AWS Summit DC 2022 - Accelerate cloud-native development with AWS CDK custom constructs

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AWS Summit DC 2022 - Accelerate cloud-native development with AWS CDK custom constructs

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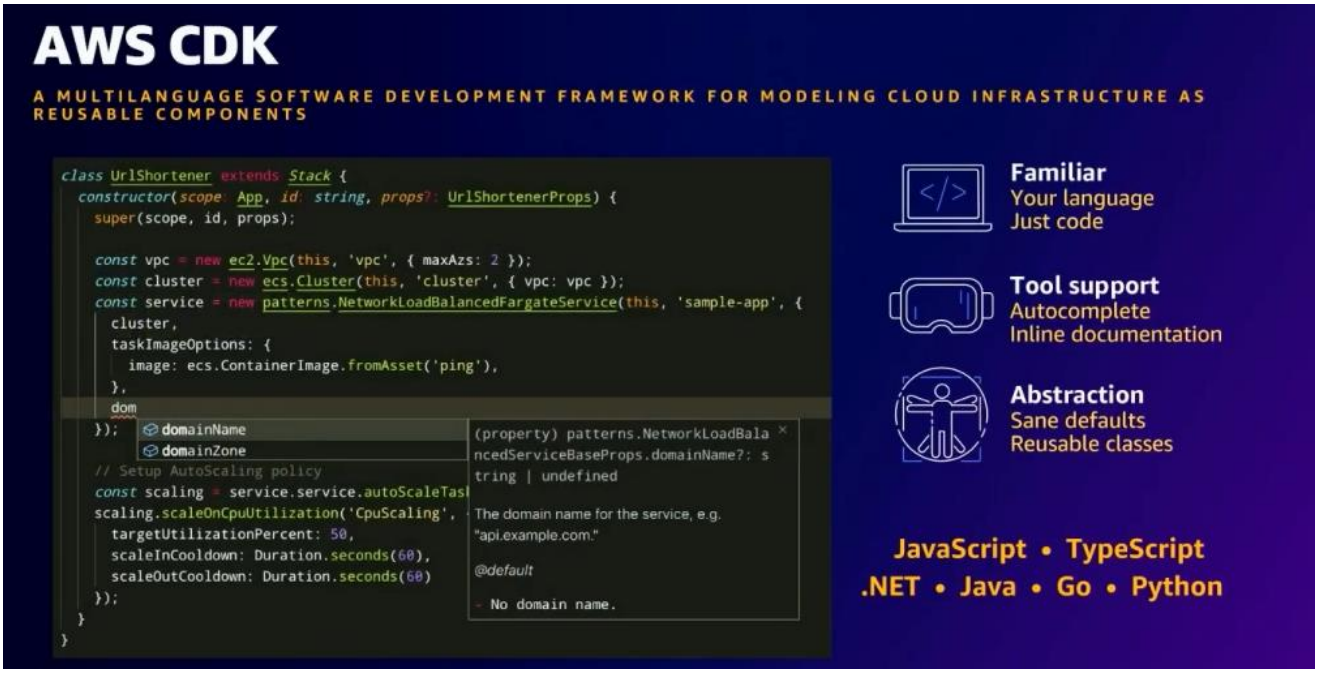
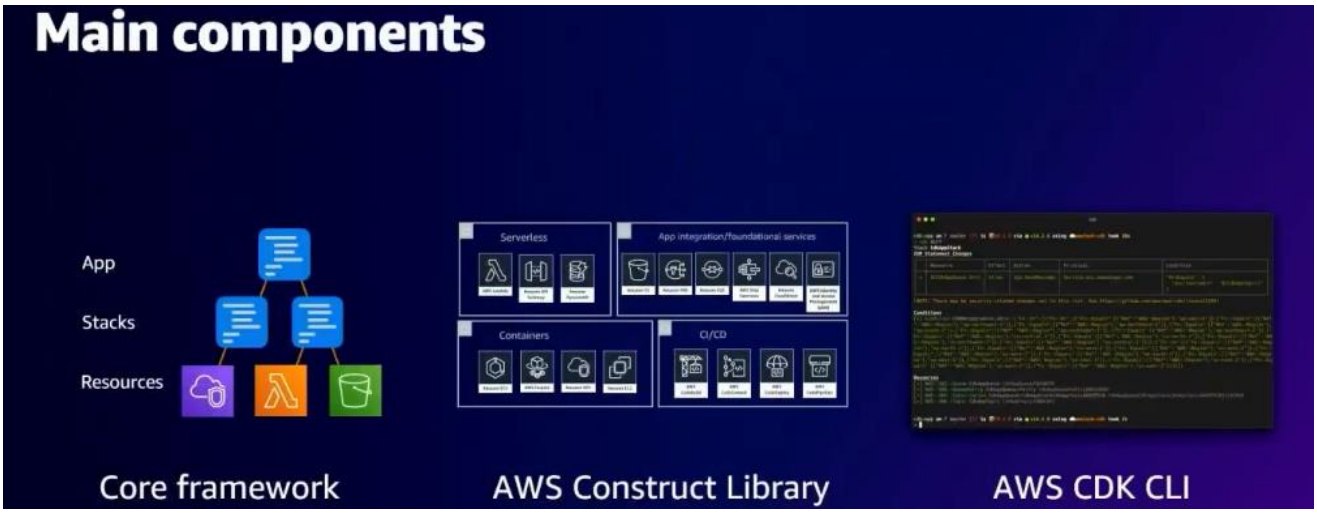
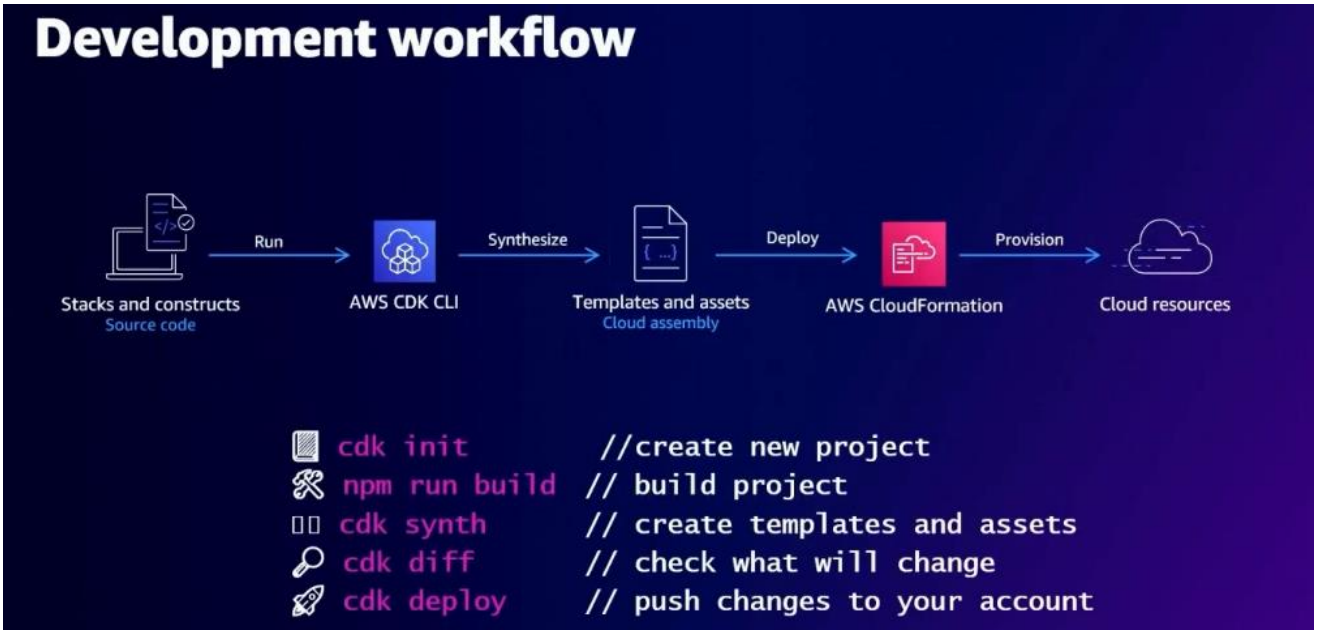
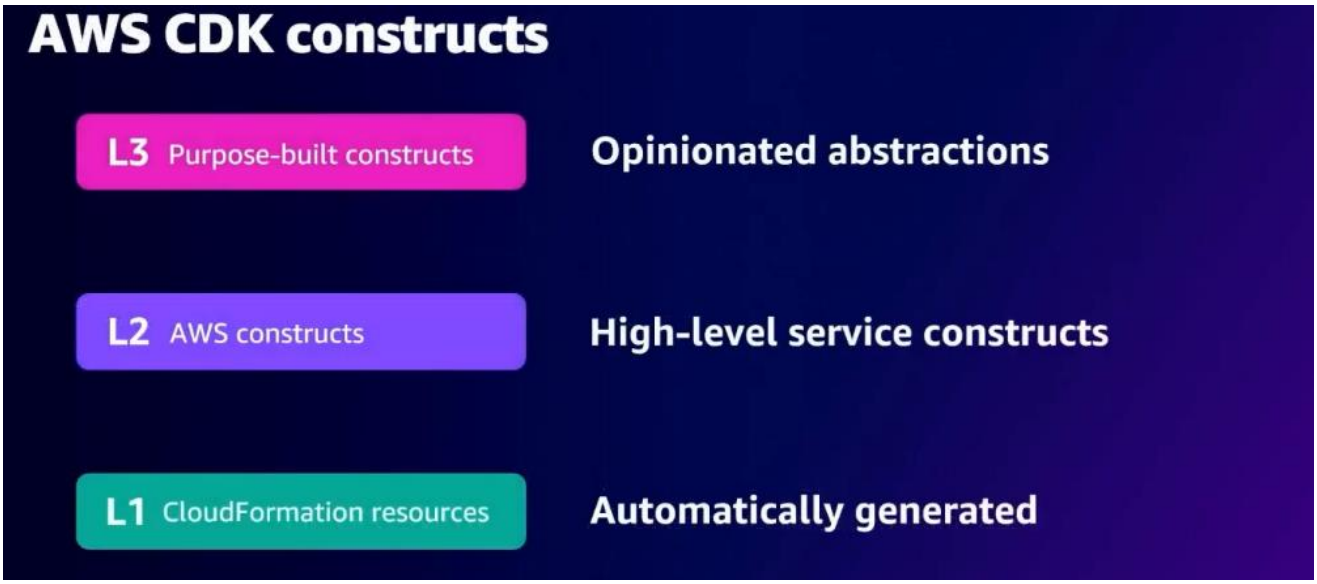
Developers starting a new project on AWS have several choices to make. Selecting services and configuring them to follow AWS best practices and organizational standards requires both time and experience. In this session, dive into how PowerSchool developed AWS Cloud Development Kit (CDK) custom constructs to quickly build and deploy well-architected cloud-native apps. This effort lowered the barriers for application development teams to start building on AWS and accelerated the development of dozens of new projects.



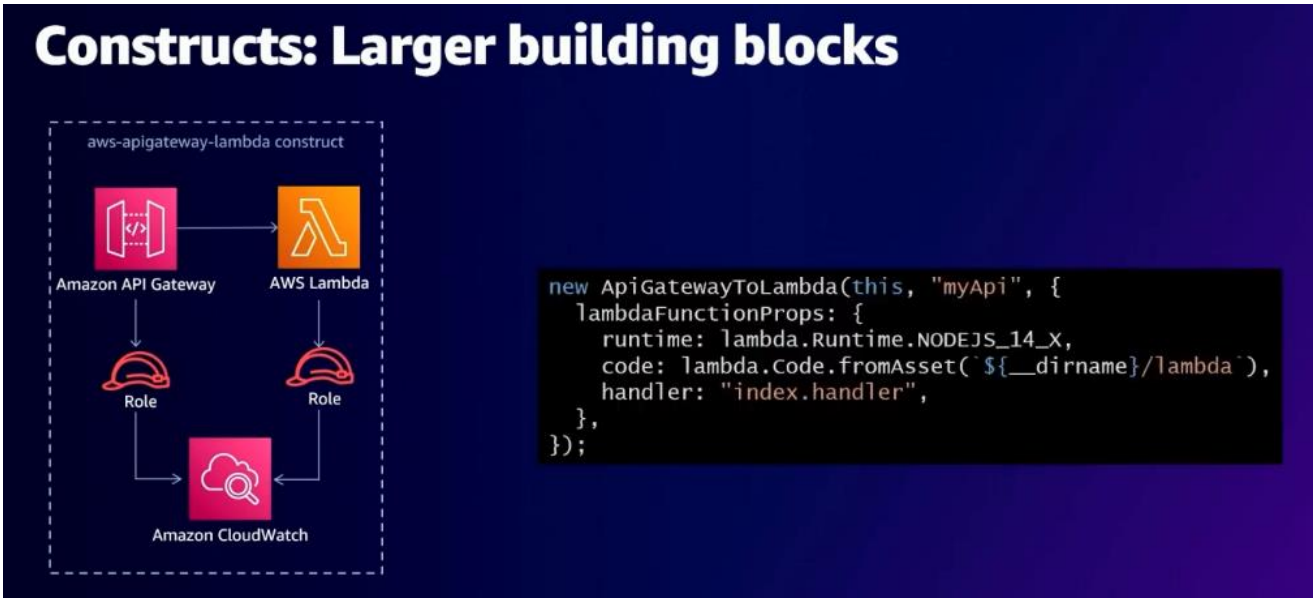


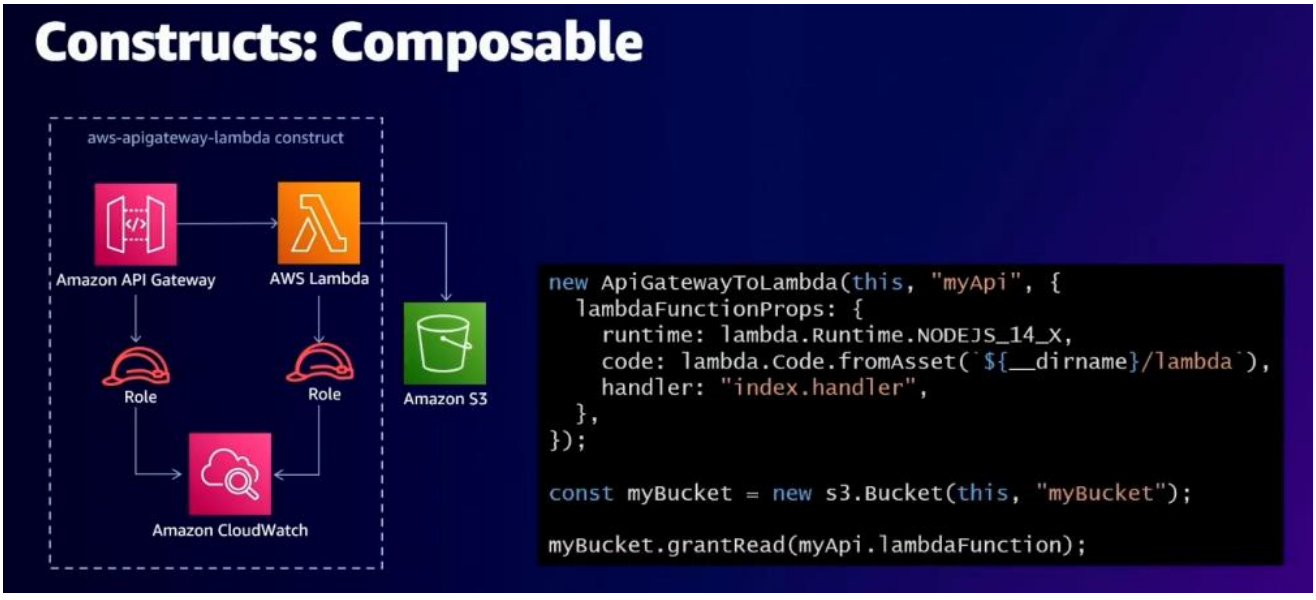
A given resource in AWS will map to a specific construct.





Constructs are units for modeling your cloud infrastructure with.





Constructs: Well architected

- Good defaults
- Integrate services
- Least privilege

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Action": [
                "xray:PutTelemetryRecords",
                "xray:PutTraceSegments"
            ],
            "Resource": "*",
            "Effect": "Allow"
        },
        {
            "Action": [
                "s3:GetBucket*",
                "s3:GetObject*",
                "s3:List*"
            ],
            "Resource": [
                "arn:aws:s3:::mystack-mybucket5af9c99b",
                "arn:aws:s3:::mystack-mybucket5af9c99b/*"
            ],
            "Effect": "Allow"
        }
    ]
}
```

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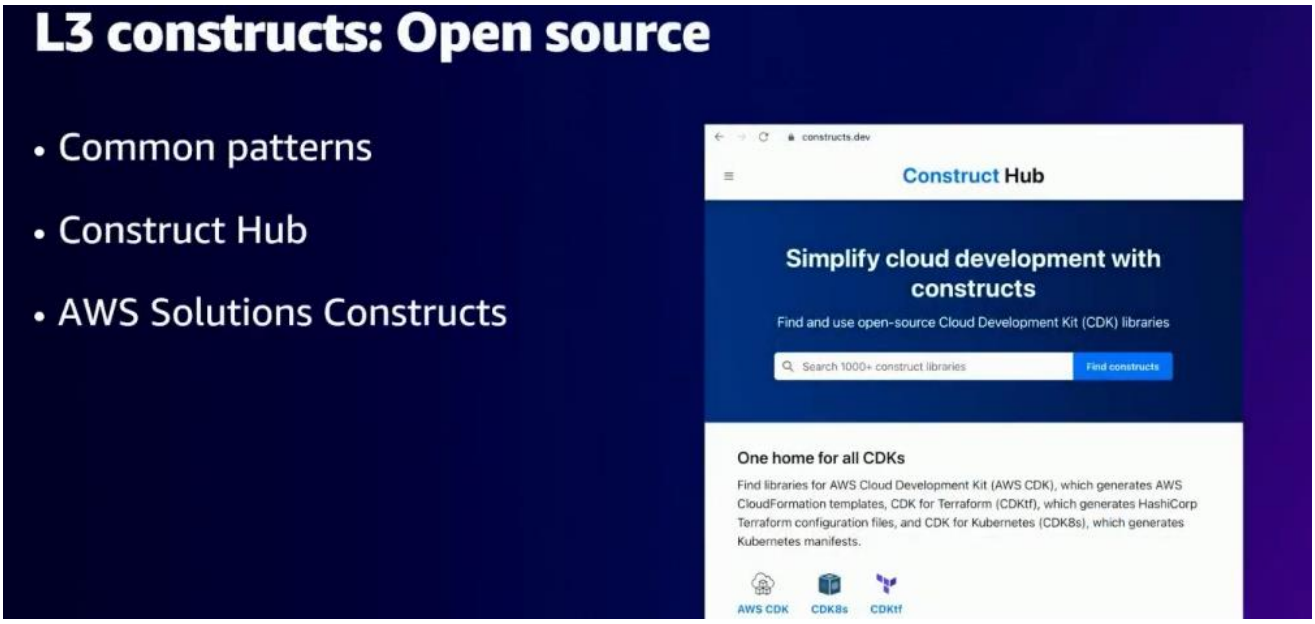
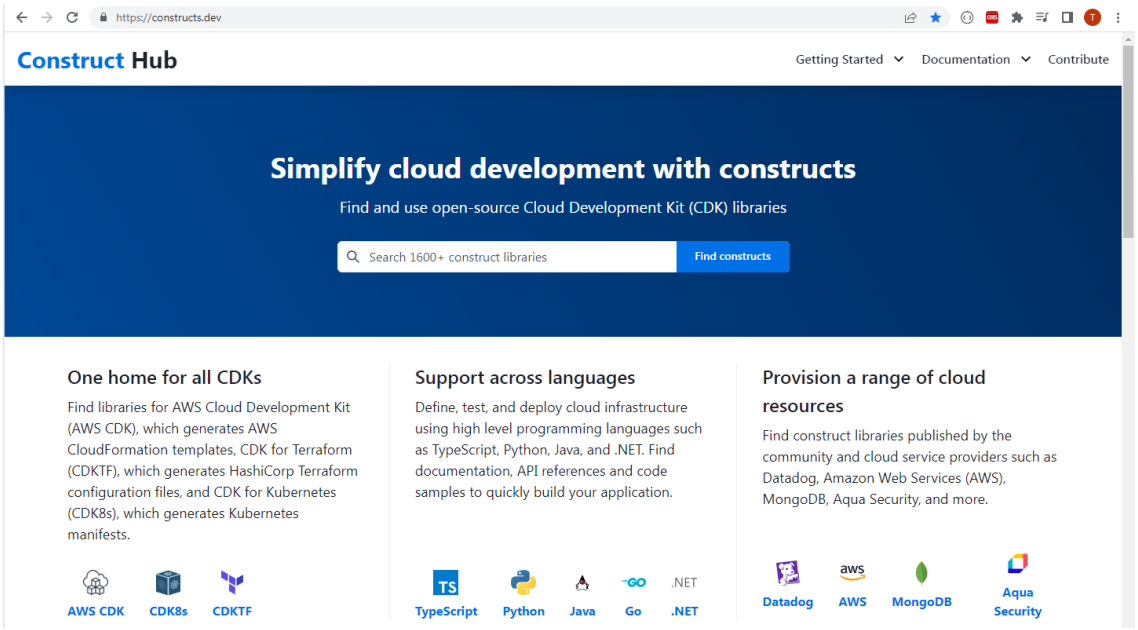
Constructs: Testable

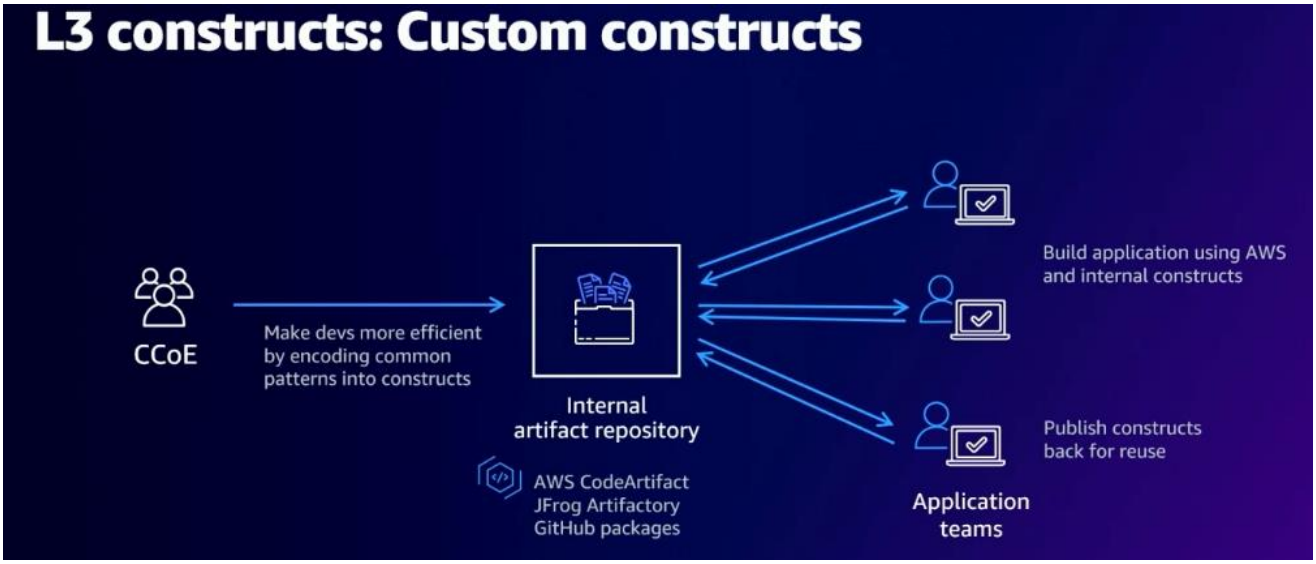
- Fine-grained assertions
- Snapshot

```
test('Test properties', () => {
// Initial Setup
  const stack = new Stack();

  const app = new ApiGatewayToLambda(this, "myApi", {
    lambdaFunctionProps: {
      runtime: lambda.Runtime.NODEJS_14_X,
      code: lambda.Code.fromAsset(`${__dirname}/lambda`),
      handler: "index.handler",
    },
  });

  expect(app.lambdaFunction !== null);
  expect(app.apiGateway !== null);
  expect(app.apiGatewayCloudWatchRole !== null);
  expect(app.apiGatewayLogGroup !== null);
});
```





https://constructs.dev/ contains over 1000 AWS Constructs patterns for use today



Matt Morgan

- Senior Director of Software Engineering, PowerSchool
- 5.5 years with Naviance product
- 24 years in EdTech
- Author/blogger/ AWS Community Builder

PowerSchool

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* A total annual enrollment served calculation representing the sum of students support across all PowerSchool customers who use at least one PowerSchool product. This amount is valid for 2021

Naviance journey

Lift and shift

2017: NAVIANCE MIGRATES TO AWS

Growing the platform

- New capabilities
- Incremental module replacement
- Better developer experience
- Scalability, reliability, observability

Micro-frontends and domain services

Data integrations

Serverless solutions

Building a framework

We needed a way to convert our team of App Developers into Cloud Engineers that use DynamoDB, S3, Lambda, etc

AWS CloudFormation and Terraform

Owned by CloudOps team

Low developer engagement

Big learning curve

AWS CDK

- Already using TypeScript
- Familiar OO patterns
- Sensible defaults
- Convenience methods and IAM least-privilege abstractions

Building cloud skills

Overview of services

- AWS Identity and Access Management (IAM)
- Amazon S3
- AWS Step Functions
- Amazon API Gateway
- AWS Lambda
- Amazon DynamoDB
- Amazon EventBridge

Working groups and meetups

- Fortnightly meetups
- Demos
- Onboarding activities
- Focused groups to produce documentation and best practices

Reference implementation

Simple app combining a few services

Uses PowerSchool constructs and best practices

Any developer can build and deploy it in a few minutes

Touchstones

- Familiar concepts applied in a new context
- Helps developers feel like they don't have to learn everything
- Examples: REST, domain design, test frameworks, UI frameworks

Sandbox accounts

Construct library

- A best practice for teams that maintain multiple CDK applications
- Prior successes with internal “inner source” libraries
- Provides a focal point for innovation

The Construct Library

Copy-pasta

- Copying boilerplate from project to project produces drift and churn
- Identified a few capabilities that should be standard
- Avoid reinventing the wheel

Best practices

- Even better with good abstractions
- Evolve over time
- A version bump away

Compliance

- Make the right choice the easiest choice
- Shift left and build into developer workflow
- Supplement but do not replace other security and compliance measures

Acceleration

- Quickstart guide
- Preconfigured constructs
- Get building ASAP
- Provide updates at scale

Publishing, versioning, and quality

- Internal repository already in use
- Versioning and alphas
- Unit tests, quality checks, and build pipeline

Development flow

- Project incepted by a single team
- Open for contributions
- Maintained by Developer Acceleration Team

TypeScript or polyglot?

- jsii allows constructs to support a variety of languages
- Decided to focus on TypeScript only
- Flexibility vs. simplicity

Stack construct

```
export class CoreStack extends Stack {
  constructor(scope: Construct, id: string, props: CoreStackProps) {
    super(scope, id, props);
    const {eventBridgeConfig, vpcConfig } = props;
    if(props.vpcConfig) this.addVpc(vpcConfig);
    if(eventBridgeConfig) this.addEventBridge(eventBridgeConfig);
  }
  private addVpc() { … }
  private addEventBridge() { … }
  Aspects.of(this)….
}
```

Lambda construct

```
export class LambdaFunction extends Construct {
  function: NodejsFunction;
  logGroup: LogGroup;
  constructor(scope: Construct, id: string, props: LambdaFunctionProps) {
    super(scope, id);
    const { functionName, functionProps, retentionPolicy, removalPolicy } = props;
    this.function = new NodejsFunction(this, functionName, functionProps);
    this.logGroup = new LogGroup(this, `${functionName}-lg`, {
      logGroupName: `/aws/lambda/${functionName}`,
      retentionPolicy,
      removalPolicy,
    });
  }
}
```

TypeScript + OpenAPI

```
export interface User {
  username: string;
  givenName: string;
  familyName: string;
  middleName?: string;
  role: Role;
  email?: string;
  sms?: string;
  phone?: string;
}
```

ts-json-schema-generator

```
UserModel:
  properties:
    username:
      type: string
    givenName:
      type: string
    familyName:
      type: string
    middleName:
      type: string
    role:
      $ref: "#/components/schemas/RoleModel"
    email:
      type: string
    sms:
      type: string
    phone:
      type: string
```

A REST API construct with OpenAPI spec that API Gateway ingests or is created from the API Gateway. We create the TS interface that gets used to create the OpenAPI spec file.

AWS WAF construct

```
export class S3LoggingWaf extends Construct {
  constructor(scope: Construct, id: string, props: S3LoggingWafProps) {
    super(scope, id);
    const wafBucket = new Bucket(…);
    const wafRole = new Role(…);
    const waf = new CfnWebAcl(this,`MyWaf-${props.someId}`, { …props };
    for(const restApi of props.restApis) {
      this.associateWebACL(restApi);
    }
  }

  private associateWebACL(…) {…}
}
```

This construct puts AWS WAF in front of your API Gateway and your CloudFront.

Third-party tooling constructs

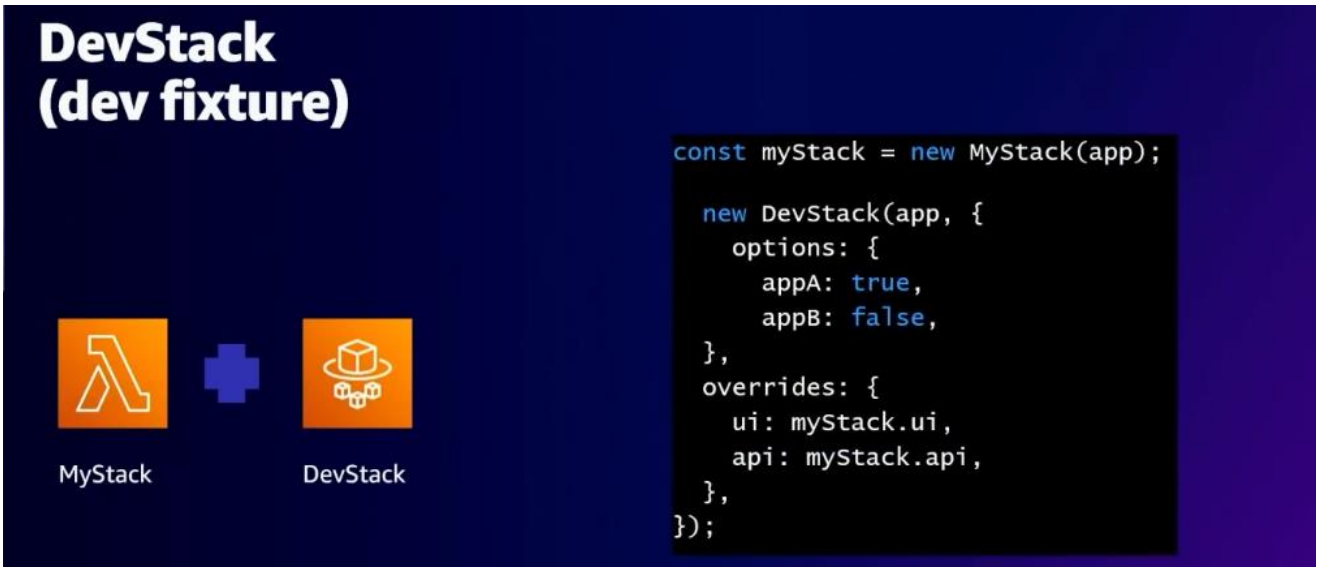
```
export class NewRelic implements Iaspect {
  public visit(node: IConstruct) {
  if(node instanceof Function) {
    node.addEnvironment('NEW_RELIC_ACCOUNT_ID', this.acctId);
    node.addToRolePolicy(
      new PolicyStatement({
        actions:['secretsmanager:GetSecretValue'],
        resources: [licenseARN]
      })
    );
    node.addLayers(LayerVersion.fromLayerVersionArn(node, 'NewRelicLayer', newRelicLayer));
    }
  }
}
```

Observability constructs

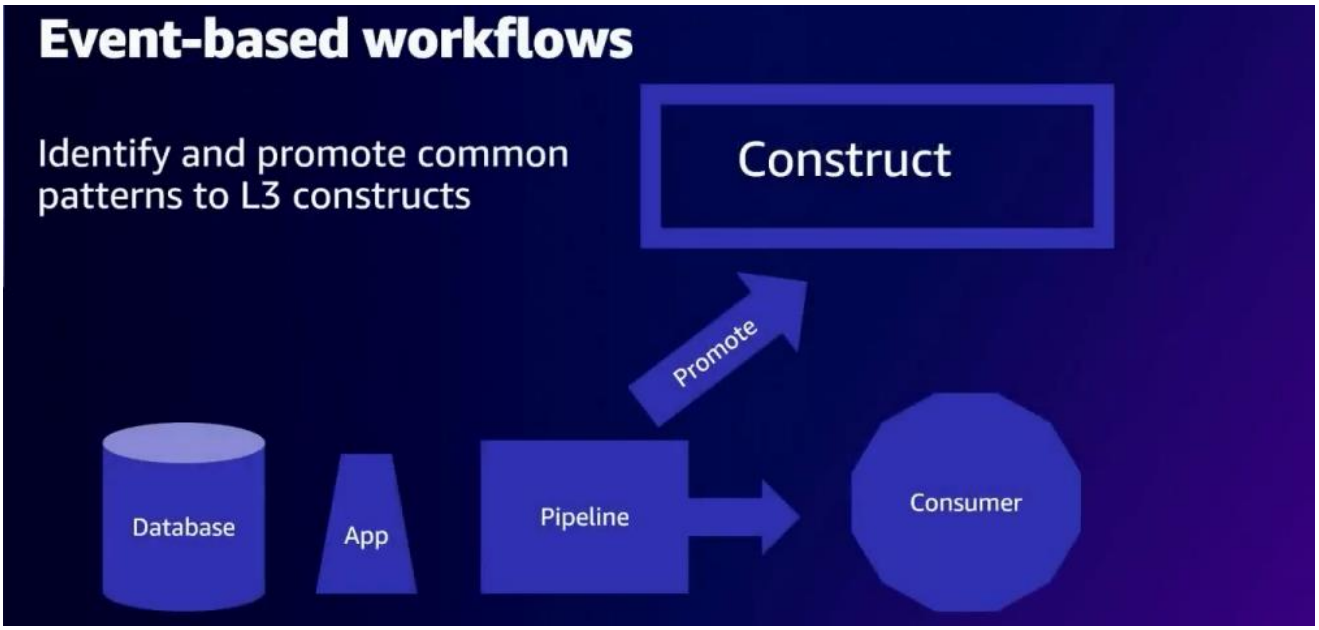
```
export const alarmDynamoDB =
  ({ stack, table, overrides }) => {
  const throttleAlarm = new Alarm(stack,
    `${table.tableName}Throttle`, { …presets, …overrides });
  const readAlarm = new Alarm(…);
  const writeAlarm = new Alarm(…);

  return [throttleAlarm, readAlarm, writeAlarm];
});
```

DevStack (dev fixture)



Event-based workflows



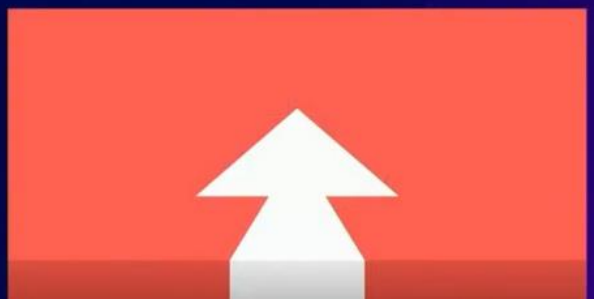
This is for async and event-based workflows that are complex.

Metrics

- 164 commits
- 12 contributors
- 40+ dependent projects
- 20+ production apps

Papercuts

- Developers creating IAM roles
- AWS CDK versioning/bootstraps
- CloudFormation UPDATE_ROLLBACK_FAILED



Takeaways

- Development acceleration
- Understanding
- Adoption of best practices
- Innovation
- Culture

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