AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

DOP301

How to reuse patterns when developing infrastructure as code

Brian Terry (he, him)
Senior Developer Advocate – AWS CloudFormation
Amazon Web Services

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“Good programmers know what to write. Great ones know what to rewrite (and reuse).”

Eric S. Raymond

American software developer, open-source software advocate

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Agenda

About me

Challenge

Options

Leveling up reuse patterns

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About me

Brian Terry – @ineedhelpbrian; brianter@amazon.com

- Sr. Developer Advocate, AWS CloudFormation
- Athens, GA
- Previously
  - Sr. AWS Partner Solutions Architect, Segment Tech Lead CMT
  - DevOps Engineer, Seller Labs
  - Over 20 years' experience as a developer
- Education
  - B.S. Computer Science, M.Ed. Instructional Design and Technology – University of Georgia
  - M.S. Computer Science – University of West Georgia
- 9 AWS Certifications



aws

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How did I get started with CloudFormation?

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From one simple request . . .

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1) What is AWS?
2) What is CloudFormation?



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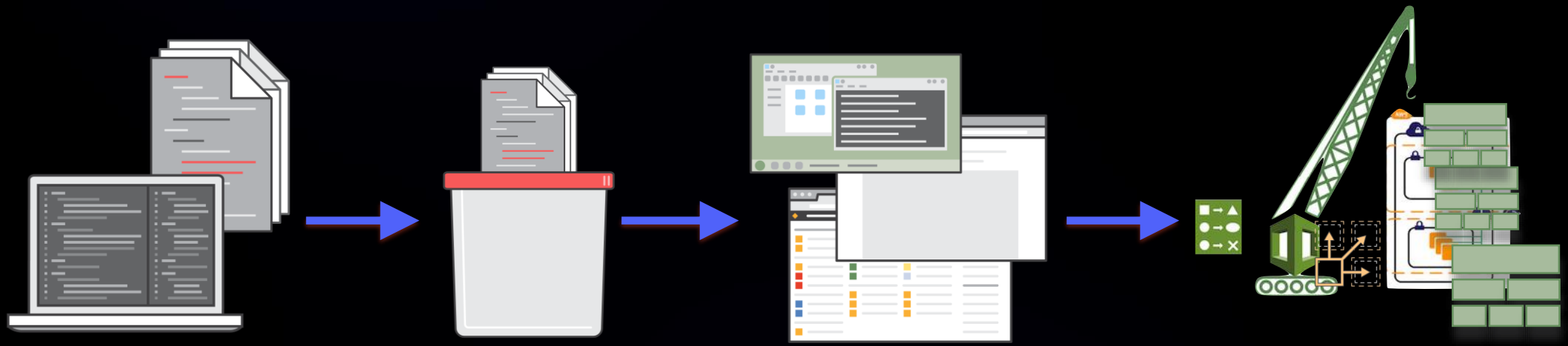


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IaC recap



Code in YAML or JSON directly or use sample templates

Upload local files or from an Amazon S3 bucket

Create stack using console, API, or CLI

Stacks and resources are provisioned

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New message

To brianter@amazon.com

Subject Infrastructure request



Hey Brian,

This is Sam from R&D. We need a deployment pipeline for our new service. Can you create and deploy this **by the end of the week?**

Best,
Sam

Challenges

- Builders are spending too much time trying to figure out resource intricacies and best practices
- Applications often share common architectural elements
  - For example, one or more Lambda functions that can read/write to an Amazon DynamoDB table
- Modeling infrastructure becomes repetitive; “reimplementing the wheel”
  - Defining and configuring each service
  - Integrating with other services
  - Adhering to best practices
- Takes valuable development time from building unique features

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AWS to the rescue

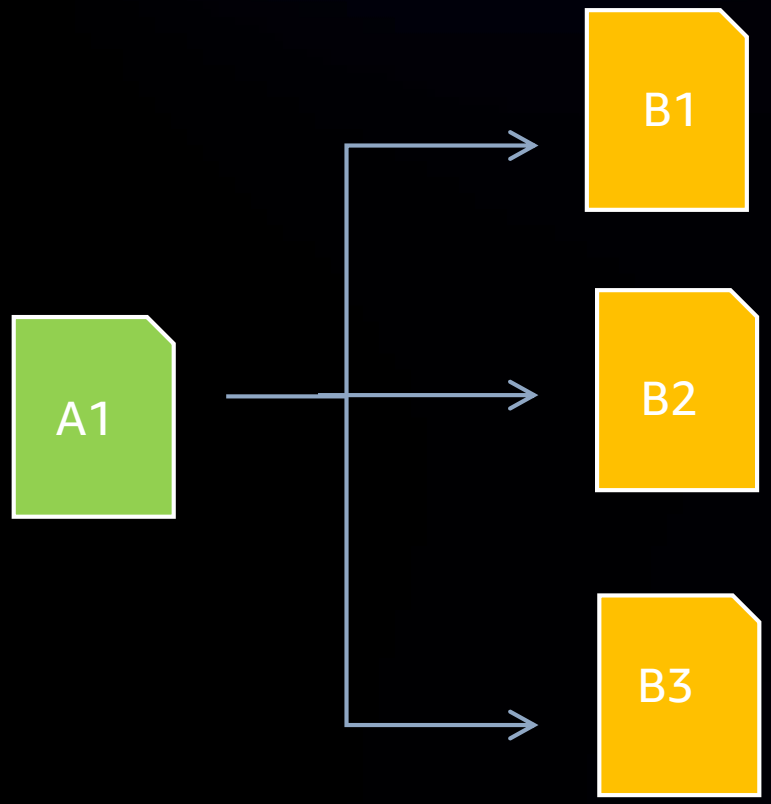




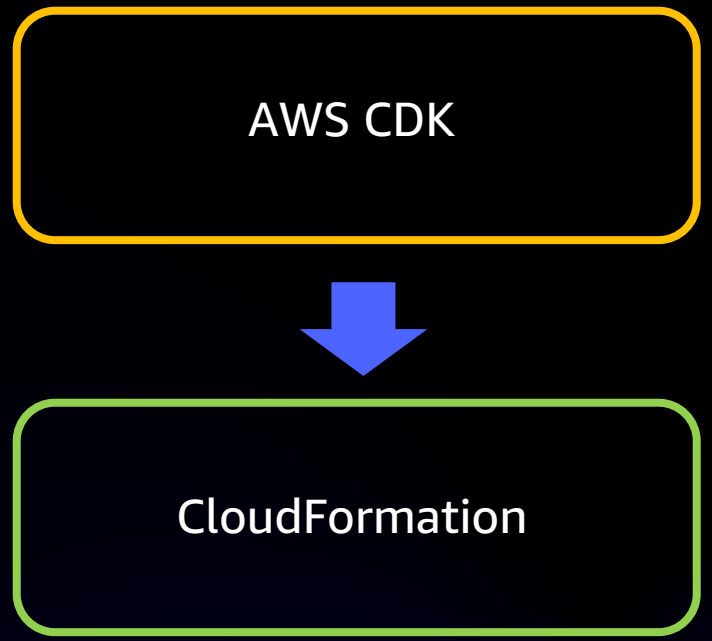
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AWS to the rescue

CloudFormation modules



AWS Cloud Development Kit (AWS CDK)



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CloudFormation modules

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What are modules and why should I use them?



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Modules

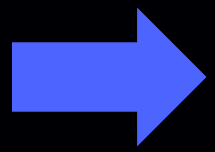
- Encapsulate common solutions
- Opinionated best practices
- Reuse across an organization

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Example

```
{
    "Description": "AWS::S3::BucketPrivateAccess::Module -
 provisions a bucket with Private Access Control",
    "Parameters": {
        "VersionConfigInputParameter": {
            "Description": "VersioningConfiguration",
            "Type": "String",
            "AllowedValues": [
                "Enabled",
                "Suspended"
            ]
        }
    },
    "Resources": {
        "MyPrivateBucket": {
            "Type": "AWS::S3::Bucket",
            "Properties": {
                "AccessControl": "Private",
                "VersioningConfiguration": {
                    "Status": {
                        "Ref": "VersionConfigInputParameter"
                    }
                }
            },
            "DeletionPolicy": "Delete"
        }
    },
    "Outputs": {
        "BucketNameOutput": {
            "Value": {
                "Ref": "MyPrivateBucket"
            },
            "Description": "Output the name of the bucket"
        }
    }
}
```

CloudFormation template JSON/YAML



```
AWSTemplateFormatVersion: 2010-09-09
Description: “Template that uses resources and a module"
Resources:
  myKey:
    Type: AWS::KMS::Key
    Properties:
      …
  S3Module:
    Type: AWS::S3::BucketPrivateAccess::Module
    Properties:
      VersionConfigInputParameter: Enabled
…
```

Reusable module in template JSON/YAML

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Using the module

- Used in the Resources section of the template
- Differentiated from resources by having a 4th section type that ends in “Module”
- Templates that use modules can be in JSON or YAML

```
AWSTemplateFormatVersion: 2010-09-09
Description: “Template that uses resources and a module"
Resources:
  myKey:
    Type: AWS::KMS::Key
    Properties:
      …
  S3Module:
    Type: AWS::S3::BucketPrivateAccess::Module
    Properties:
       VersionConfigInputParameter: Enabled
…
```

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The schema

Template Fragment

```
{
    "Description": "AWS::S3::BucketPrivateAccess::Module -
 provisions a bucket with Private Access Control",
    "Parameters": {
        "VersionConfigInputParameter": {
            "Description": "VersioningConfiguration",
            "Type": "String",
            "AllowedValues": [
                "Enabled",
                "Suspended"
            ]
        }
    },
    "Resources": {
        "MyPrivateBucket": {
            "Type": "AWS::S3::Bucket",
            "Properties": {
                "AccessControl": "Private",
                "VersioningConfiguration": {
                    "Status": {
                        "Ref": "VersionConfigInputParameter"
                    }
                }
            },
            "DeletionPolicy": "Delete"
        }
    },
    "Outputs": {
        "BucketNameOutput": {
            "Value": {
                "Ref": "MyPrivateBucket"
            },
            "Description": "Output the name of the bucket"
        }
    }
}
```

Modules can contain other modules as well

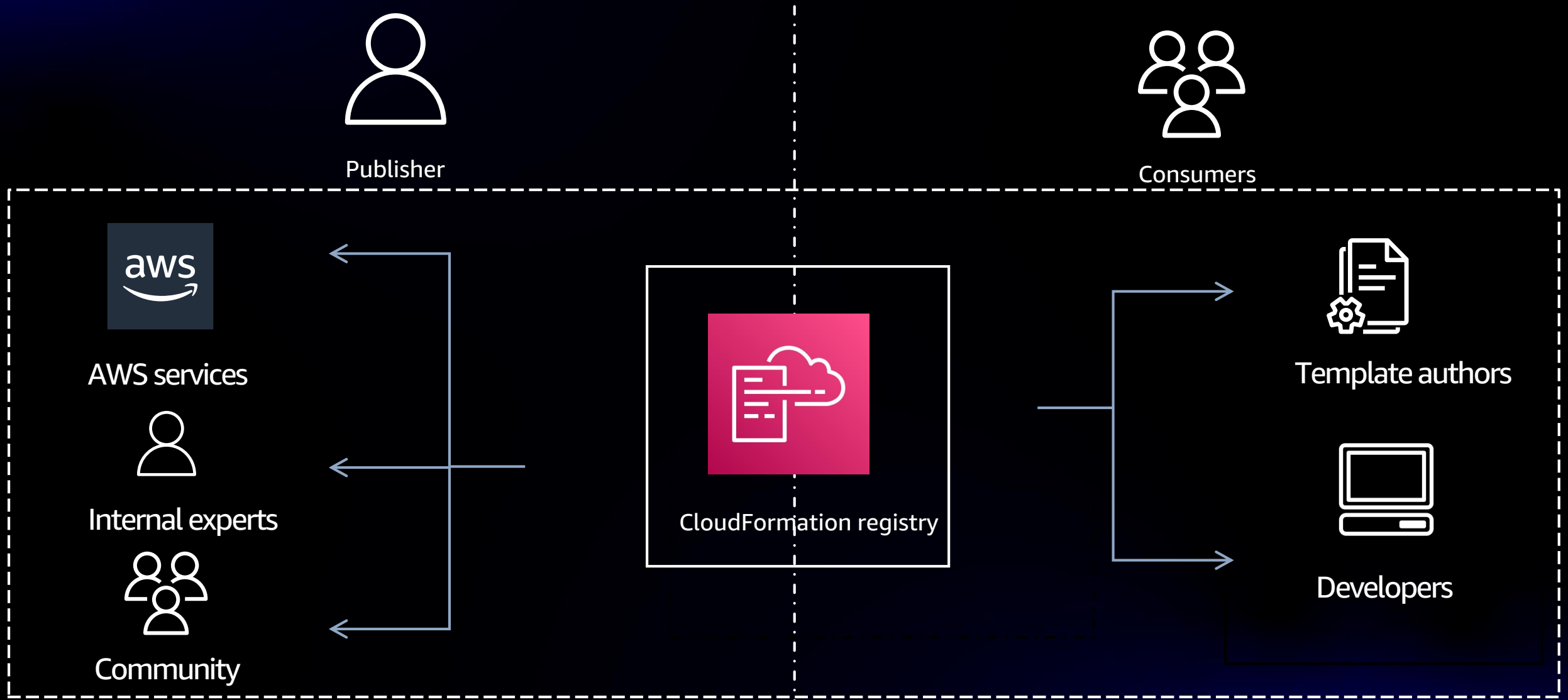
```
{
    "typeName": "AWS::S3::BucketPrivateAccess::Module",
    "description": "Schema for a simple S3 module",
    "sourceUrl": "https://github.com/aws-cloudformation/aws-
cloudformation-module-simple-s3",
    "parameters": {
        "VersionConfigInputParameter": {
            "description": "Version Configuration",
            "type": "string",
            "minLength": 1,
            "maxLength": 10,
            "pattern": "[a-zA-Z0-9]{1,10}"
        },
    },
    "resources": {
        "MyPrivateBucket": {
            "$ref": "aws-s3-bucket.json"
        },
    },
    "outputs": {
        "BucketOutput": {
            "description": "Bucket name output",
            "type": "string"
        }
    }
}
```

Auto-generated using CloudFormation-CLI

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Modules platform model



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Who does this benefit?

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Everyone!

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Benefits everyone



Publisher

- Encapsulate and **share best practices** across your organization
- **Distribute** updates using native version management



Consumers

- Effortlessly **adhere to best practices** and guidelines
- **Abstract away** resource intricacies for easier authoring
- Leverage **reusable** template code to reduce development time
- Build your infrastructure and applications with **modular** components

aws

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Module availability



Private registry

Contains modules only available to your account



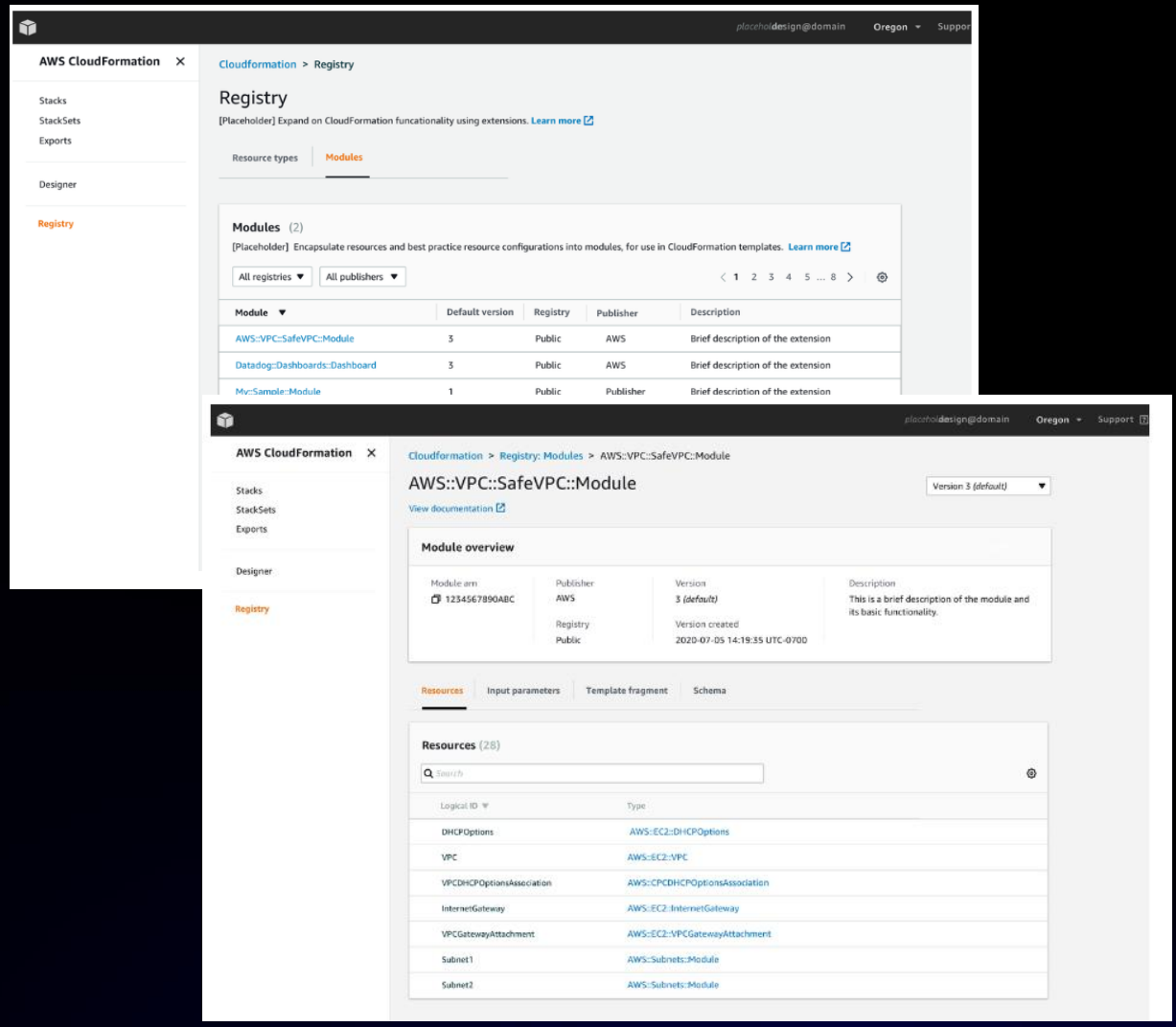
Public registry

Contains modules that are publicly available

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CloudFormation registry

- Modules are a CloudFormation registry extension type, just like a resource
- Modules are listed on the console and provide details into the version, description, and publisher
- Clicking on a module displays additional details including the resource, parameters, and schema



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Things to note



- Modify module’s input parameter values
- ‘Ref’ resources inside the module
- ‘Fn::GetAtt’ attributes inside the module
- Resources or properties **can’t** be modified

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New message

To brianter@amazon.com

Subject Infrastructure request

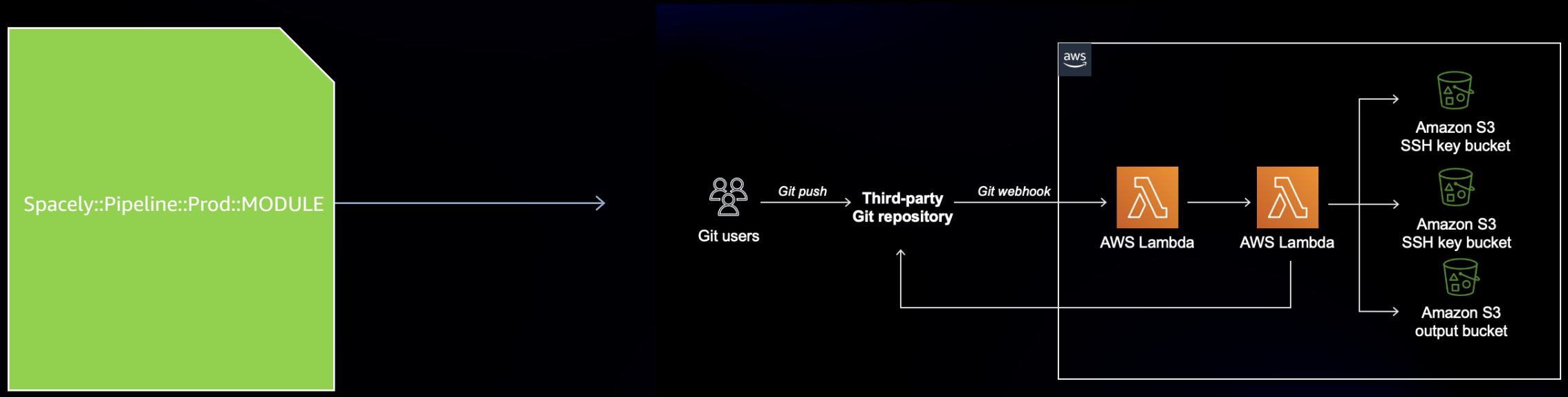


Hey Brian,

This is James from the frontend team. We need a deployment pipeline for our Angular app. We need to host this app on S3, and it needs to be **ready in two days!**

Best,
James

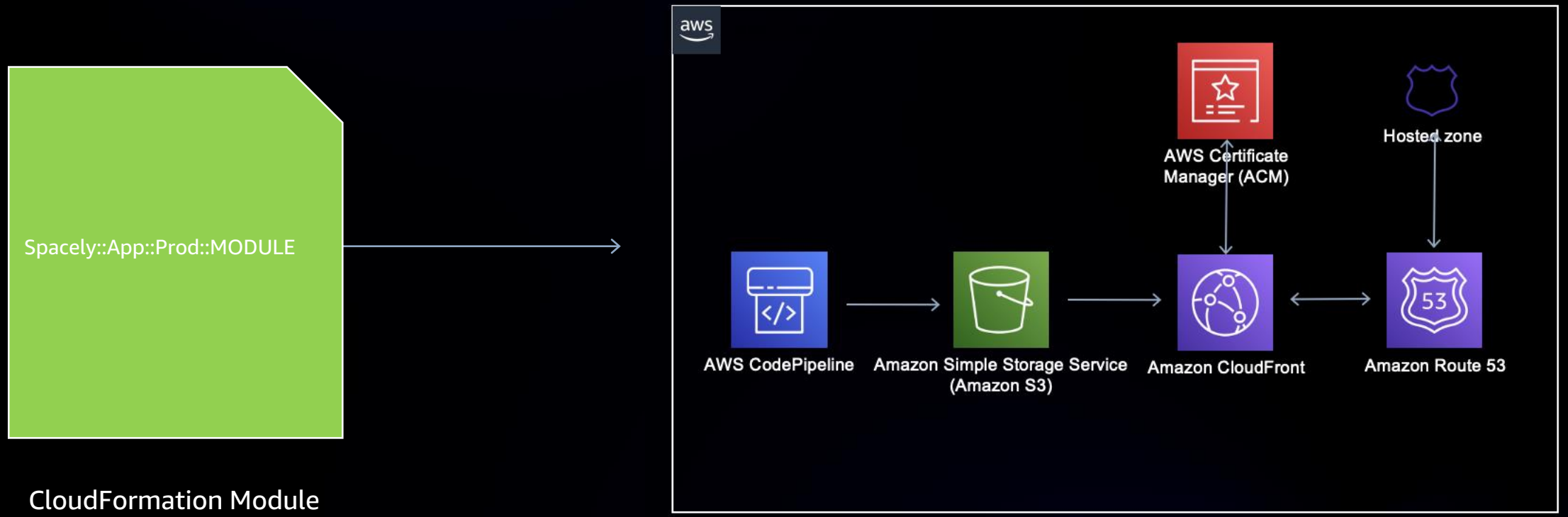
Architecture: Git to S3 webhooks expanded



CloudFormation Module

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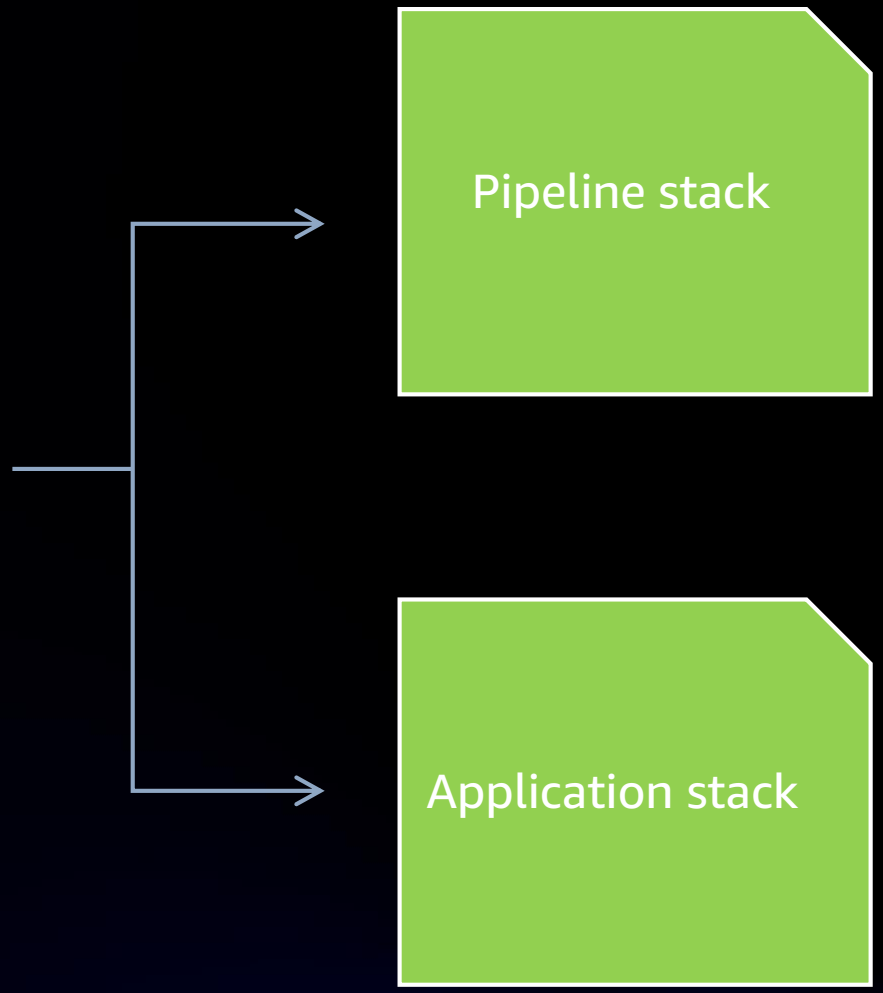
Architecture: Git to S3 webhooks expanded



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Architecture: Git to S3 webhooks expanded

```
"Resources": {
      "App": {
         "Type": "Spacely::Pipeline::Prod::MODULE",
         "Properties": {
            ....
         }
      },
      "Pipeline": {
         "Type": "Spacely::App::Prod::MODULE",
         "Properties": {
            ...
         }
      }
   },
```



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AWS CDK



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AWS CDK

A MULTI-LANGUAGE SOFTWARE DEVELOPMENT FRAMEWORK FOR MODELING CLOUD INFRASTRUCTURE AS REUSABLE COMPONENTS

```
class UrlShortener extends Stack {
  constructor(scope: App, id: string, props?: UrlShortenerProps) {
    super(scope, id, props);

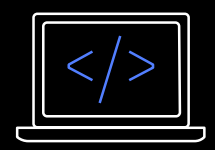
    const vpc = new ec2.Vpc(this, 'vpc', { maxAzs: 2 });
    const cluster = new ecs.Cluster(this, 'cluster', { vpc: vpc });
    const service = new patterns.NetworkLoadBalancedFargateService(this, 'sample-app', {
      cluster,
      taskImageOptions: {
        image: ecs.ContainerImage.fromAsset('ping'),
      },
      dom
    });
                domainName
                domainZone
    // Setup AutoScaling policy
    const scaling = service.service.autoScaleTas
    scaling.scaleOnCpuUtilization('CpuScaling',
      targetUtilizationPercent: 50,
      scaleInCooldown: Duration.seconds(60),
      scaleOutCooldown: Duration.seconds(60)
    });
  }
}
```

```
(property) patterns.NetworkLoadBala
ncedServiceBaseProps.domainName?: s
tring | undefined

The domain name for the service, e.g.
"api.example.com."

@default

- No domain name.
```



Familiar
Your language
Just code



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AutoComplete
Inline documentation



Abstraction
Sane defaults
Reusable classes





Java



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```

```
domainName
domainZone
```

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Reusable classes

Java

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AWS CDK

A MULTI-LANGUAGE SOFTWARE DEVELOPMENT FRAMEWORK FOR MODELING CLOUD INFRASTRUCTURE AS REUSABLE COMPONENTS

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      scaleOutCooldown: Duration.seconds(60)
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```

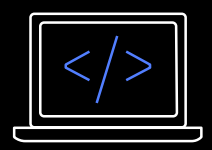
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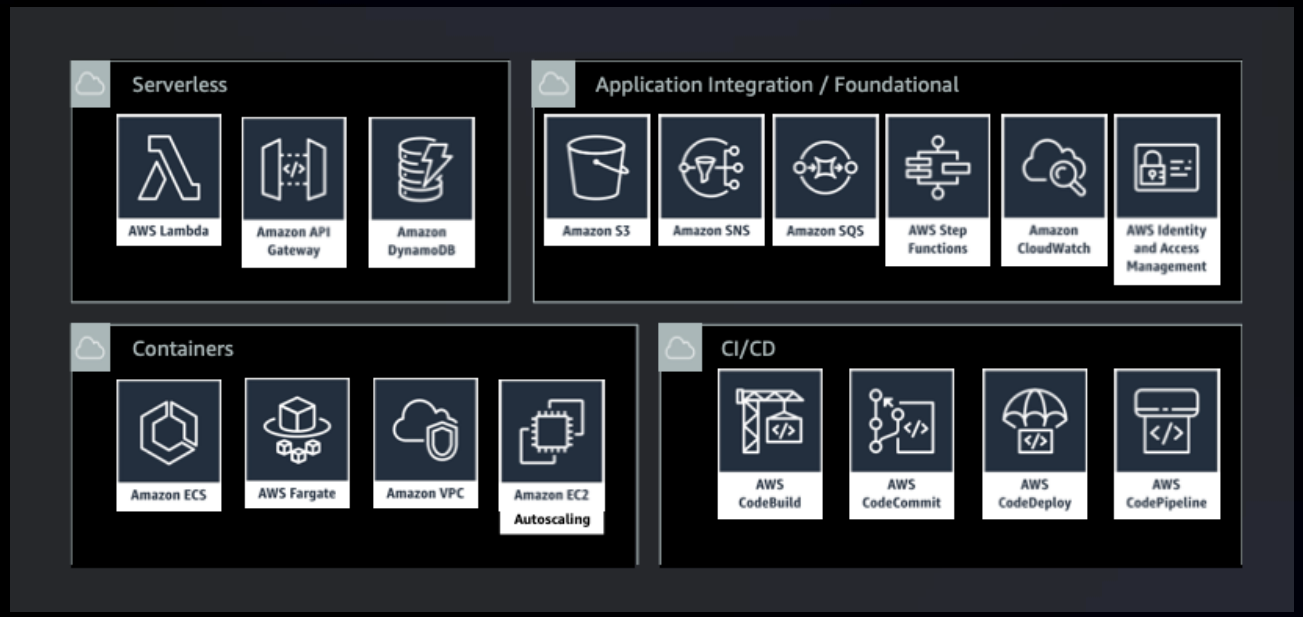


Java



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AWS Construct Library



New GA modules

- Amazon Cognito user pools
- Amazon Kinesis
- Amazon Relational Database Service (Amazon RDS)
- Amazon Route 53 patterns
- AWS CloudTrail
- AWS Config
- AWS Step Functions
- Custom resources

New dev preview modules

- AWS App Mesh
- AWS AppSync
- AWS CDK Pipelines
- Amazon CloudFront
- Amazon CloudWatch Synthetics
- Amazon Elastic Kubernetes Service (Amazon EKS)

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Emerging ecosystem

DEFINE COMPOSABLE CONFIGURATION MODELS THROUGH CODE

AWS Solutions Constructs

Vetted, configurable, higher-level infrastructure-as-code patterns **provided by AWS Solutions Architecture group**

aws.amazon.com/solutions/constructs

Deeper dive



Turbocharge the AWS CDK with AWS Solutions Constructs

CDK Patterns

A catalog of higher-level constructs **provided by CDK community members**

cdkpatterns.com/

@CDKPATTERNS



Awesome CDK

Central **"awesome list"** for CDK Open-source projects, guides, blogs, and resources

github.com/kolomied/awesome-cdk



AWS Construct Library

Constructs provided by the **AWS CDK team** to encapsulate a single service's configuration interface

aws.amazon.com/cdk/

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Go CDK

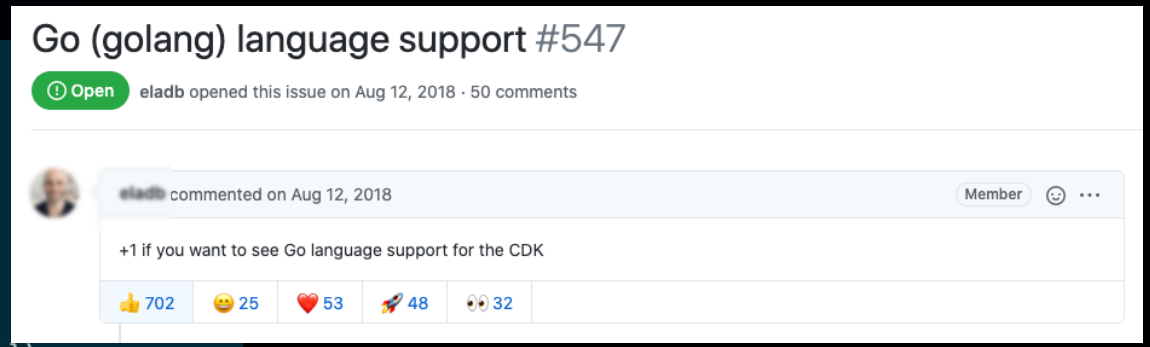
```go
func main() {
  app := cdk.NewApp()
  stack := cdk.NewStack(app, "aws-ecs-integ-ecs")

  // Create a cluster
  vpc := ec2.NewVpc(stack, "Vpc", ec2.VpcProps{MaxAzs: 2})

  cluster := ecs.NewCluster(stack, "EcsCluster", ecs.ClusterProps{Vpc: vpc})
  cluster.addCapacity("DefaultAutoScalingGroup", ecs.AddCapacityOptions{
    InstanceType: ec2.InstanceClass.T2,
    InstanceSize: ec2.InstanceSize.MICRO,
  })

  // Create Task Definition
  taskdefinition := ecs.NewEc2TaskDefinition(stack, "TaskDef")
  container := taskdefinition.AddContainer("web", ecs.AddContainerOptions{
    Image:          ecs.ContainerImage.fromRegistry("amazon/amazon-ecs-sample"),
    MemoryLimitMiB: 256,
  })

  container.AddPortMappings([]ecs.PortMapping{
    {
      ContainerPort: 80,
      HostPort:      8080,
      Protocol:      ecs.Protocol.TCP,
    },
  })
```





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New message

To brianter@amazon.com

Subject Infrastructure request



Hey Brian,

This is Mary from the backend team. We need a deployment pipeline for our Angular monitoring dashboard. Can you create the CDK Constructs? **We need it in 2 hours.** Sorry for the rush!

Best,
Mary

Thank you!

Brian Terry

Twitter: @ineedhelpbrian
brianter@amazon.com

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