Navigating the No-Code to Full-Code Spectrum
A Platform Engineering Journey

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Preflight Checks

Why are we building a Platform?

What do we want to accomplish?

Why build a Platform?

Many **dev teams face the same challenges** when deploying cloud infrastructure:

- Know and apply configuration best practices
- Ensure security and compliance
- Integrate into internal IT landscape

The solution:

A centrally managed platform to take the load of off developers so they can focus on their actual goals

We want: a *Universal* API

Many companies rely on a **lot of different technologies** to run their infrastructure and manage their development process.

Developers **need to understand a lot of different tools** and APIs

i.e. RDS, Azure Devops, S3, Artifactory and many more

By building a **central Kubernetes-based platform** we can provide a universal API with the **same set of tools for everything**

We want: a *Declarative* API

Many APIs and tools are designed in an imperative fashion:

- **Different data formats and schemas**
- **No continuously monitored state** unless the system is accessed
- **Manual action required** to update individual components

By building a **Kubernetes-based platform** that relies on **continuous reconciliation and eventual consistency** we allow developers to define their infrastructure in a **GitOps fashion**

We want: a *Simple* API

- Many APIs, i.e. cloud provider's, offer a **huge set of options** to configure infrastructure to specific needs
- Companies put their own regulation regarding compliance and security on top
- **Smaller dev teams don't have the capacity** to manage all theses components.

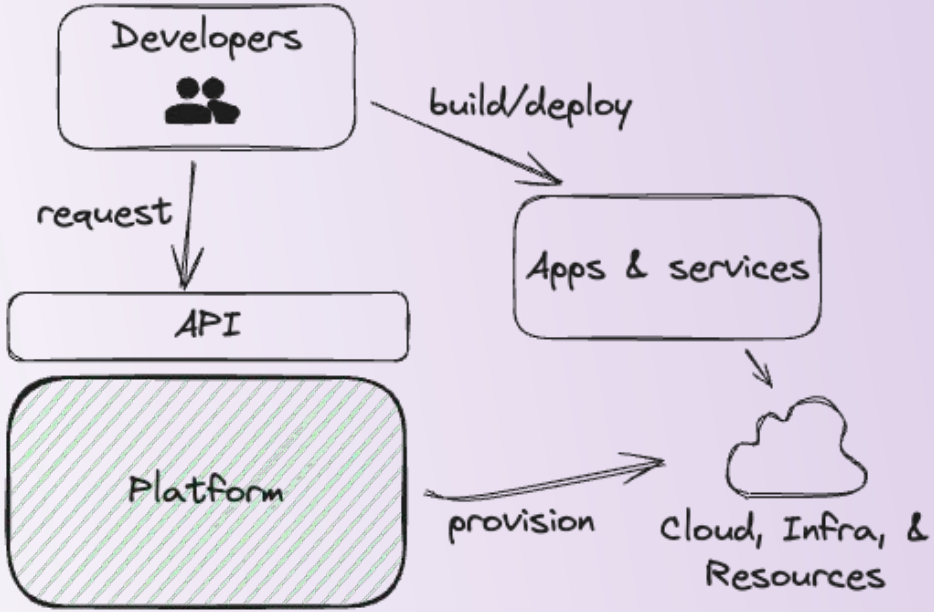
By providing an **abstract platform API with standardized components** we can limit the choice of configuration values, provide **compliance by default** and **simplify operations**.

Step 1: Control Plane

2018 - The Journey Begins

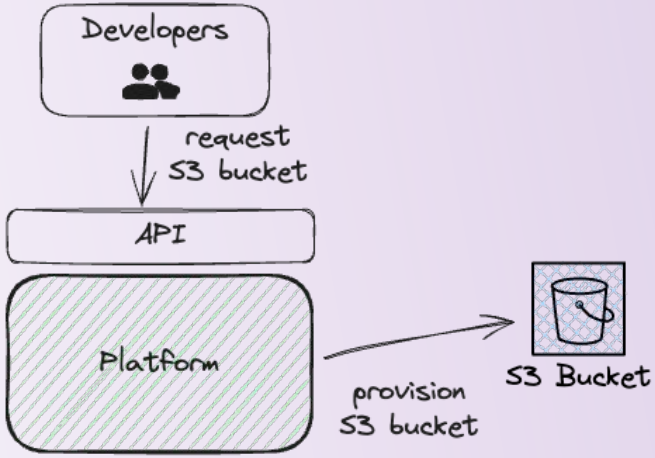
Where do we start?

- Provide developers with infrastructure/resources
- Keep those resources healthy



Platform API Starter Pack

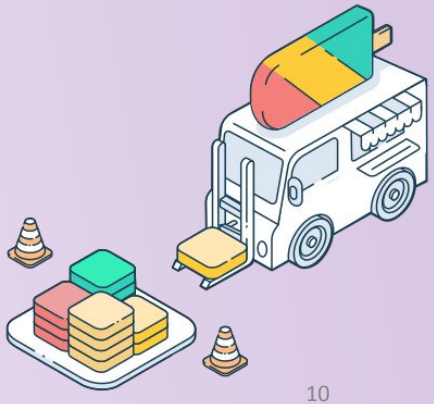
- Developers need to request infra & resources
  - We need an **API**
- Our API could be very **granular** - expose all the things
  - Buckets, VPCs, VMs, IAM Role, etc.
- Devs get what they need and into production **fast**!



Implementation w/ Crossplane

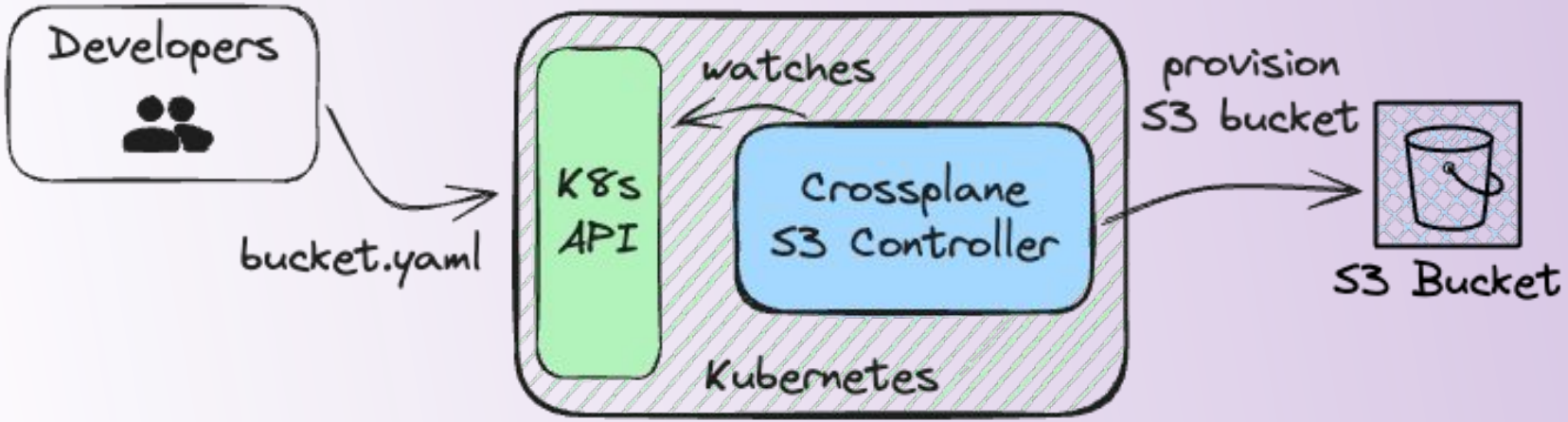
- CNCF open source project
- Extends Kubernetes to manage all your resources
  - **Universal** control plane, unifying all cloud providers & environments
- Each resource is exposed as a CRD in K8s API

```yaml
apiVersion: s3.aws.upbound.io/v1beta1
kind: Bucket
metadata:
  name: cool-bucket
spec:
  forProvider:
    region: us-west-1
    tags:
      team: core
      env: prod
```



Implementation w/ Crossplane

- Desired state is reconciled with actual state in real world



This is NOT a Platform…

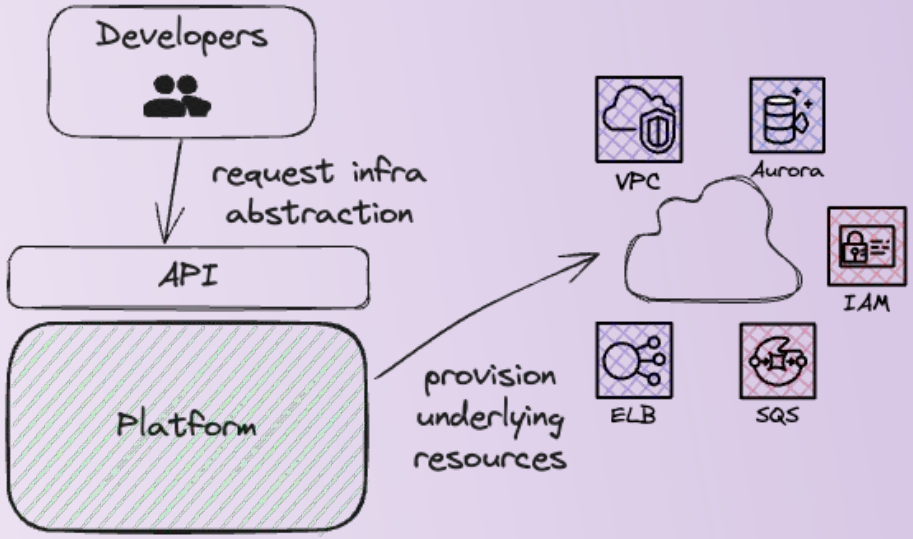
- …at least not a good one!
- No abstraction - everything is exposed
  - forces devs to understand all options & complexity
  - no separation of concerns between platform and devs
- Requires write permissions to low level resources
  - May as well give your devs AWS console access 🤪
- No custom logic or variable configuration
- Not great for building a platform

Step 2: A Real Platform

2020 - Crossplane Compositions

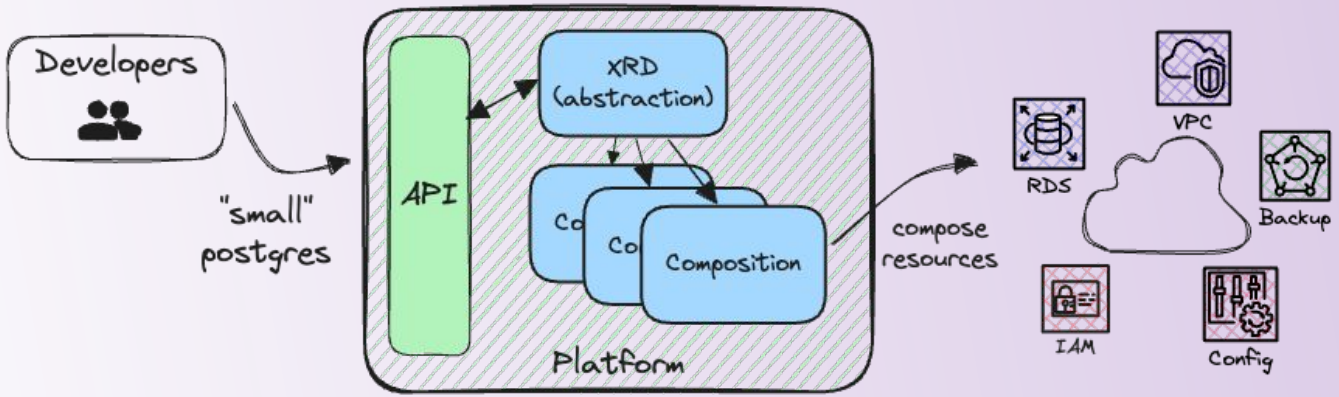
A real platform would …

- Utilize best practices
- Provide compliance by default
- Hide infrastructure complexity
- Provide simple config options
- Reduce manual steps required by devs to setup everything



Compose resources with Compositions

- “Patch-and-Transform” framework
- Generate K8s manifests based on user input and default values
- Crossplane takes care of create, update and delete



Finally, an actual platform

- Universal
- Simple & Abstract

… but we still hit limits

- “Patch-and-transform” is a very limited framework
  - Declarative approach not always possible
  - Can only copy data between input and output resources
- Basically a black box - very hard to debug

Step 3: Higher Level Logic

2023- The previously impossible is now possible

We need more…

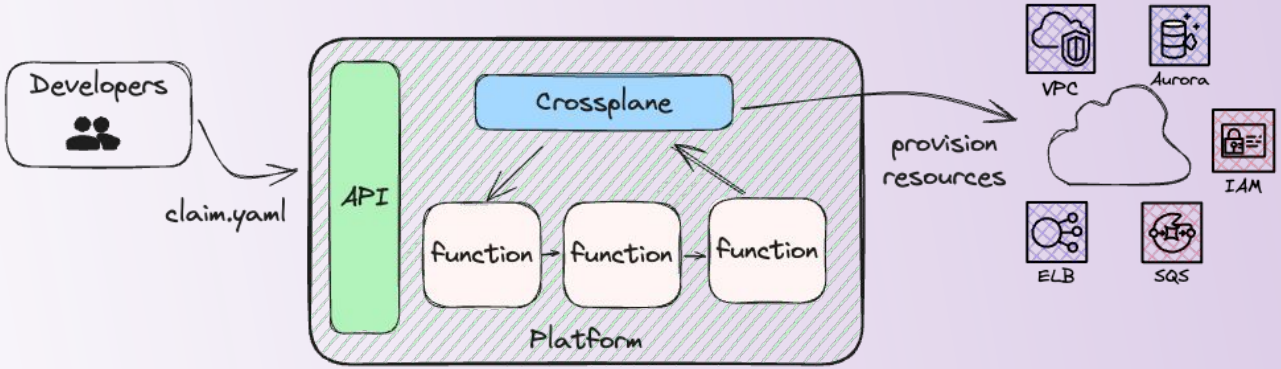
- We have a real platform w/ a real API
  - it’s complex to use but it doesn’t do complex things yet
- We need more advanced logic
  - flow control, conditionals, templating, etc.
  - composition is not a programming language
- We should also escape static YAML hell while we’re at it…

Use case

- Good for an Ops focused platform team that wants
  - a mostly declarative experience
  - to express more complex config and logic without full programming
  - to use a config language they specialize in
- no code → low code → **medium code** → full code

Crossplane Functions

- Run a pipeline of simple functions to compose resources
- Use your language of choice for your unique logic
  - helm/go templating, CUE, KCL, PKL, CEL, etc.
- Let Crossplane do the heavy lifting of CRUD-ing resources, reconciling, finalizers, owner refs, etc.



function-go-templating

```
pipeline:
- step: render-templates
  functionRef:
    name: function-go-templating
  input:
    apiVersion: gotemplating.fn.crossplane.io/v1beta1
    kind: GoTemplate
    inline:
      template: |
        {{- range $i := until ( .observed.composite.resource.spec.count | int ) }}
        apiVersion: iam.aws.upbound.io/v1beta1
        kind: AccessKey
        spec:
          forProvider:
            userSelector:
              matchLabels:
                crossplane.io/name: user-{{ $i }}
        {{- end }}
```

function-kcl

```
pipeline:
- step: render-instances
  functionRef:
    name: kcl-function
  input:
    apiVersion: krm.kcl.dev/v1alpha1
    kind: KCLInput
    spec:
      source: |
        regions = ["us-east-1", "us-east-2"]
        items = [{
            apiVersion: "ec2.aws.upbound.io/v1beta1"
            kind: "Instance"
            metadata.name = "instance-" + r
            spec.forProvider: {
                ami: "ami-0d9858aa3c6322f73"
                instanceType: "t2.micro"
                region: r
            }
        } for r in regions]
```

Thanks @Peefy!

function-cue

```
// if a base ARN exusts, render a policy with all ARNs.
if baseARN != "unknown" {
    let allTuples = list.Concat([
        [baseARN, baseARN + "/*"],
        [
            for a in additionalARNs {[a, a + "/*"]},
        ],
    ])
    let allResources = list.FlattenN( allTuples, 1)
    response: desired: resources: iam_policy: resource: {
        apiVersion: "iam.aws.upbound.io/v1beta1"
        kind:       "Policy"
        metadata: {
            name: "\(compName)-access-policy"
        }
        spec: {
            forProvider: {
                path: "/"
                policy: json.Marshal({
                    Version: "2012-10-17"
                    Statement: [
                        {
                            Sid: "S3BucketAccess"
                            Action: [
                                "s3:GetObject",
                                "s3:PutObject",
                            ]
                            Effect:   "Allow"
                            Resource: allResources
                        },
                    ]
                })
            }
        }
    }
}
```

Thanks @gotwarlost!

Benefits of Functions

- Start using high level languages of your choice
- Get more logic, flexibility, and expressiveness
- Choose the language/UX your team is most comfortable with
  - Mix and match languages if needed
- Lots of supported languages, community keeps building!
- Bonus: Earlier testing and validation
  - Rapid platform dev/testing feedback loop

Step 4: Full Code - Full Power

2024 - General Purpose Programming Languages

Certain use cases require a full scale programming language

- Multi-step setups (i.e. tenant onboarding)
- Complex transformations
- Easy code sharing between components
- Ability to unit tests certain features
- … or developers just prefer Go over KCL, CUE or YAML

Custom functions in Go

- Full code - full power - full complexity
- Import CRD structs from Crossplane providers
  - Static code validation ensured by Go compiler
- Access the whole Go toolchain
  - Linters
  - Unit tests
  - Code generators (Kubebuilder etc.)

Functions are modular!

- We don’t have to write everything in Go

E2E Tests in Go

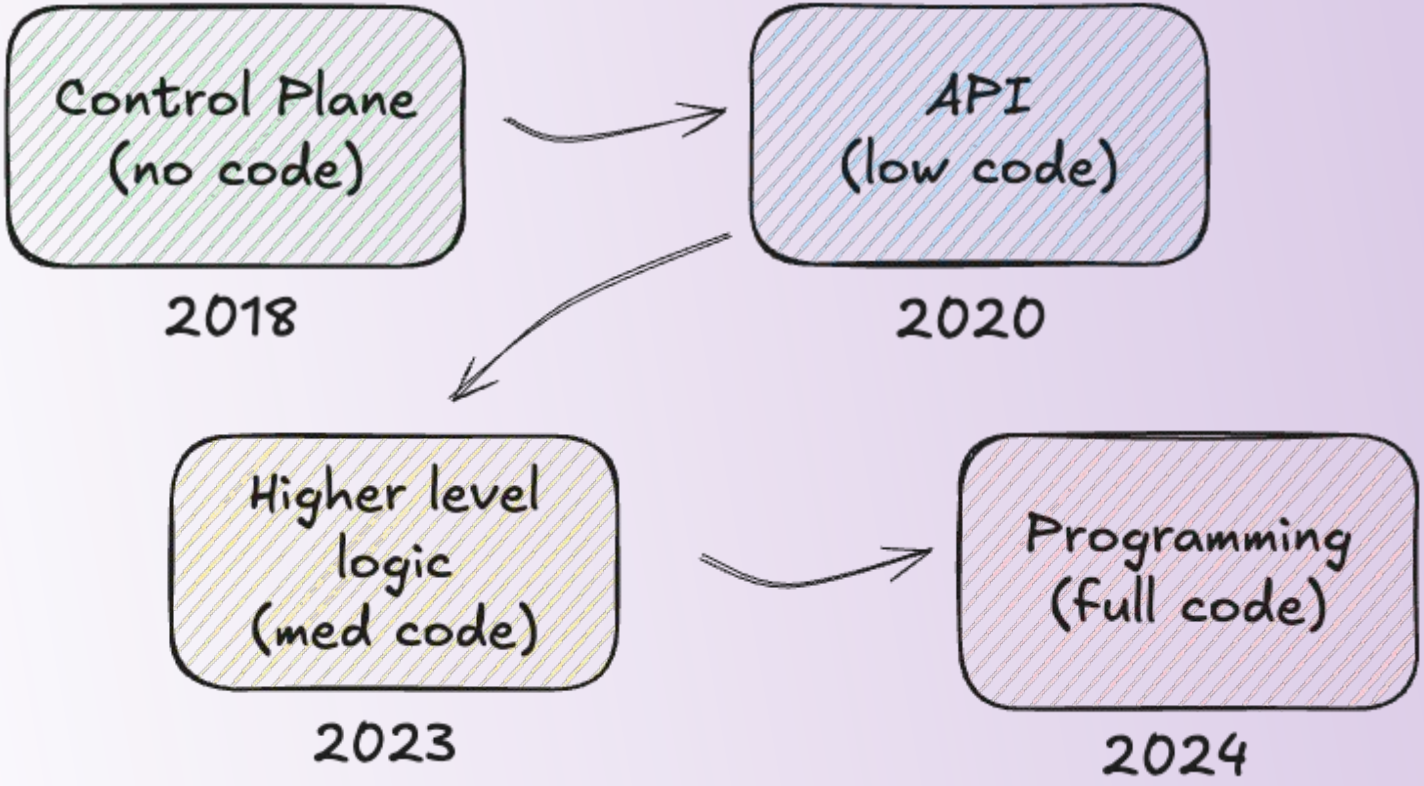
Treat your platform as a real software project

Replay full real-life use cases as Go tests before every rollout

1. Create resource claims
2. Wait until resources get ready
3. Access external system (like a real user)
4. Work with the external system (like a real user)

Platform Journey in Summary

Let’s review…



API that is Universal, Declarative, Simple …and Powerful

Links for further reference

Crossplane:

- Website: crossplane.io
- GitHub: github.com/crossplane/crossplane
- Slack: slack.crossplane.io

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