CDK driven Testing

Test Driven Cloud Development or CDK driven Testing- gglawe@tecracer.de

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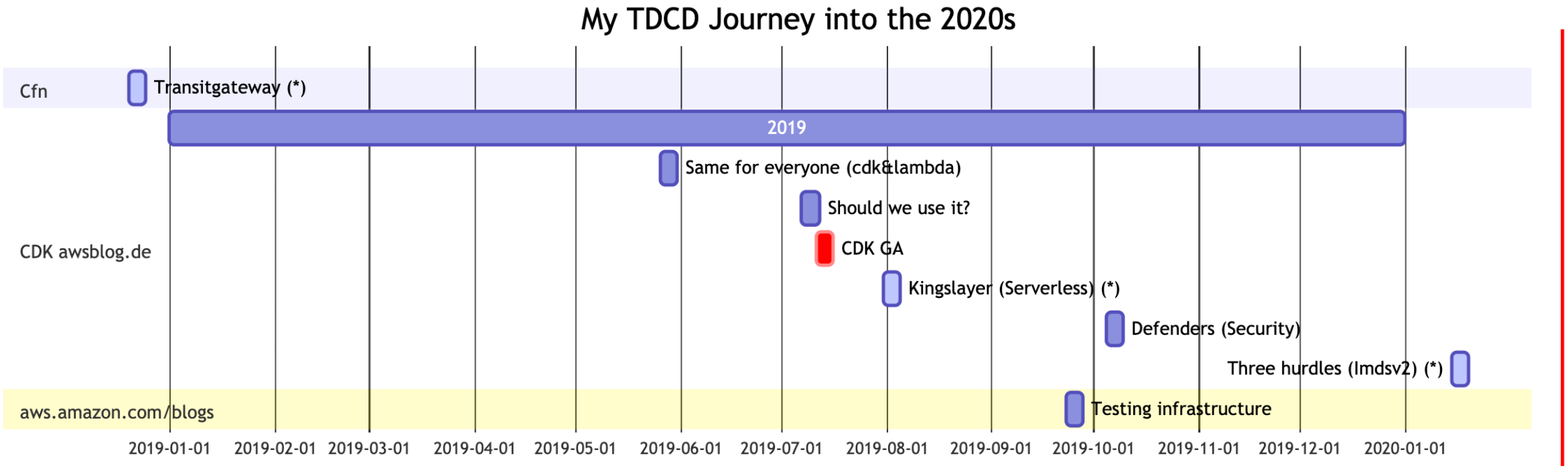
TDCD- Testing the cloud from the 2010s to the 2020s



TDCD - Testing the cloud from the 2010s to the 2020s

Views to the environment

First Part of the Journey: Create Test Environments

Second Part of the Journey: Test the Cloud

Third Part: Inspec(t) the Cloud

A Pyramid View

Views to the environment

Testing Phases

1. Setup environment
2. Test functionality
3. Teardown environment

Create Test Environments

Use Cases

- Transit Gateway 2010s and 2020s
- Instances: My Testing instance
- IMDBv2

Comparing Aspects :

1. Source Language
2. Management
3. Testing

Why showing UseCases for Testing if its about CDK?

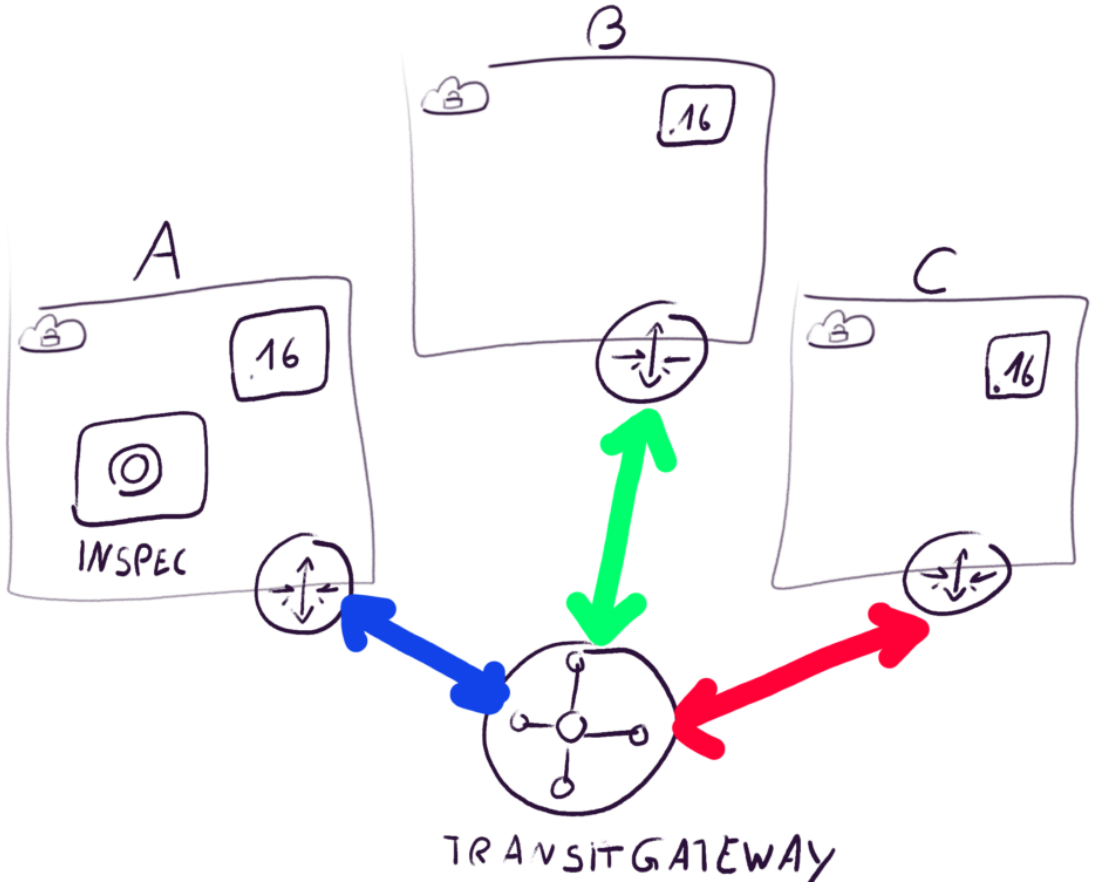
Showing how CDK can be a good tool for test automation

Showing the wiring of tools and CDK

With an new generated infrastructure environment you minimize environmental test pollution

UseCase 1 - The Transit Gateway Test

- The (then) new Transit Gateway connects n VPCs instead of only two like VPC Peering
- As a consultant I have to know how it works
- I have seen people fail presenting with doing it manually, so automate it



Infrastructure: Testing Transit Gateway - 2010s

Source Language: CloudFormation

Management:

- Clouds-aws
- Makefile

Testing: taskCat

See: https://github.com/tecracer/demo-transit-gateway

CloudFormation - 2010s - D=DRY = Repeat yourself

Pure CloudFormation: Ugly

- Count the Lines!

Management - 2010s

Good Old Makefile

- Makefile works, but
  - no good cross OS (i mean windows implementation)
  - no standard way to describe tasks

"Simple" Help Hack = awk magic

```
help:
	@grep -E '^[a-zA-Z_-]+:.*?## .*$$' $(MAKEFILE_LIST) | sort | awk 'BEGIN {FS = ":.*?## "}; {printf "\033[36m%-30s\033[0m %s\n", $$1, $$2}'
```

```
deploy: ## Deploy stack
```

Management - 2010s

"Clouds-aws" as Cloudformation CLI

- Simple stack management tool
- Use directory structure as Template names
- Get deployed Templates
- Manage parameters

```
└── stacks
    ├── demo-vpc-a
    ├── demo-vpc-b
    └── demo-vpc-c
```

Testing 2010 - taskcat

- Test tool for deploying stacks
  - in several regions
  - with parameter sets
  - deploy and destroy automatically

```
.
├── LICENSE
├── Makefile
├── ci
│   ├── debug_a.json
│   ├── debug_b.json
│   ├── debug_c.json
│   └── taskcat.yml
```

Testing 2010 - taskcat run

```
(python3) silberkopf@Gernots-MacBook-Pro:demo-transit-gateway(AWS:ggtrcadmin)>make lint-cfn
cp stacks/demo-vpc-a/template.yaml templates/testa.yaml
cp stacks/demo-vpc-b/template.yaml templates/testb.yaml
cp stacks/demo-vpc-c/template.yaml templates/testc.yaml
taskcat  -c ci/taskcat.yml -l
 _             _              _
| |_ __ _ ___| | _____ __ _| |_
| __/ _` / __| |/ / __/ _` | __|
| || (_| \__ \   < (_| (_| | |_
 \__\__,_|___/_|\_\___\__,_|\__|


version 0.8.19


[taskcat] :AWS AccountNumber:    [            ]
[taskcat] :Authenticated via:    [environment]


[taskcat] :Reading Config form: ci/taskcat.yml
[taskcat] |Queing test => scenario-a
[taskcat] |Queing test => scenario-b
[taskcat] |Queing test => scenario-c
[INFO   ] :Lint passed for test scenario-a on template demo-transit-gateway/templates/testa.yaml:
[INFO   ] :Lint passed for test scenario-b on template demo-transit-gateway/templates/testa.yaml:
[INFO   ] :Lint passed for test scenario-c on template demo-transit-gateway/templates/testa.yaml:
[INFO   ] :Linting completed
```

Testing 2010 - taskcat report

GitHub Repo: https://github.com/aws-quickstart/taskcat
Documentation: http://taskcat.io
Tested on: Tuesday - Dec,11,2018 @ 22:05:38

taskcat

Test Name	Tested Region	Stack Name	Tested Results	Test Logs
scenario-a	eu-central-1	tCaT-tag-scenario-a-89b456d8	CREATE_COMPLETE	View Logs
scenario-a	eu-west-1	tCaT-tag-scenario-a-89b456d8	CREATE_COMPLETE	View Logs
scenario-b	eu-central-1	tCaT-tag-scenario-b-89b456d8	CREATE_COMPLETE	View Logs
scenario-b	eu-west-1	tCaT-tag-scenario-b-89b456d8	CREATE_COMPLETE	View Logs
scenario-c	eu-central-1	tCaT-tag-scenario-c-89b456d8	CREATE_COMPLETE	View Logs
scenario-c	eu-west-1	tCaT-tag-scenario-c-89b456d8	CREATE_COMPLETE	View Logs

Generated by taskcat 0.8.19

Infrastructure: Testing Transit Gateway - 2020s

Source Language:

- CDK
- polyglott

Management:

- CDK: All commands for deploy, destroy, diff included
- task: a better Makefile

Testing:

- CDK

Testing Transit Gateway CDK

DRY Routing Loop

```
for (var i = 0, len = vpnVPC.privateSubnets.length;
  i < len;
  i++) {
  new CfnRoute(this, "tgwVpc"+i,
  {
    routeTableId: vpnVPC.privateSubnets[i]
      .routeTable.routeTableId,
    destinationCidrBlock: net2Cidr,
    transitGatewayId: buildEnvTransitGateway.ref,
  }).addDependsOn(vpnVpcAttachment);      }
```

- Advantage to cfn: Do not repeat yourself, instead loop equals parts

Management - Taskfile

```yaml
# https://taskfile.dev
tasks:
  deploy:
    desc: deploy cdk "SingleInstanceStack"
    deps: [build-cdk]
    dir: single-instance
    cmds:
      - cdk deploy SingleInstanceStack
    silent: true
```

- Runs on "all" OS because of golang
- A better Makefile: Just works

CDK

Management

- Development and Management in one tool
- Supports Change Sets with `diff`
- List status of Stacks missing

Testing

- Deployment to different regions possible
- Region dependencies aware e.g. AMI images
- You can still use taskcat for reporting

Testing with CDK - Simple OK/NOK reporting

Report

```
Testing ec2-autostop
Do 6 Feb 2020 17:41:08 CET
✅ ec2-autostop OK
```

Script from tecracer cdk-templates

```
task edge-of-tomorrow >../log/$i.log 2>../log/$i.err
    if [ $? -eq 0 ]
    then
        echo ✅ $i OK
    else
        echo ❌ $i NOK
    fi
```

Edge of tomorrow is live, die, repeat

- Instead of using tascat, you can let cdk handle deploy and destroy
- The taskfile unifies the access, so that `task deploy` is alwas deploy, decoupled from the tool
- Let it run with each cdk update to detect hidden breaking changes

```yaml
edge-of-tomorrow:
  desc: deploy destroy repeat
  cmds:
    - task: update
    - task: deploy
    - task: destroy
```

UseCase 2 : My Testing Instance

Security: myip

- automatically deploy least privileges Security Group

Cost Efficiency: Stop Rule

- automatically deploy Cloudwatch rule to stop instance at the end of the day

Automating LP* Security groups

- Get external IP address

```
const baseUrl = 'http://checkip.amazonaws.com/';
...
var result = await request.get(options);
...
return clientIp;
```

- Use it in Security Groups

```
clientIp.then((ip) => {
    sg.addIngressRule(Peer.ipv4(ip), Port.tcp(22), "Ssh Client incoming")
```

Cost Efficiency: Stop Rule

Install

```
npm i cdk-instance-stop-rule
```

EC2 Target for CloudWatch events

```
new InstanceStopRule(this, "myTest Instance",{
  machineImage: linuxImage,
      instanceType: instanceType,
      instanceName: "testServer",
      vpc: testVPC,
      stopHour: 17,
  });
```

- See cdk-construct github/tecracer `cdk-instanceStopRule`

Use Case 3: Instance Metadata Service - V2 1of2

What is IMDS?

- Service to give apps on an ec2 the credentials from the Instance-Profile/Role

Security Problems with IMDSv1

- See technical background for Capital One
- V2 - More secure way to get EC2 credentials

What is instance connect?

- Problem: distributing ssh keys for individual users or (dont do it) shared users
- Solution: instance connect creates a one time ssh key for the user authenticated by IAM
- In Terminal: `mssh $instanceid` is fast and secure

But do these services work together?

> It turned out - not yet, so testing was needed and successfull

Goal: Fast&Easy Test enviroment setup

Solutions: CDK & Task work together

CDK

- Spins up VPC, EC2 with UserData

Taskfile /Script

- test mssh (instanconnect) with imdsv2 on/off

```
INSTANCEID:
  sh: aws cloudformation list-exports --region eu-central-1
  --query "Exports[?Name == 'demoInstanceId'].Value" --output text
```

```
    - aws ec2 modify-instance-metadata-options --instance-id {{.INSTANCEID}}
    --http-endpoint enabled --http-token required
```

Testresults IMDSv2 & Instanceconnect

- Software part on EC2 was not ready (but was quickly solved)
- You have to update sdk/cli/ssm agent *before* enabling IMDSv2, then everythings works together
- You have to update the instanceconnect package on the instance to newest version, which is
  - not included by default in AMI
  - maybe not available in repositories yet

=> Trust is good, testing is better

Second Part: Test the Cloud

Integration

- Deploy Constructs for testing *and* example code

Unit Test

- Which CloudFormation code is generated?

Snapshots

- For refactoring and hidden side effects

Integration Test

CDK Source: Functions are located in `/lib`

- `aws-cdk/packages/@aws-cdk/aws-ec2/lib`

Tests are located in `/test`

- `aws-cdk/packages/@aws-cdk/aws-ec2/test`
- Unit Tests: `.../aws-ec2/test/test.vpc.ts`
- Integration Tests: `.../aws-ec2/test/integ.vpc.ts`

Integration test are usage examples

- Execute with `cdk --app ../aws-ec2/test/integ.vpc.ts`

Example of an integration test `integ.vpc.ts`

```
// Test Security Group Rules
const sg = new ec2.SecurityGroup(stack, 'SG', { vpc });
const rules = [
  ec2.Port.icmpPing(),
  ec2.Port.icmpType(128),
  ec2.Port.allIcmp(),
  ec2.Port.allUdp(),
  ec2.Port.udp(123),
  ec2.Port.udpRange(800, 801),
];
for (const rule of rules) {
  sg.addIngressRule(ec2.Peer.anyIpv4(), rule);
}
app.synth();
```

Unit Testing

- What do we test?
  - Generated CloudFormation, not service behaviour
- How do we test
  - Typescript: Jest
  - Java: JUnit
  - Python: pytest
- Maturity in sample
  - Typescript: Test Resource and attributes
  - Java/Python: Test Resource

Unit Test source

```
test('SQS Queue Created', () => {
    const app = new cdk.App();
    // WHEN
    const stack = new TestCfn.TestCfnStack(app, 'MyTestStack');
    // THEN
    expectCDK(stack).to(haveResource("AWS::SQS::Queue",{
      VisibilityTimeout: 300,
    }));
});
```

Unit Test usage in the CDK source

Most Tests use `haveResource`

```
aws-cdk
grep "expect(stack).to(" packages/**/test/*ts | wc
     961    2910  114705

grep "expect(stack).to(haveR" packages/**/test/*ts | wc
     872    2676  105361
```

What to expect in cdk expect

Test for resources with

- `expect(stack).to(haveResource(`
- `expect(stack).to(countResources(`

Test whole template with

- `expect(stack).to(exactlyMatchTemplate({`
- `expect(stack).to(beASupersetOfTemplate({`
- `expect(stack).to(matchTemplate({`

Demo Unit Test - look under the hood

aka: "demo"

src/test-cfn

Snapshots

Why

- Have CloudFormation, write CDK
- Refactoring

How

- First run: `npm run test` - create Snapshot
- Second run: `npm run test` - diff Snapshot
- ReSnapshot: `npm test -- -u`

Snapshots - howto

- store current state in /test/snapshots

```
    expect(SynthUtils.toCloudFormation(stack)).toMatchSnapshot();
```

- run test
- refactor
- save new snapshot

```
npm test -- -u
```

Snapshots - look under the hood

aka "demo"

src/snapshot

Third Part: Inspect the Cloud

Test Resource with chef inspec

Test functionality

Chef InSpec DSL

> Chef InSpec is a run-time framework and rule language used to specify compliance, security, and policy requirements. It includes a collection of resources that help you write auditing controls quickly and easily.

The Chef InSpec DSL is a Ruby DSL for writing audit controls, which includes audit resources that you can invoke.

Are Resouces really created?

- Test with custom (ruby) DSL
- a "Test" just tests, a "Control" defines the impact

```
control 'aws-region-security-group-1.0' do

  impact 1.0
  title 'Ensure AWS Security Groups disallow ssh ingress from 0.0.0.0/0.'


  describe aws_security_group(group_name: 'FrontEnd', vpc_id: 'vpc-0f66cf8e7918f109c') do
    it { should exist }
    it { should_not allow_in(ipv4_range: '0.0.0.0/0', port: 22) }
  end

end
```

Inspec-AWS: Custom AWS Resources

- Used for compliance checks

Management	Security	Infrastructure
auto_scaling	iam	ec2
cloudtrail	kms	ebs
cloudwatch	security groups	rds
config	sts	s3
flow-log		SNS
		SQS
		vpc

Demo InSpec

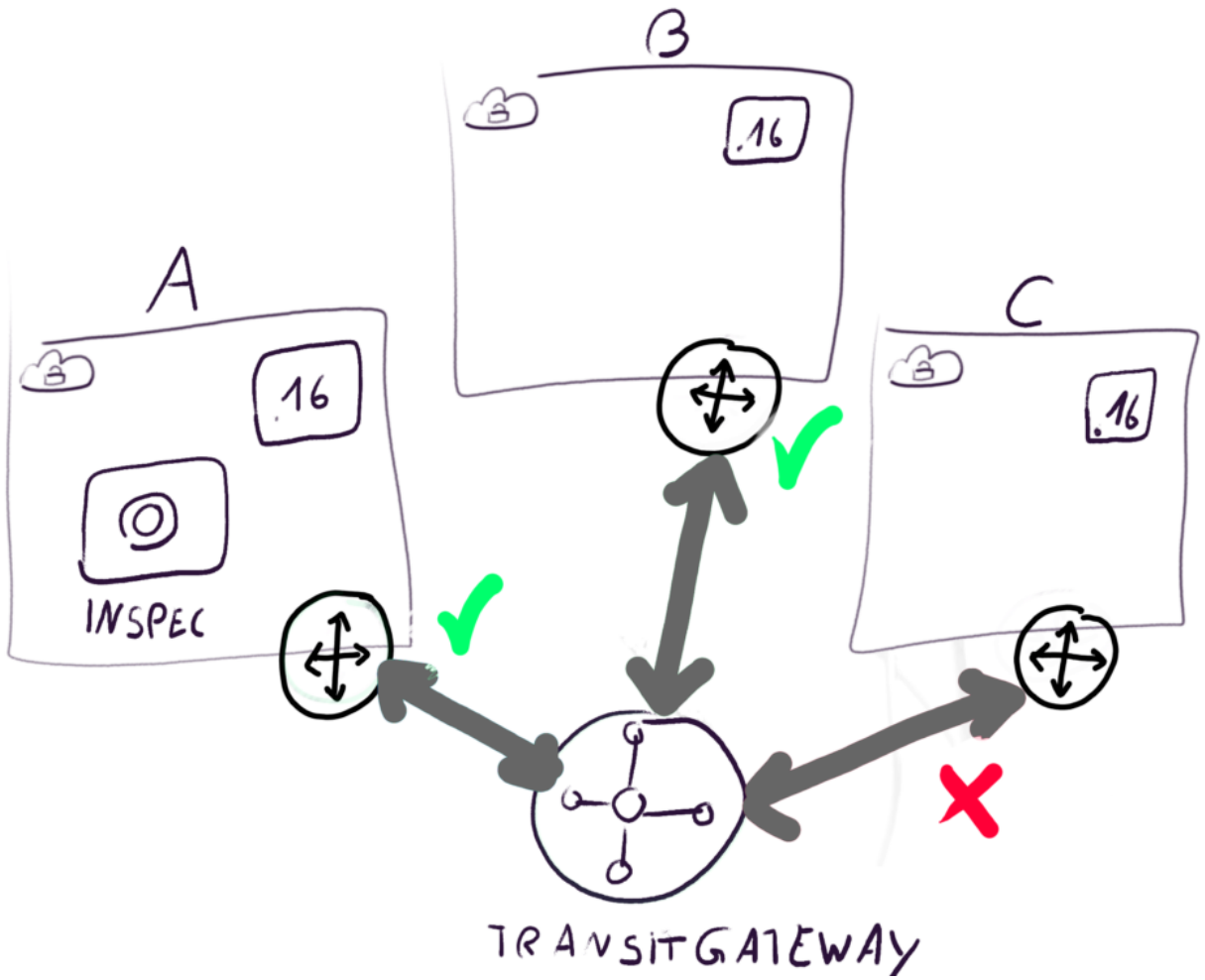
aka look under the hood

src/cdk-inspec

inspec-aws

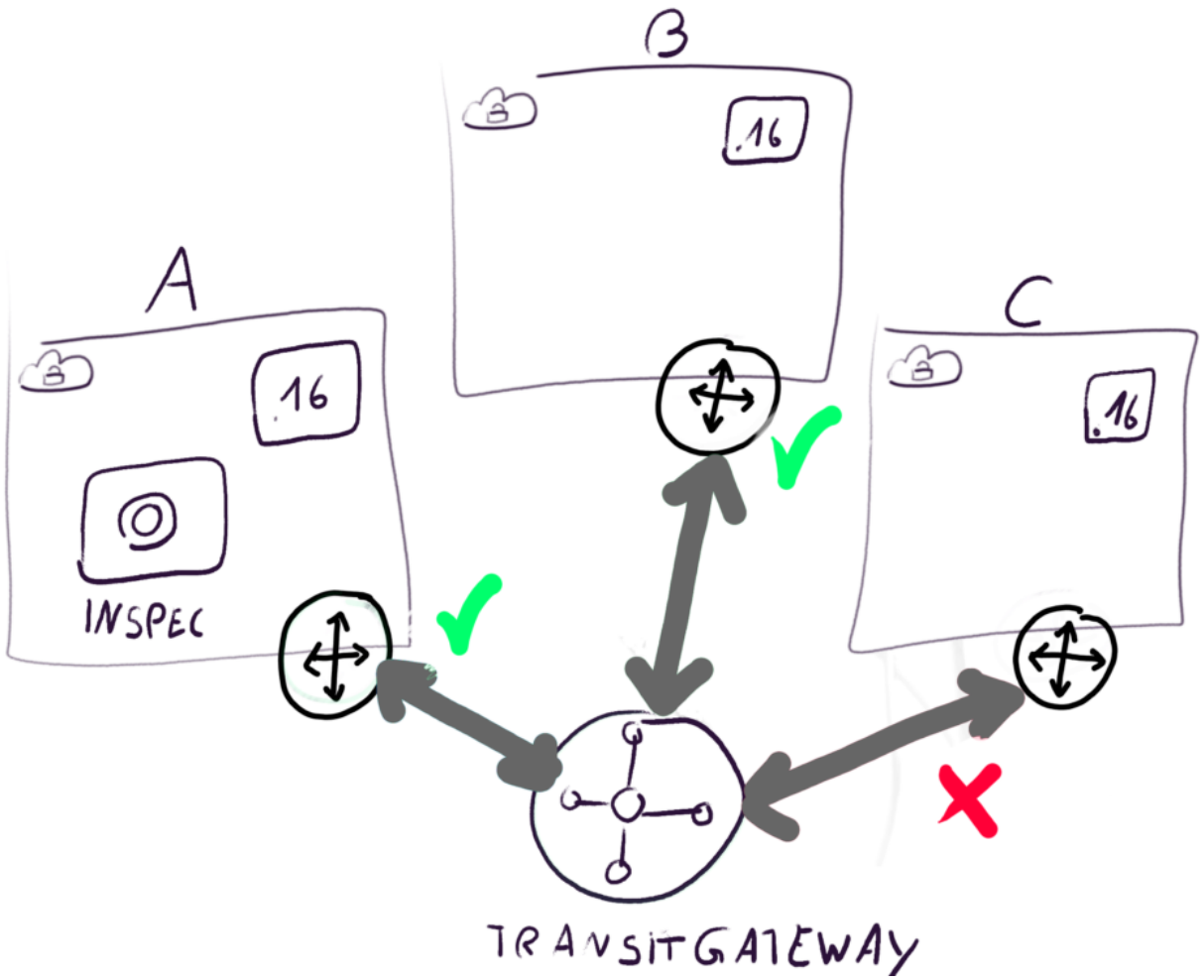
One Step further: Test Instances with Test kitchen

- After checking a resouce exists
- Testing whether it really works
- UseCase TransitGateway:
  Can EC2 instances in VPC A access web server on instance in VPC B across VPCs?



One Step further: Test Instances with Test kitchen

- CDK creates Webserver instances in A,B,C
- Test Kitchen spins up instance in chosen vpc
- Test Kitchen runs test: HTTP Request
- If TGW and routing works, test is ok



Platform Definition & Server Access Test

- CDK creates VPC and gives image_id and subnet_id

```
platforms:
  - name: amazon
    driver:
      region: eu-central-1
      image_id: ami-0cfbf4f6db41068ac
      instance_type: t2.large
      subnet_id: subnet-01cb511f85c1b2356
      tags:
        Name: "Kitchen Test Instance ec2"
```

```
describe http('http://10.0.1.16') do
  its('status') { should cmp 200 }
  its('body') { should eq 'Node A' }
end
```

Fresh from AWS Blog today

"Unit testing IAM policies across multiple accounts"

- Test IAM with SDK Tests

```
response = client.simulate_principal_policy(
    PolicySourceArn=source, ActionNames=actions
)`
```

- Uses Lambda as test agents

A CDK enabled Cloud Test Pyramid

Functionality Tests

Service Tests

Unit Tests

A CDK enabled Cloud Test Pyramid

- Functionality Tests
  - Use kitchen as a driver framework
  - write your own lambda
  - CDK creates test environment infrastructure
- Service Tests
  - Inspec as a DSK with predefined functionality
  - Write in your own language
  - CDK creates test environment infrastructure
- Unit Tests
  - Jest Test generated CloudFormation
  - Test single functions in Construct Code

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Thank you !

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