Introduction to Crossplane

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Deutsche Kreditbank

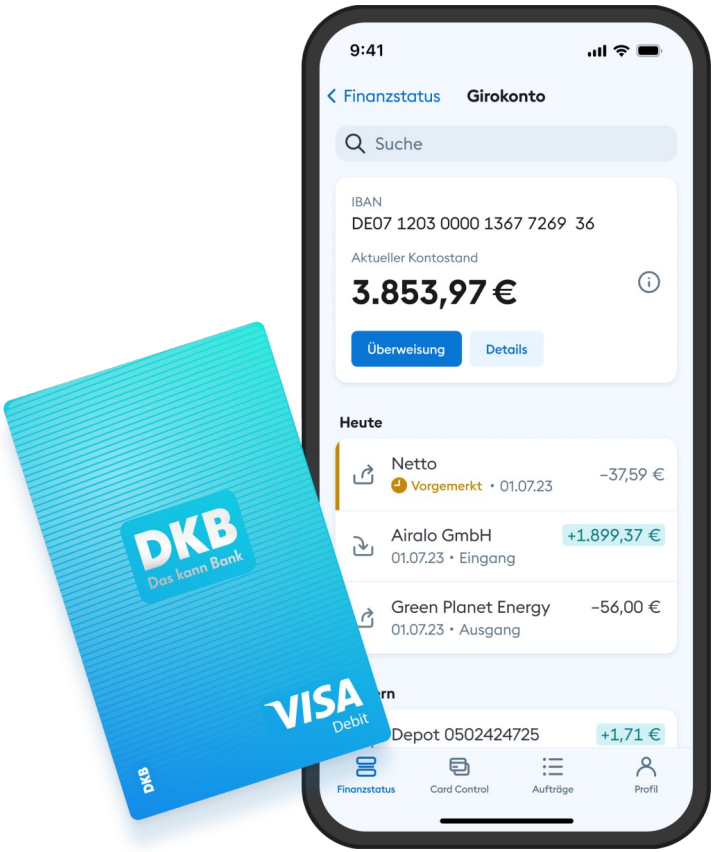
founded 1990

direct bank for private customers

- over 5 million customers
- over 5000 employees

investment bank for specific branches

- largest financer for renewable energy in Germany



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Why Crossplane at DKB?

our goal: promote **product team responsibility** -> “you build it, you run it”

... but product teams cannot bridge all required technical and bank-specific skills

Our platform is leveraging Crossplane to provide **platform building blocks** managed by the relevant teams

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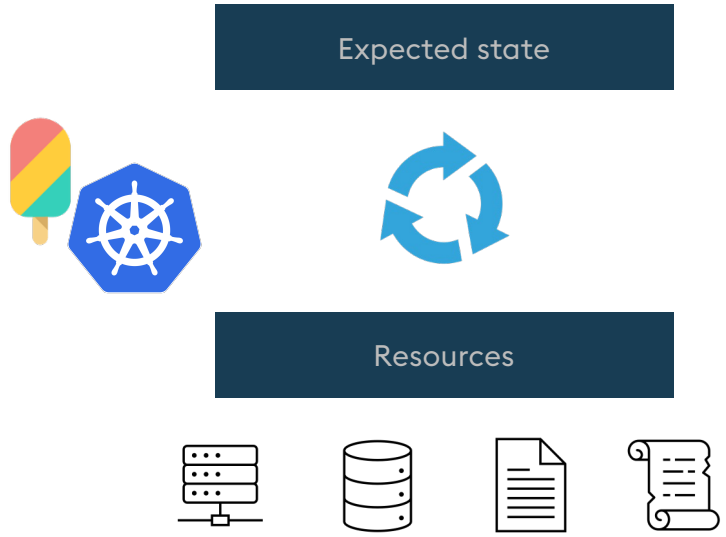
What is Crossplane?

Crossplane allows to run a resource control plane on top of Kubernetes.

Crossplane is an incubating CNCF project, mostly run by upbound.io.

Main features:

- Extension to the Kubernetes API
- Manage ***resources*** as code
- Automatically ***reconciles*** resources
- Provides a higher abstraction layer (***composite resources***), allowing better control of the relations between resources



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Crossplane and Kubernetes
Kubernetes API

What is Kubernetes?

Most people know Kubernetes as a ***container orchestration system***

Kubernetes also defines an ***extensible API*** that can be used to define your platform

Crossplane extends the Kubernetes API to manage resources located inside or outside Kubernetes

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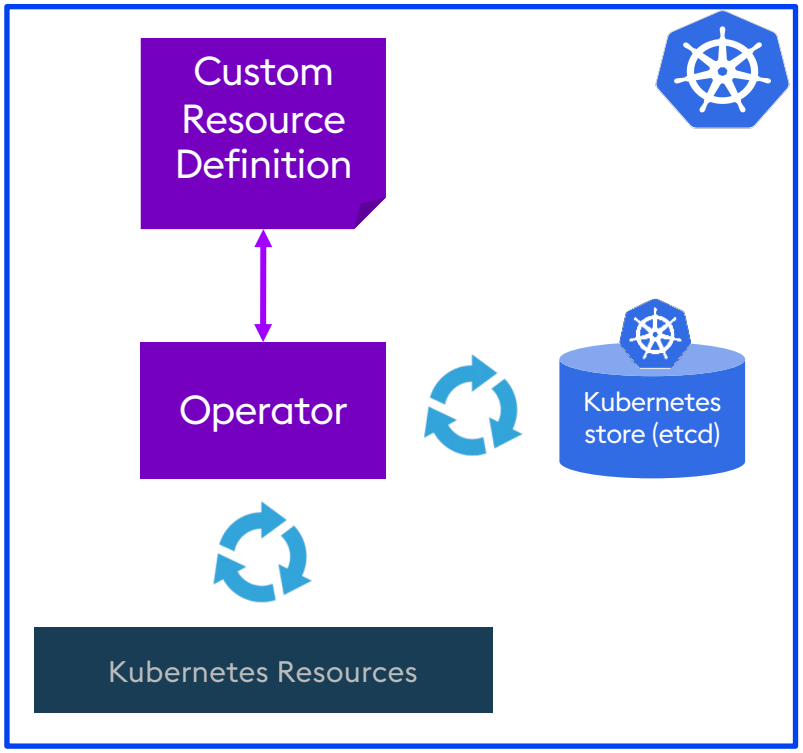
Crossplane and Kubernetes Operator pattern

Core Kubernetes objects are defined by YAML Resource Definitions.

Kubernetes allows to define custom objects through ***Custom Resource Definitions***.

CRDs are managed by ***Operators***, which are ensuring that resources are staying synchronized with their definition.



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Crossplane – Managed Resources and Providers

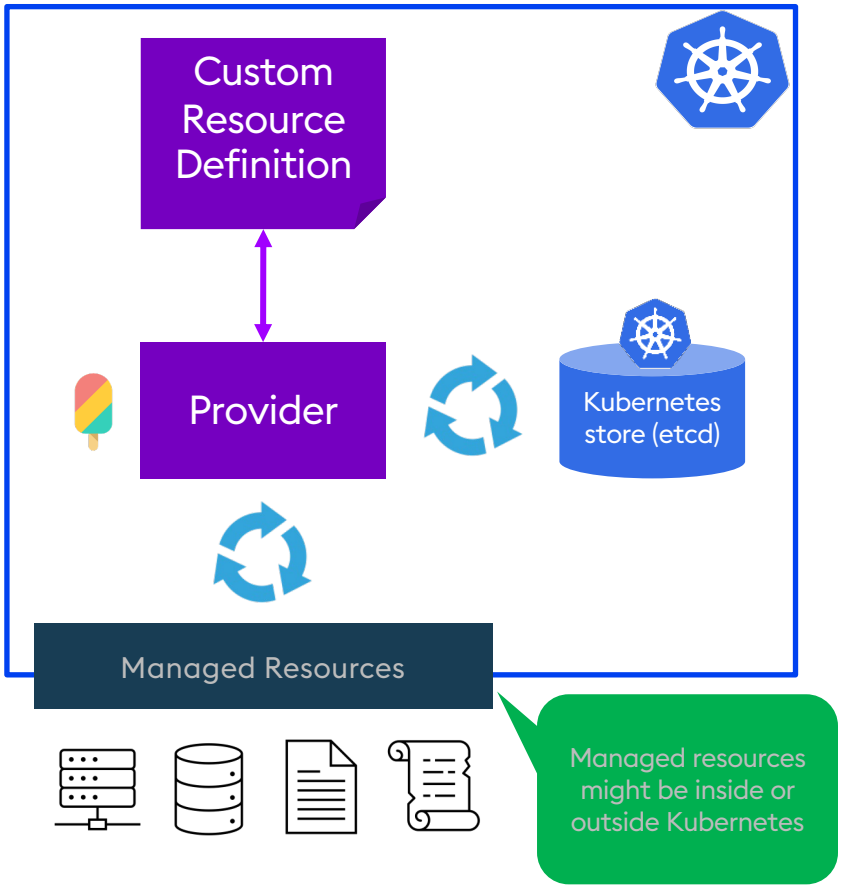
Crossplane allows to work with internal or external resources transparently by introducing the concept of ***Resource Providers***.

Resources under control of Crossplane are referred to as ***Managed Resources***.

Many open-source providers are available for different kinds of resources.

Crossplane providers can be generated from Terraform providers.

Custom providers can be created (in Go) for custom resources.



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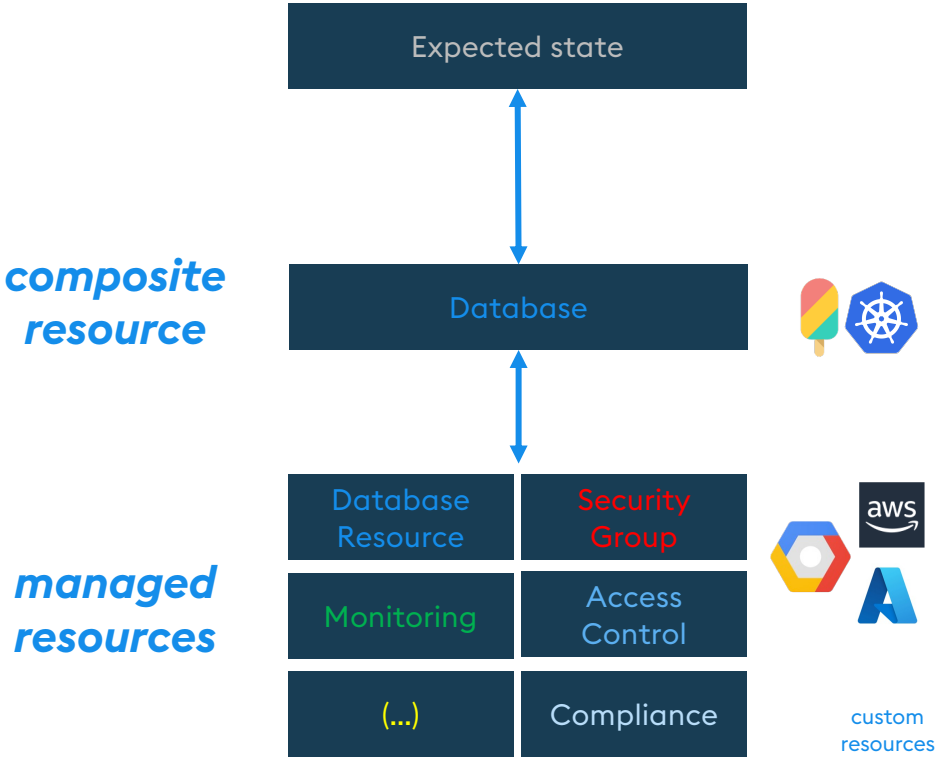
Crossplane – Composite resources

Managed resources can be aggregated into ***composite resources***.

This can be used to provide a better user experience, for example by simplifying the interface or enforcing compliance.

The API for a composite resource is defined by a ***Composite Resource Definition*** (XRD)

Its implementation is described in a ***Composition***.



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Crossplane example

composite resource

Crossplane ***PostgreSQL claim***

```yaml
apiVersion: rds.aws.dkb.cloud/v1alpha1
kind: DBInstance
metadata:
  name: example-dbinstance
  namespace: example-db
  labels:
    controlling.dkb.cloud/cost-type: "854749"
    controlling.dkb.cloud/owner: dpt-test_AT_dkb.ag
    tags.dkb.cloud/account: "0000000001"
    tags.dkb.cloud/zone: "dev"
    tags.dkb.cloud/environment: "dev"
    tags.dkb.cloud/protection-requirement: "dev"
  annotations:
    kustomize.toolkit.fluxcd.io/prune: disabled
spec:
  forProvider:
    region: eu-central-1
    allocatedStorage: 20
    autoMinorVersionUpgrade: true
    autogeneratePassword: true
    backupRetentionPeriod: 14
    dbInstanceClass: db.t3.micro
    dbName: example
    engine: postgres
    preferredBackupWindow: "7:00-8:00"
    preferredMaintenanceWindow: "Sat:8:00-Sat:11:00"
    publiclyAccessible: false
    skipFinalSnapshot: true
    storageType: gp2
  writeConnectionSecretToRef:
    name: example-dbinstance-connection
  providerConfigRef:
    name: 0000000001-cat
```

(claim = request for a composite resource)

`kubectl apply`

managed resources

RDSInstance

```
Db:
  API Version:  database.aws.crosspla
  Kind:         RDSInstance
  Name:                              269j
  Status:
    At Provider:
      Db Instance Arn:     arn:aws:rd
      Db Instance Status:  configurin
      Db Parameter Groups:
        Db Parameter Group Name:  def
        Parameter Apply Status:   in-
      Db Resource Id:             db-
      Db Subnet Group:
        Db Subnet Group Description:
        Db Subnet Group Name:
        Subnet Group Status:
```

DBSubnetGroup

```
Cnp - Postgres - Dbsubnetgroup:
  API Version:  database.aws.crossplane.io/
  Kind:
  Name:                                -269j4
  Status:
    At Provider:
      Arn:     arn:aws:rds:eu-cent
      State:  Complete
      Subnets:
        Subnet ID:      subnet-7
        Subnet Status:  Active
        Subnet ID:      subnet-c
        Subnet Status:  Active
        Subnet ID:      subnet-4
        Subnet Status:  Active
      Vpc Id:           vpc-348d
    Conditions:
      Last Transition Time:  2021-10-07T09
      Reason:                Available
```

SecurityGroup

```
Sg:
  API Version:  ec2.aws.crossplane.io/v1beta1
  Kind:         SecurityGroup
  Name:                              -269j4
  Status:
    At Provider:
      Owner Id:           430
      Security Group ID:  sg-(              3c5
    Conditions:
      Last Transition Time:  2021-10-07T09:58:
      Reason:                Available
      Status:                True
      Type:                  Ready
      Last Transition Time:  2021-11-09T11:30:
      Reason:                ReconcileSuccess
      Status:                True
      Type:                  Synced
```

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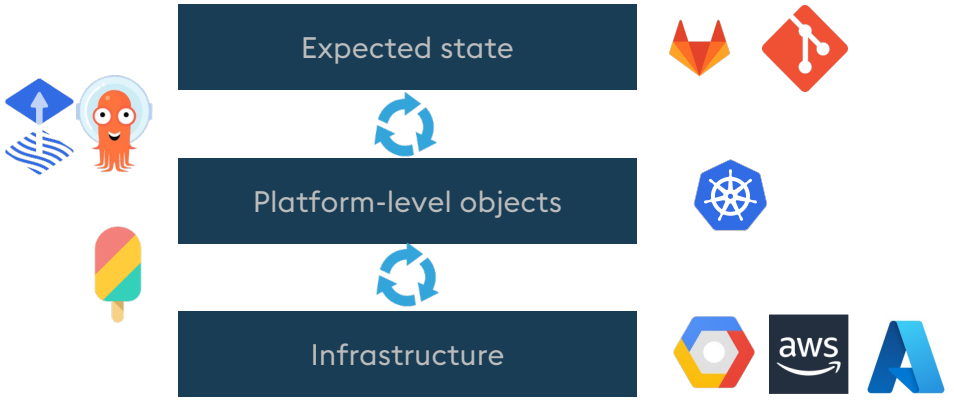
Crossplane and GitOps

The expected state is stored in a code repository, and synchronized using ***GitOps***.

GitOps principles:

- git repository describing the infrastructure is synchronized with the platform
- manual platform operations are discouraged

This can be implemented with ***Argo CD*** or ***Flux*** for example.



https://about.gitlab.com/topics/gitops/

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Lessons learned
Team organization

Start small and focused

- Spend time directly with customer stakeholders in the beginning, rather than only with internal organization
- Start with a small platform engineering team and expand when needed

Aim for short feedback loops

- Start with an “officially experimental” platform (MVP, not prototype)
- Identify the best pilot users (easy to work with, provide good feedback)
- Clearly document the state of the platform features

Lessons learned
Communication with consumers

Explain the platform concepts well

- Crossplane involves a lot of abstraction that is not trivial for everyone, especially for developers not used to cloud-native.

Be ready to assist consumers technically

- Readily available developer information usually documents access to the cloud API, not Crossplane. Developers will need help to convert this to Crossplane.
- “Embed” engineers in the consumer teams if needed, or create a specific sub-team.

Define consumer application components well

- Clarify what are the important components and how their health can be assessed.
- Good monitoring + clear SLIs/SLOs are very useful to quickly identify issues when troubleshooting.

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Lessons learned
GitOps and Operations

Separate application code and expected resources state

- use different directories or repos
- standardize the structure as much as possible
- simplifies operations and troubleshooting

Work on the main branch for expected resources state

- allows to troubleshoot effectively, especially when different people are involved
- allows for reviews of the environment without direct production access

Train Operations to work with Crossplane

- Operations are typically not used to work with GitOps and reconciliation
- Operations must understand very well how the infrastructure is defined, so that they can easily make modifications

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