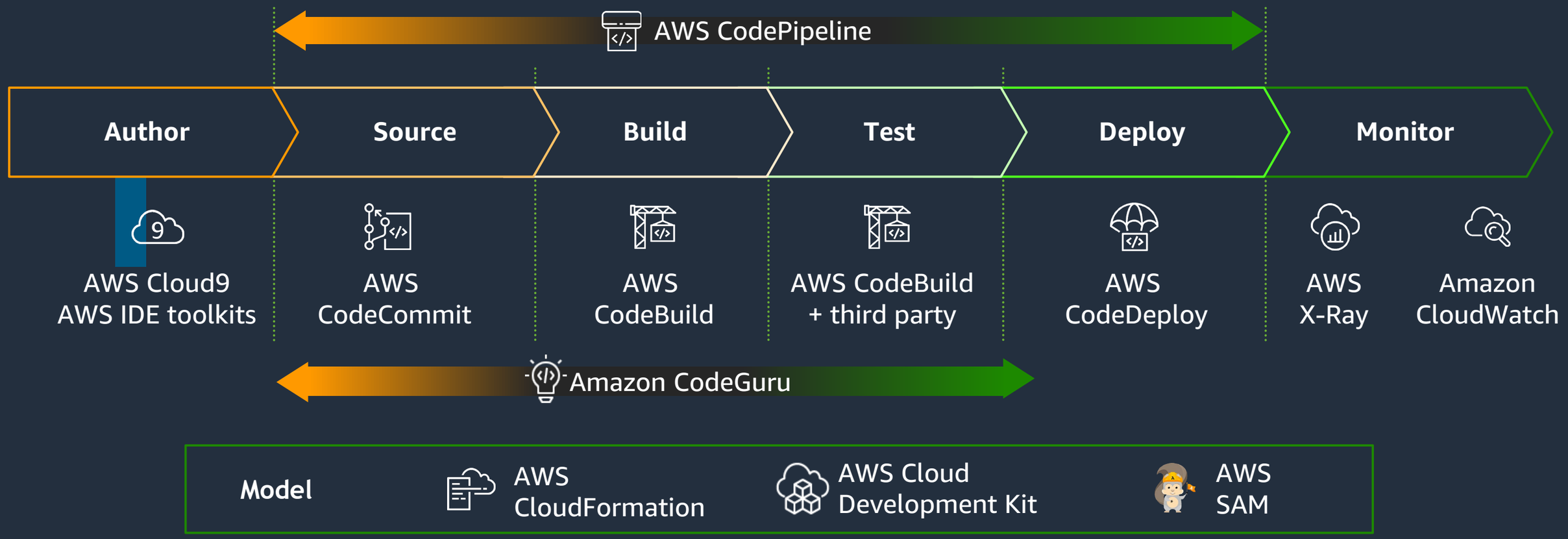
CI/CD for modern software delivery



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[1] 451 Research, *Demystifying Cloud Transformation: Where Enterprises Should Start*, September 2019.

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