AWS CloudFormation: Infrastructure as Code

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amazon web services

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Why did we build AWS CloudFormation?

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Some customer challenges

- Creating and managing AWS resources
- Provisioning and updating infrastructure resources in an orderly manner
- Version controlling infrastructure like software

What is CloudFormation?

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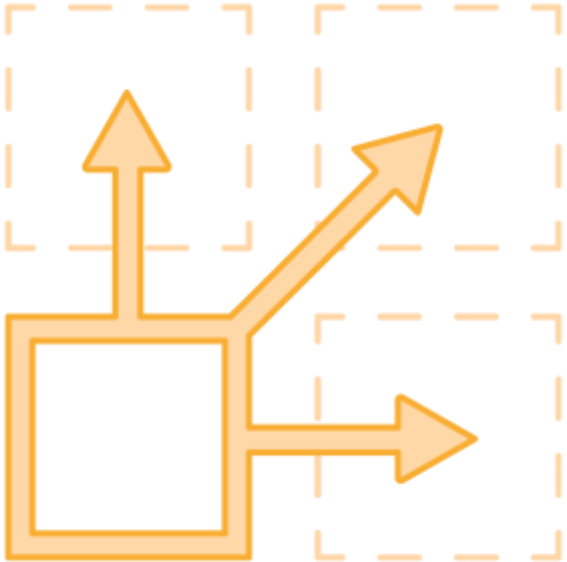
Templated resource provisioning

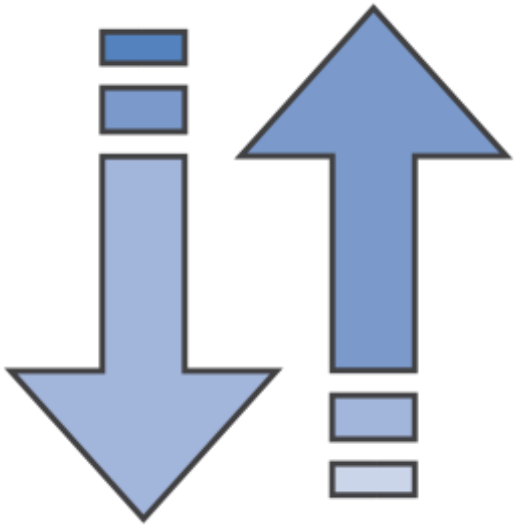


- Create templates to describe the AWS resources used to run your application
- Provision identical copies of a stack

Infrastructure as code

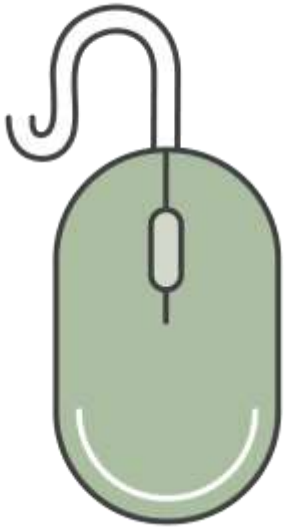
- Templates can be stored in a source control system
- Track all changes made to your infrastructure stack
- Modify and update resources in a controlled and predictable way

Declarative and flexible



- Just choose the resources and configurations you need
- Customize your template through parameters

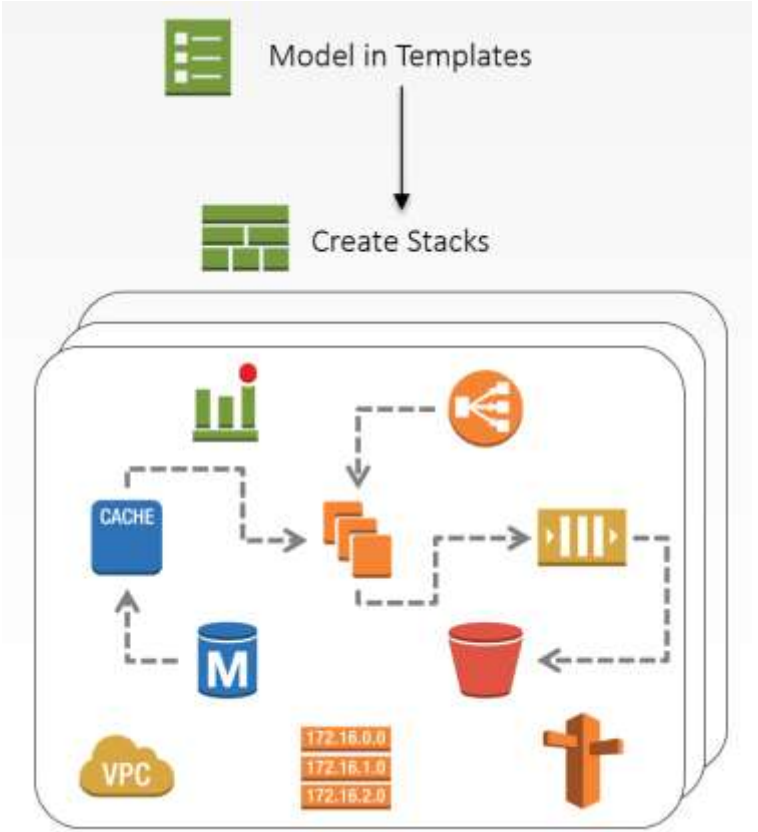
Easy to use



- Access through console, CLI, or SDKs
- Start with one of the many sample templates
- Integrate with your development and management tools

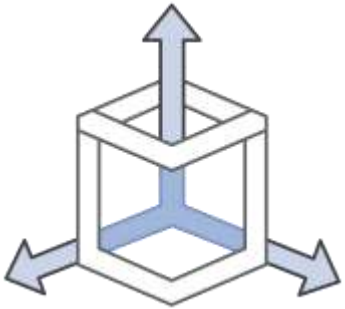
CloudFormation

- Create templates of the infrastructure and applications you want to run on AWS
- Have CloudFormation automatically provision the required AWS resources and their relationships from the templates
- Easily version, replicate, or update the infrastructure and applications using the templates
- Integrates with other development, CI/CD, and management tools

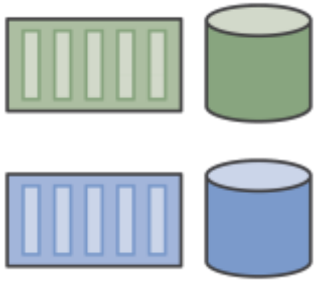


Common use cases

Stack replication



Infrastructure
scale out



Blue/green
deployments

Infrastructure
as code

Pricing

- There is no additional charge for CloudFormation
- Customers pay only for the AWS resources (e.g., EC2 instances, EBS volumes) created using CloudFormation

Use a wide range of AWS services

- ✓ Auto Scaling
- ✓ Amazon CloudFront
- ✓ AWS CloudTrail
- ✓ Amazon CloudWatch
- ✓ Amazon DynamoDB
- ✓ Amazon EC2
- ✓ AWS Elastic Beanstalk
- ✓ Amazon ElastiCache
- ✓ Elastic Load Balancing
- ✓ AWS Identity and Access Management (IAM)
- ✓ Amazon Kinesis
- ✓ AWS OpsWorks
- ✓ Amazon RDS
- ✓ Amazon Redshift
- ✓ Amazon Route 53
- ✓ Amazon S3
- ✓Amazon SNS
- ✓ Amazon SQS
- ✓ Amazon VPC

and more …

Frequent improvements–Posted June 9, 2016

- New resource support
  - Amazon VPC flow logs
  - Amazon Kinesis Firehose
- Updated support for existing resources
  - AWS Lambda source code
  - SNS topic updates
  - Amazon Kinesis stream names
  - New Auto Scaling update policy

For new announcements, see: https://aws.amazon.com/new/#management-tools

How do I get started with CloudFormation?

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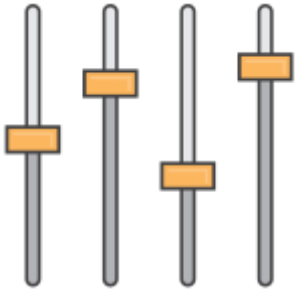
CloudFormation terminology

Stacks

Templates



Parameters

Policies

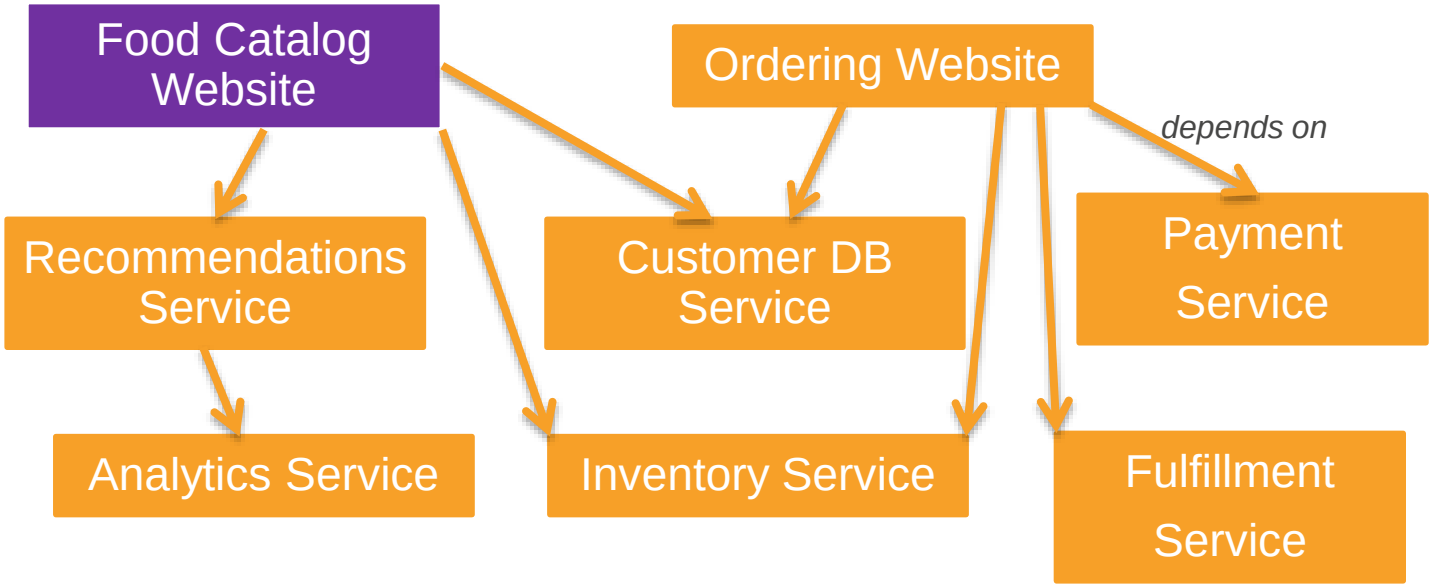
Basic steps

- Create or use an existing template
- Upload template to CloudFormation
- Specify parameter values
- Set up policies, tags, or notification options
- Review and create

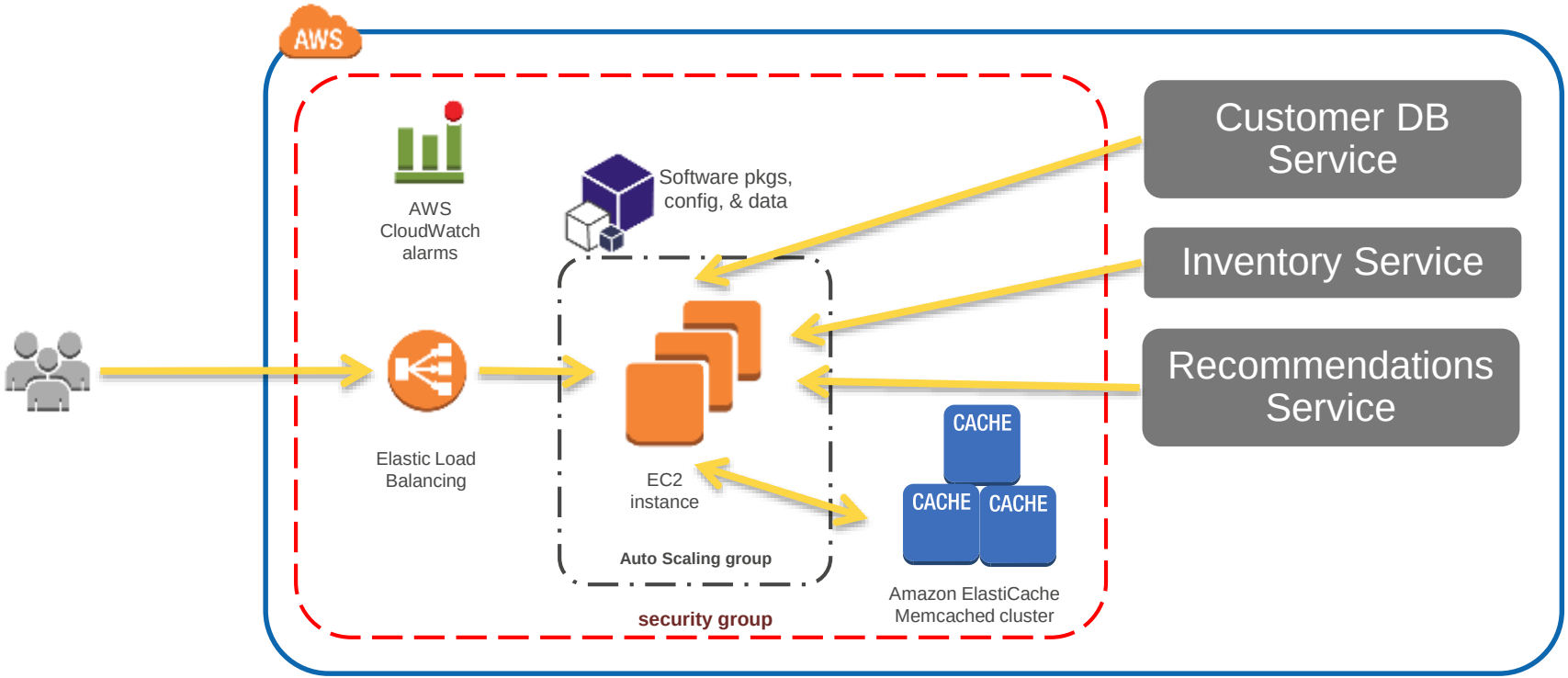
Sample Resources section of a template

```
"Resources" : {
    "EC2Instance" : {
      "Type" : "AWS::EC2::Instance",
      "Properties" : {
        "InstanceType" : { "Ref" : "InstanceType" },
        "SecurityGroups" : [ { "Ref" : "InstanceSecurityGroup" } ],
        "KeyName" : { "Ref" : "KeyName" },
        "ImageId" : { "Fn::FindInMap" : [ "AWSRegionArch2AMI", { "Ref" : "AWS::Region" },
                              { "Fn::FindInMap" : [ "AWSInstanceType2Arch", { "Ref" :
"InstanceType" }, "Arch" ] } ] }
      }
    },
```

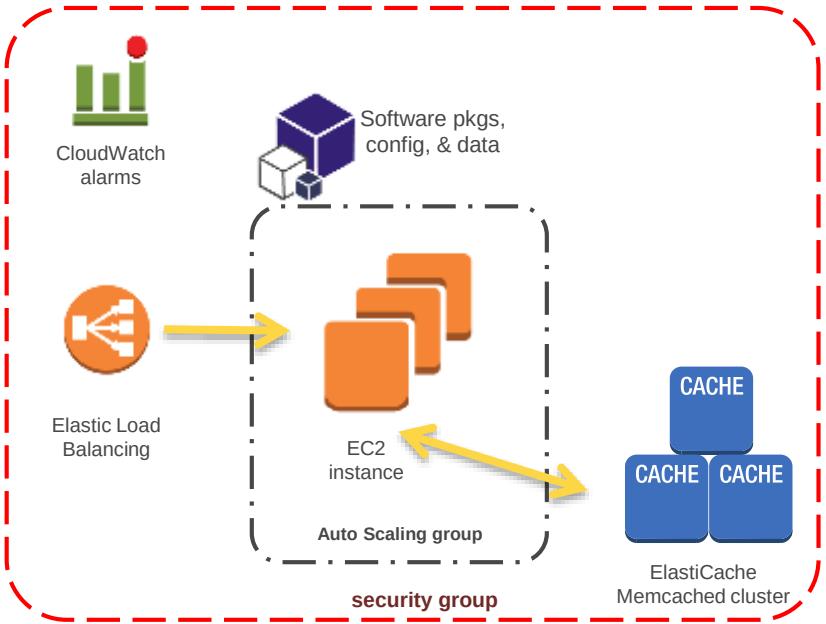
Design–Imagine building a food ordering service



Create template–example for the Food Catalog website



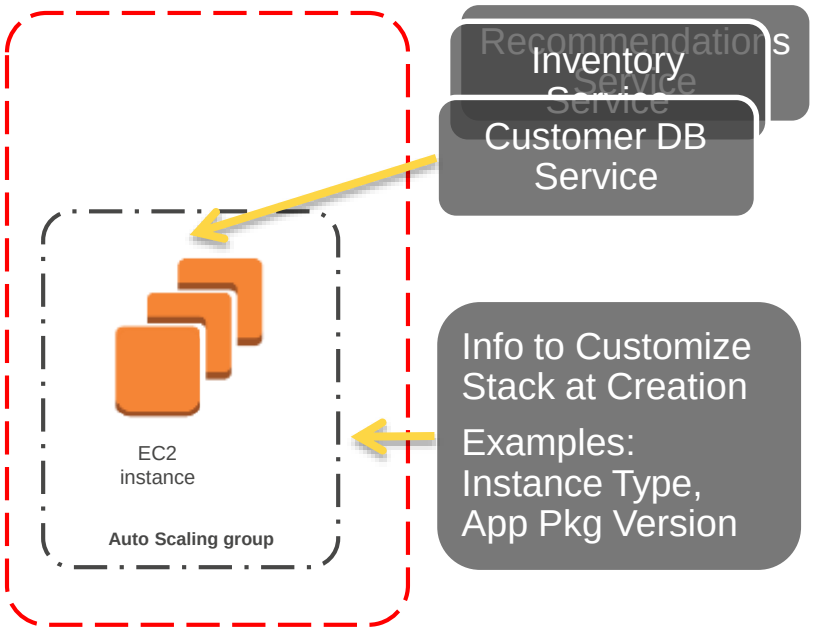
Create template–Resources



CloudFormation template

```
"Resources" : {
    "SecurityGroup" : {},
    "WebServerGroup" : {
        "Type" : "AWS::AutoScaling::AutoScalingGroup",
        "Properties" : {
            "MinSize" : "1",
            "MaxSize" : "3",
            "LoadBalancerNames" : [ { "Ref" :
"LoadBalancer" } ],
            ...
        }
    },
    "LoadBalancer" : {},
    "CacheCluster" : {},
    "Alarm" : {}
},
```

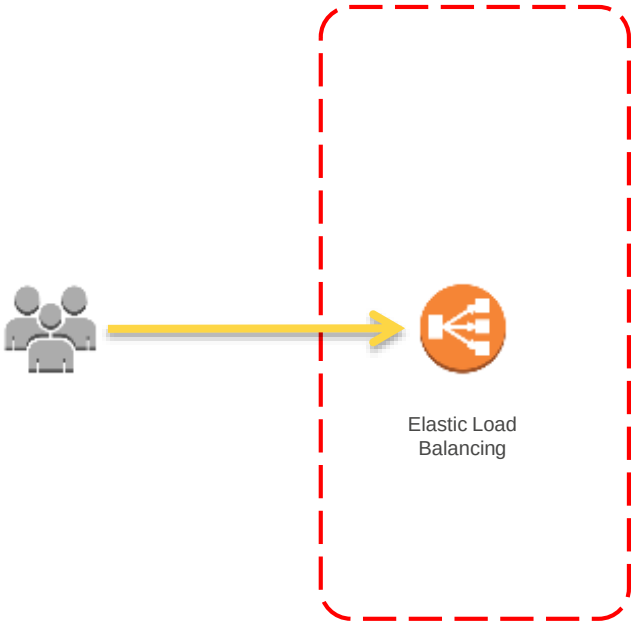
Create template–Parameters



CloudFormation template

```
"Parameters" : {
    "CustomerDBServiceEndPoint" : {
        "Description" : "URL of the Customer DB Service",
        "Type" : "String"
    },
    "CustomerDBServiceKey" : {
        "Description" : "API key for the Customer DB
Service",
        "Type" : "String",
        "NoEcho" : "true"
    },
    "InstanceType" : {
        "Description" : "WebServer EC2 instance type",
        "Type" : "String",
        "Default" : "m3.medium",
        "AllowedValues" :
["m3.medium","m3.large","m3.xlarge"],
        "ConstraintDescription" : "Must be a valid
instance type"
```

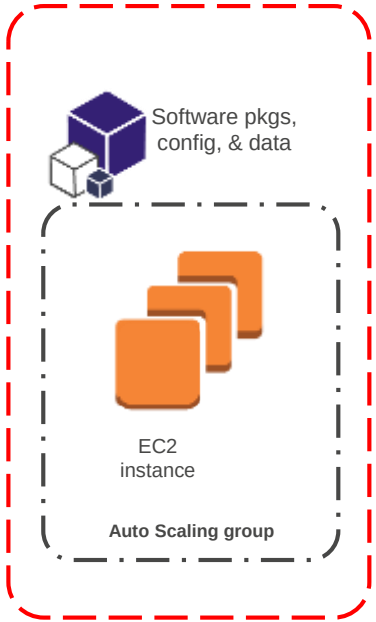
Create template–Outputs



CloudFormation template

```
"Resources" : {
    "LoadBalancer" : {},
    ...
},
"Outputs" : {
    "WebsiteDNSName" : {
        "Description" : "The DNS name of the website",
        "Value" :  {
            "Fn::GetAtt" : [ "LoadBalancer", "DNSName" ]
        }
    }
}
```

Create template–deploy and configure software



CloudFormation template

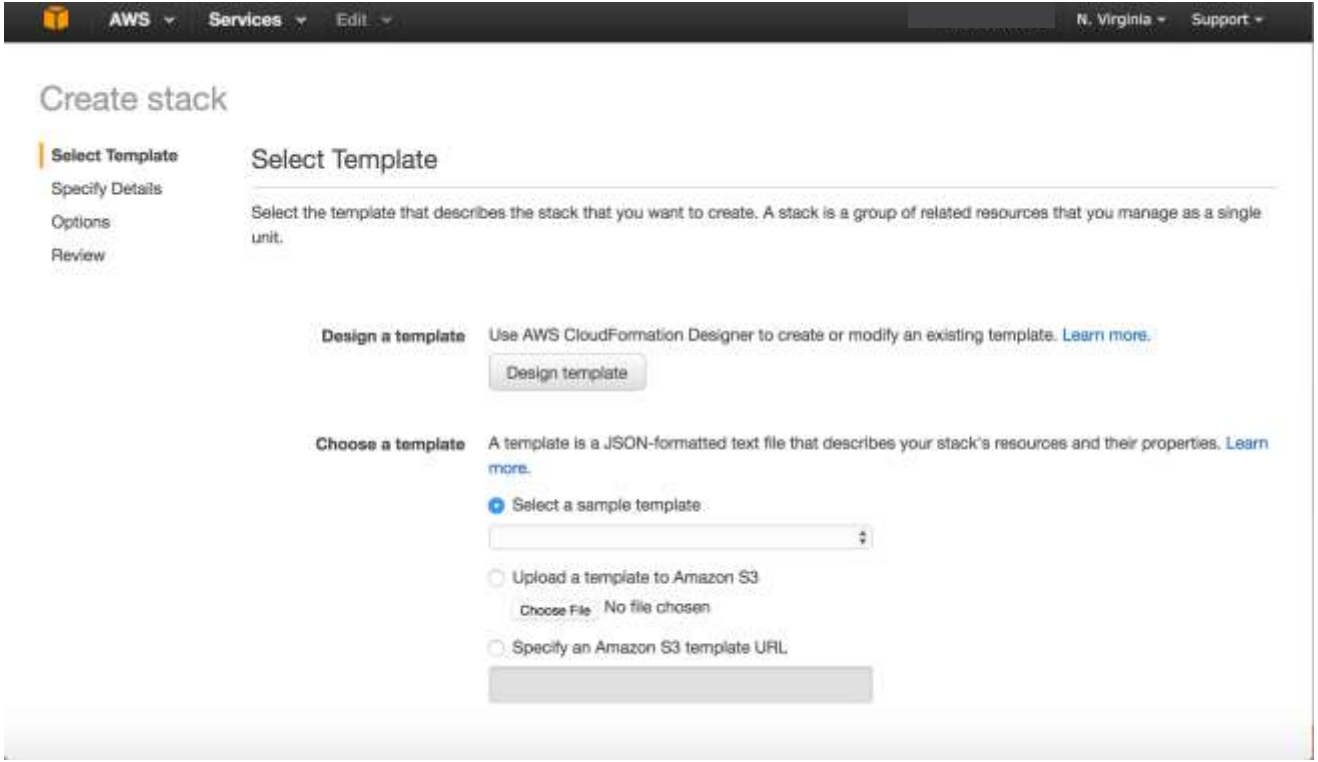
```
"AWS::CloudFormation::Init": {
    "webapp-config": {
        "packages" : {}, "sources" : {}, "files" : {},
        "groups" : {}, "users" : {},
        "commands" : {}, "services" : {}
      },

    "chef-config" : {}
}
```

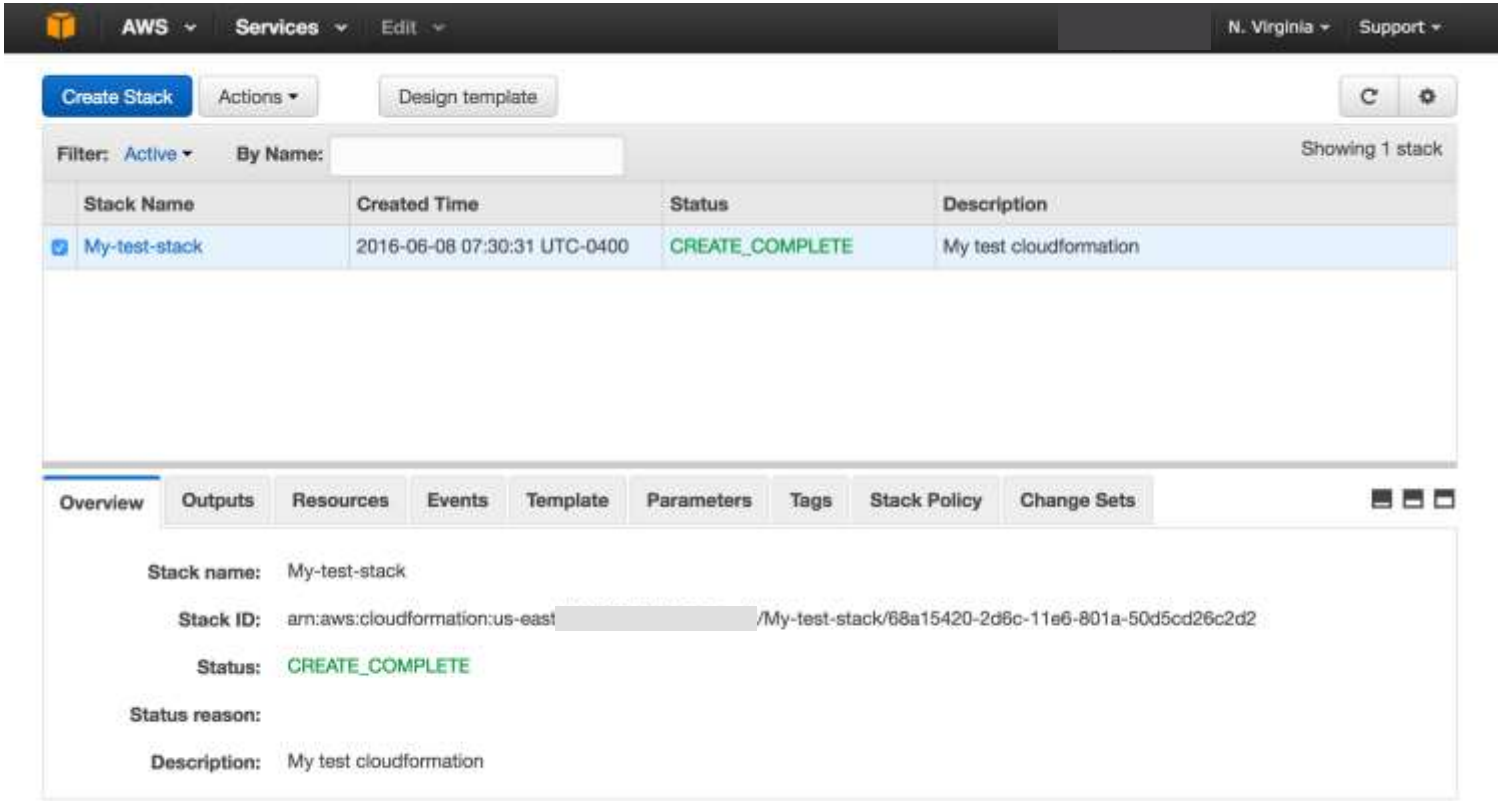
- ✓ Declarative
- ✓ Debuggable
- ✓ Updatable

Create template–language features

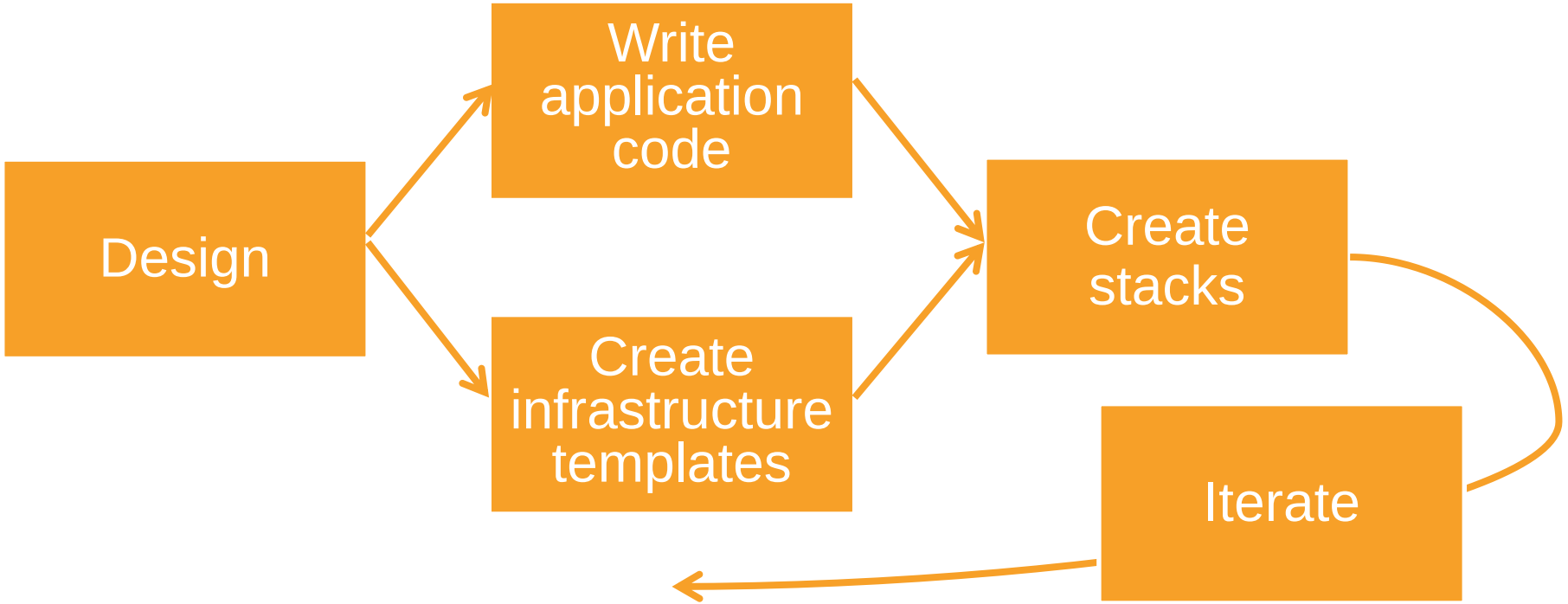
Create stack



Operate stack



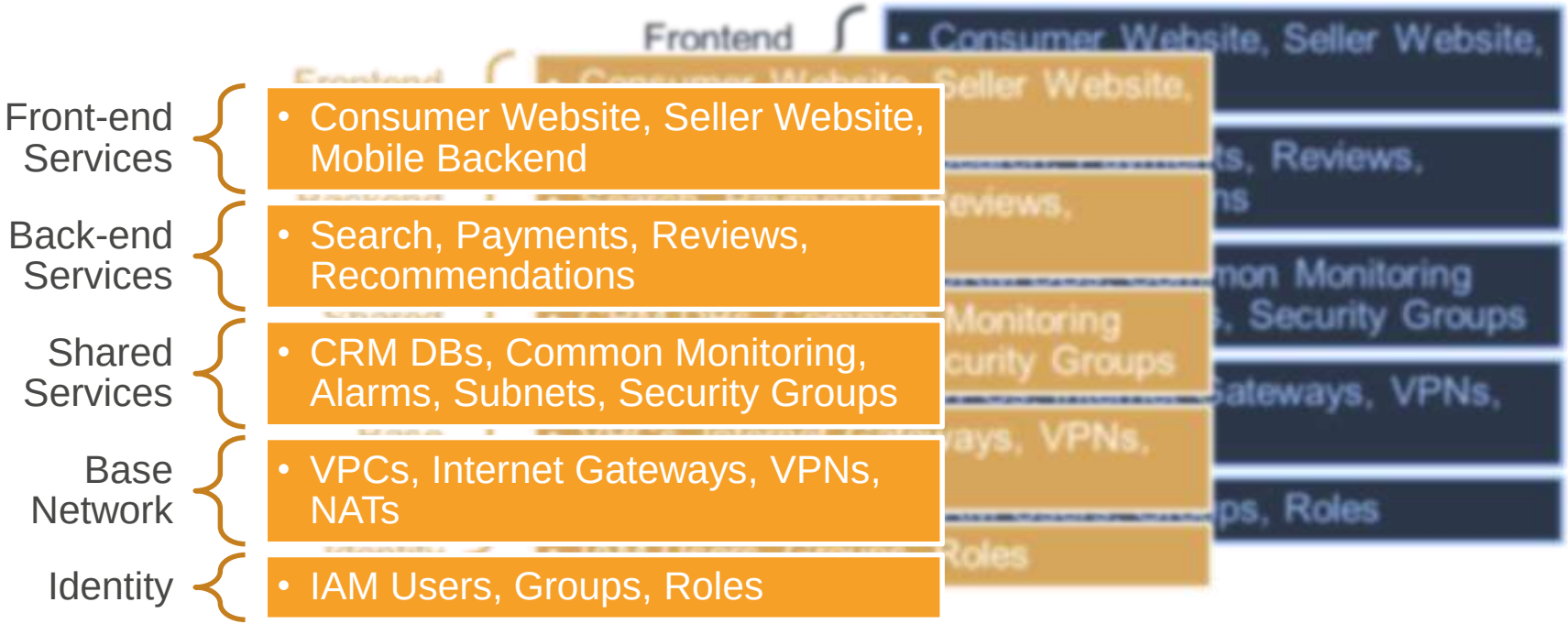
Basic workflow



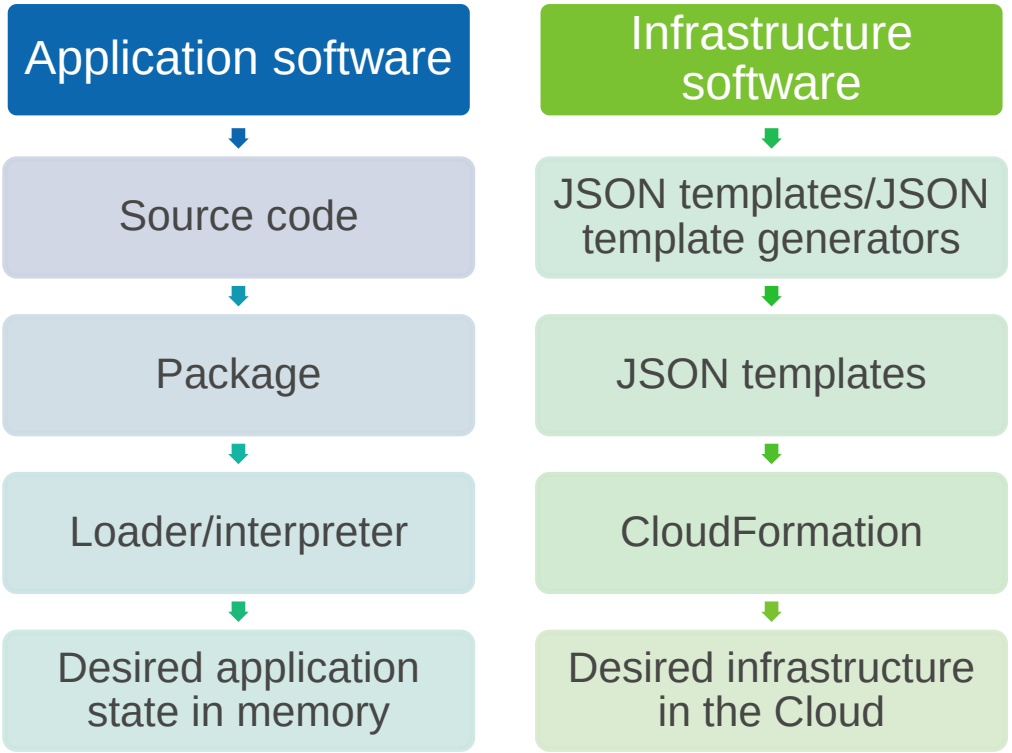
Infrastructure as code workflow

“It’s all software”

“It’s all software”–Organize like it’s software



“It’s all software”–Build and operate like it’s software



Iterate on infrastructure: Update stack

In-place

Faster

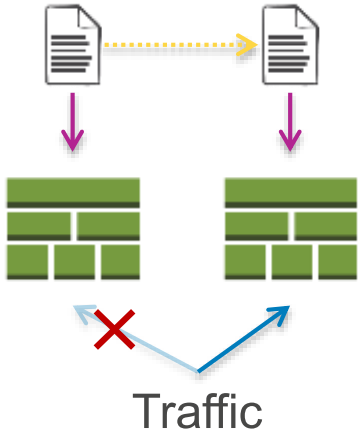
Cost-efficient

Simpler state and data migration

Templates

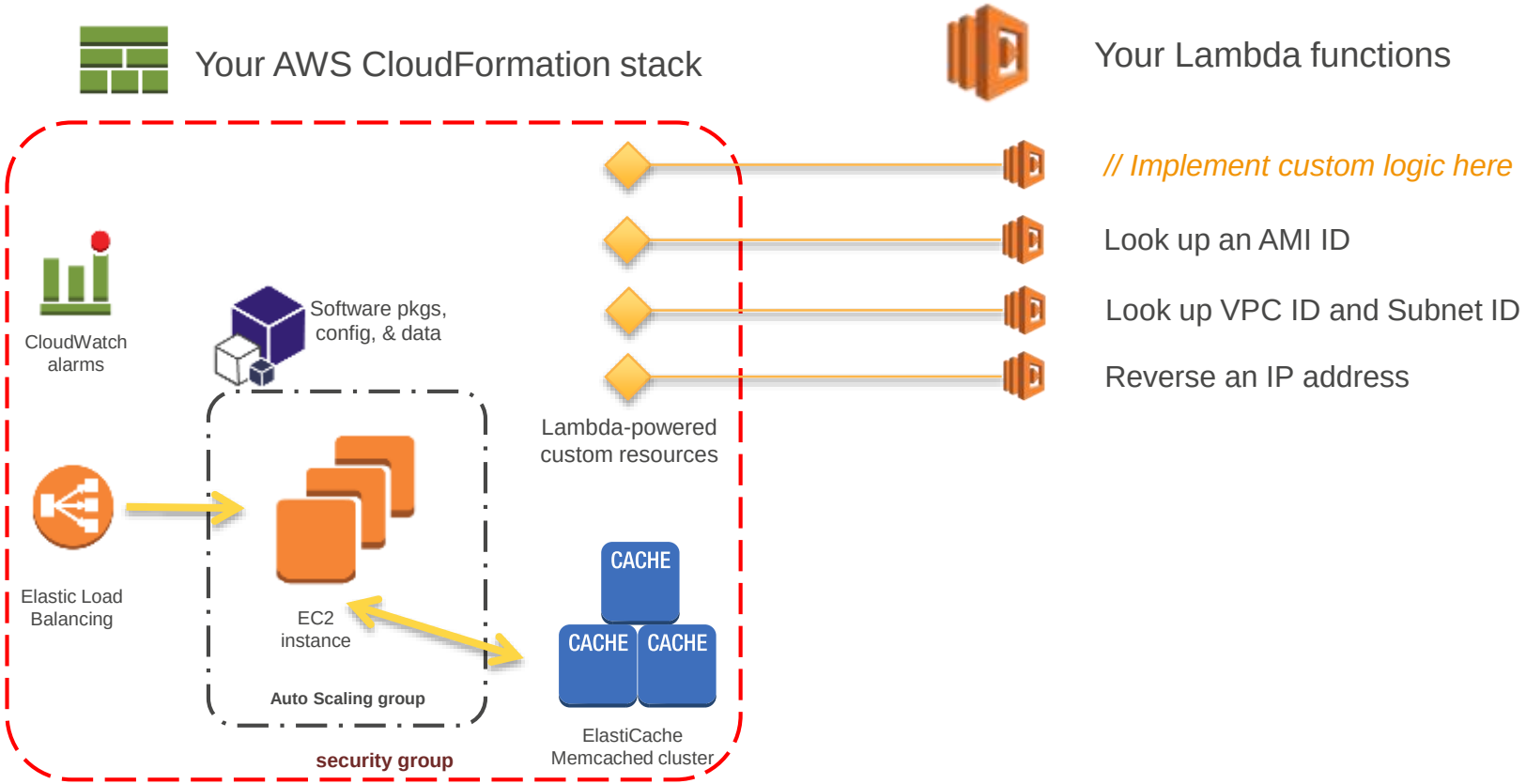
Stacks

Blue/Green

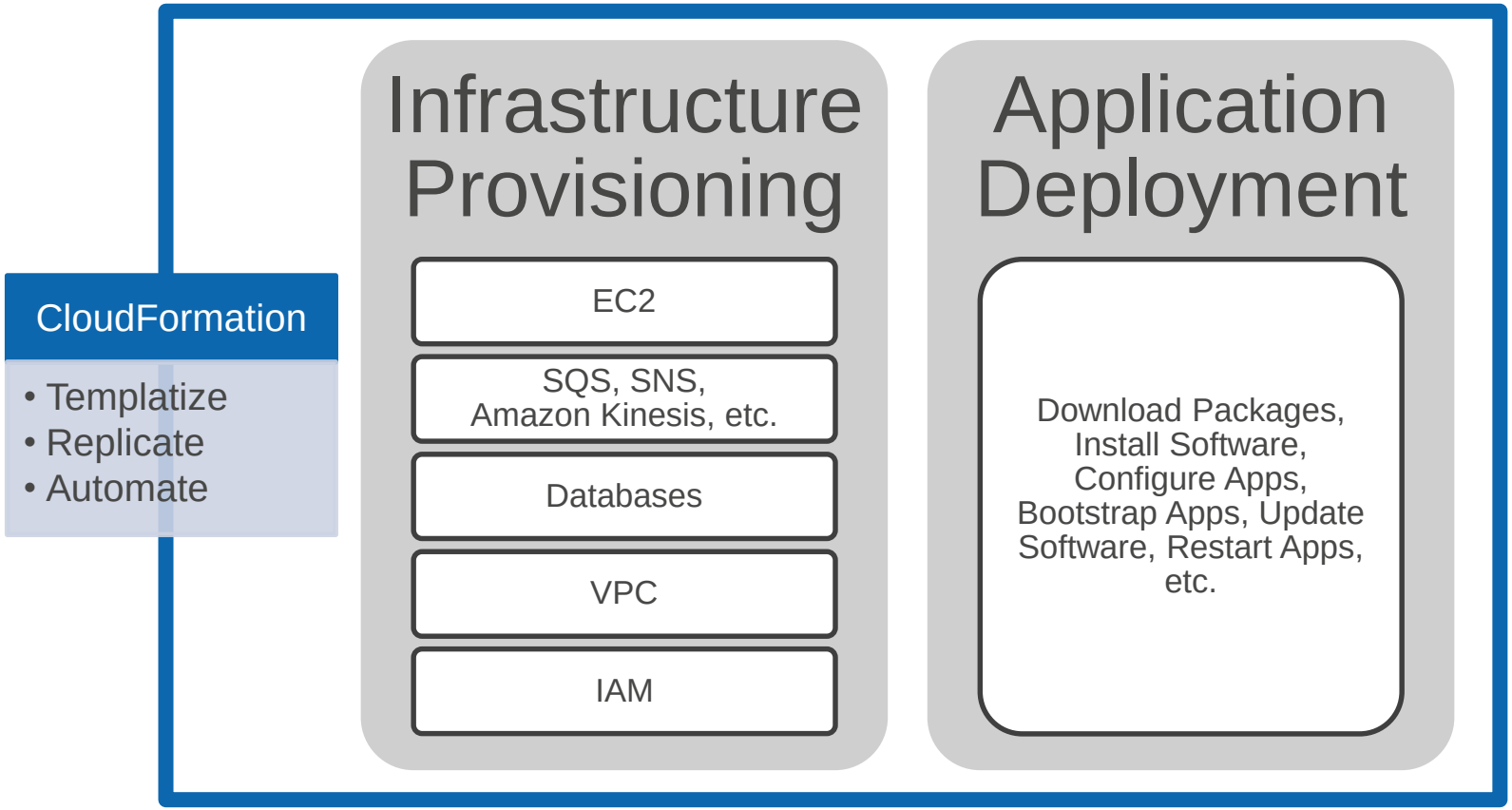


Working stack not touched

Extending CloudFormation: Lambda-backed custom resources



Application deployment as code



Best practices (1 of 2)

- Planning and organizing
  - Organize your stacks by lifecycle and ownership
  - Reuse templates to replicate stacks in multiple environments
  - Verify quotas for all resource types
  - Use nested stacks to reuse common template patterns
- Creating templates
  - Do not embed credentials in your templates
  - Use AWS-specific parameter types
  - Use parameter constraints
  - Validate templates before using them

See: http://docs.aws.amazon.com/AWSCloudFormation/latest/UserGuide/best-practices.html

Best practices (2 of 2)

- Managing stacks
  - Manage all stack resources through CloudFormation
  - Create change sets before updating your stacks
  - Use stack policies
  - Use CloudTrail to log CloudFormation calls
  - Use code reviews and revision controls to manage your templates

See: http://docs.aws.amazon.com/AWSCloudFormation/latest/UserGuide/best-practices.html

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