

PostgreSQL & Kubernetes



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- DevOps ~20 ans
  - Go, Python (Django)
  - Oracle, MySQL puis PostgreSQL



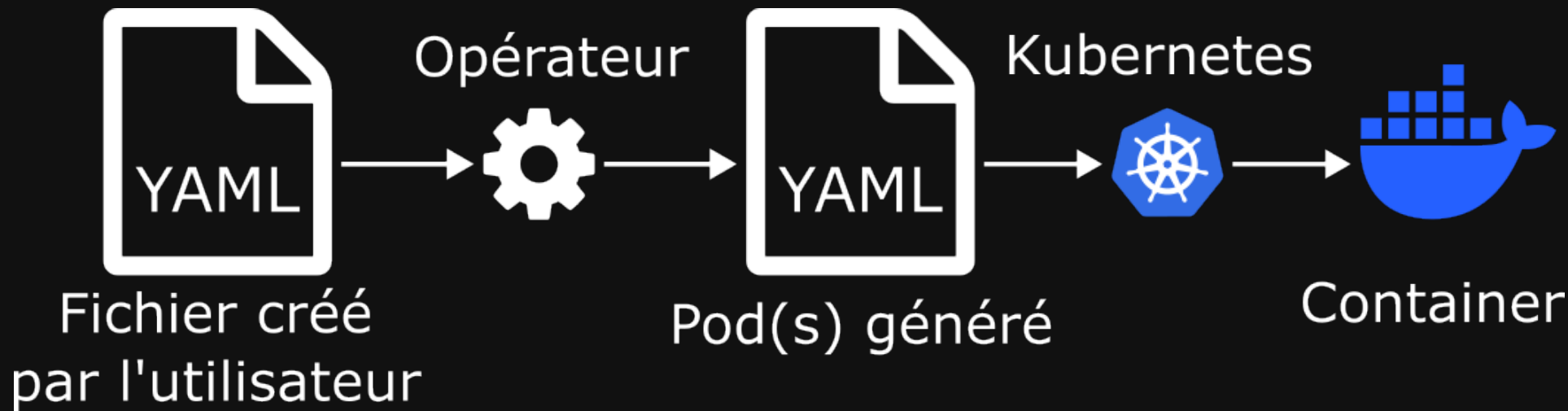
# Bleəmeo

- Solution SaaS de monitoring
- Backend : Python / Django
- PostgreSQL depuis + 10 ans

# Kubernetes 101

- Orchestrateur de containers (Pod)
- Déclaratif (fichier yaml)
- Extensible via des opérateurs Kubernetes

# Opérateur Kubernetes



# Opérateurs PostgreSQL

- Stolon
  - ⊕ Fonctionne sans Kubernetes
  - ⊕ Plutôt simple à prendre en main
  - ⊖ Maintenance peu active
- Zalando Postgres Operator
  - ⊕ Solution mature, utilise Patroni
  - ⊖ Prise en main plus complexe
- CloudNative PG
  - ⊕ Bonne intégration à Kubernetes
  - ⊕ Simple à prendre en main

# Création d'un Cluster

Définition déclaratif :

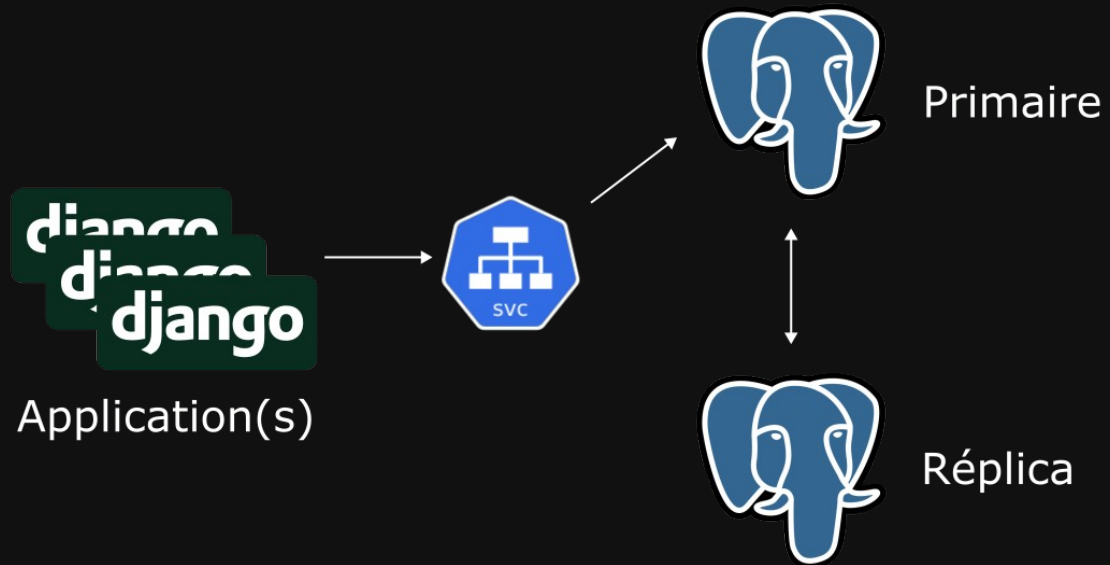
- Paramètres
- Extension à charger
- Changement à chaud (quand c'est possible)

```
apiVersion: postgresql.cnpg.io/v1
kind: Cluster
metadata:
  name: myproject-postgresql18
spec:
  instances: 2
  postgresql:
    shared_preload_libraries:
      - pg_stat_statements
    parameters:
      shared_buffers: "128MB"
  bootstrap:
    initdb:
      database: myproject
      owner: myproject_user
  storage:
    size: 5Gi
```

# Application

```
env:
  - name: DATABASE_URL
    valueFrom:
      secretKeyRef:
        name: myproject-postgresql18-app
        key: fqdn-uri
```

```
# Content of secret myproject-postgresql18-app
data:
  dbname: test
  fqdn-jdbc-uri: jdbc:postgresql://myproject-postgres
  fqdn-uri: postgresql://test_user:gZI8jjyQXnSj0VZj01
  host: myproject-postgresql18-rw
  jdbc-uri: jdbc:postgresql://myproject-postgresql18-
  password: gZI8jjyQXnSj0VZj01onBP20obXa6cbZ8ioLzyzqL
  pgpass: myproject-postgresql18-rw:5432:test:test_us
  port: 5432
  uri: postgresql://test_user:gZI8jjyQXnSj0VZj01onBP2
  user: test_user
  username: test_user
```



# Création d'un Cluster (suite)

```
apiVersion: postgresql.cnpg.io/v1
kind: Cluster
metadata:
  name: postgresql-test
spec:
  # Specify version to avoid relying on default version
  imageName: ghcr.io/cloudnative-pg/postgresql:18.3

  # Set timeout for faster shutdown / startup
  smartShutdownTimeout: 15
  stopDelay: 120
  switchoverDelay: 120
  startDelay: 300

  resources:
    requests:
      memory: "600Mi"
      cpu: "200m"
  [...]
```

# Noeud dédié

```
$ kubectl describe nodes ip-10-20-30-40.eu-west-3.compute.intern
Name:          ip-10-20-30-40.eu-west-3.compute.internal
Roles:         postgres
Labels:        node-role.kubernetes.io/postgres=
               beta.kubernetes.io/instance-type=r5.large
[...]
Taints:        node-role.kubernetes.io/postgres:NoSchedule
[...]
```

```
[...]
resources:
  requests:
    memory: "19Gi"
    cpu: "2000m"

affinity:
  enablePodAntiAffinity: true
  topologyKey: kubernetes.io/hostname
  podAntiAffinityType: required
  nodeSelector:
    node-role.kubernetes.io/postgres: ""
  tolerations:
  - key: node-role.kubernetes.io/postgres
    operator: Exists
    effect: NoSchedule
```

# Sauvegarde

```
[...]
  name: myproject-postgresql18-s3-store
spec:
  configuration:
    destinationPath: s3://my-bucket/myproject-backup-postgresql18
    s3Credentials:
      inheritFromIAMRole: true
    wal:
      compression: gzip
[...]
```

```
plugins:
- name: barman-cloud.cloudnative-pg.io
  isWALArchiver: true
  parameters:
    barmanObjectName: myproject-postgresql18-s3-store
    # Increment this after each restore
    serverName: "epoc-1"
```

```
apiVersion: postgresql.cnpg.io/v1
kind: ScheduledBackup
metadata:
  name: myproject-postgresql18-daily-backup
spec:
  # Everyday 7h30 (UTC)
  schedule: "0 30 7 * * *"
  # Do a backup just after server creation
  immediate: true
  backupOwnerReference: self
  cluster:
    name: myproject-postgresql18
  method: plugin
  pluginConfiguration:
    name: barman-cloud.cloudnative-pg.io
```

# Monitoring

```
# HELP cnpg_pg_stat_database_tup_updated Number of rows updated by queri
# TYPE cnpg_pg_stat_database_tup_updated counter
cnpg_pg_stat_database_tup_updated{datname=""} 8
cnpg_pg_stat_database_tup_updated{datname="postgres"} 4
cnpg_pg_stat_database_tup_updated{datname="template0"} 0
cnpg_pg_stat_database_tup_updated{datname="template1"} 765
cnpg_pg_stat_database_tup_updated{datname="test"} 3.29499e+06
# HELP cnpg_pg_stat_database_xact_commit Number of transactions in this
# TYPE cnpg_pg_stat_database_xact_commit counter
cnpg_pg_stat_database_xact_commit{datname=""} 0
cnpg_pg_stat_database_xact_commit{datname="postgres"} 21306
cnpg_pg_stat_database_xact_commit{datname="template0"} 0
cnpg_pg_stat_database_xact_commit{datname="template1"} 1932
cnpg_pg_stat_database_xact_commit{datname="test"} 1.117582e+06
# HELP cnpg_pgbench_accounts_balance_sum Sum of balance of accounts
# TYPE cnpg_pgbench_accounts_balance_sum gauge
cnpg_pgbench_accounts_balance_sum -1.899779e+06
# HELP cnpg_pgbench_accounts_total Number of accounts in pgbench table
# TYPE cnpg_pgbench_accounts_total gauge
cnpg_pgbench_accounts_total 2.5e+06
```

```
data:
  custom-queries: |
    pgbench_accounts:
      query: "SELECT count(*) as total,
              sum(abalance) as balance_sum
              FROM pgbench_accounts"
      metrics:
        - total:
            usage: "GAUGE"
            description: "Number of accounts in pgbench table"
        - balance_sum:
            usage: "GAUGE"
            description: "Sum of balance of accounts"
```

# PgBouncer

```
apiVersion: postgresql.cnpg.io/v1
kind: Pooler
metadata:
  name: myproject-postgresql18-pooler
spec:
  cluster:
    name: myproject-postgresql18

  instances: 2
  type: rw
  pgbouncer:
    poolMode: transaction
```

# Kubectl plugin

```
pierref@mbp-de-pierre:~$ kubectl cnpg -n talk status myproject-postgresql18
Cluster Summary
Name                                talk/myproject-postgresql18
System ID:                          7625758850936262681
PostgreSQL Image:                   ghcr.io/cloudnative-pg/postgresql:18.3-system-trixie
Primary instance:                    myproject-postgresql18-1
Primary promotion time:              2026-04-06 21:19:16 +0000 UTC (12m11s)
Status:                             Cluster in healthy state
Instances:                           2
Ready instances:                     2
Size:                                160M
Current Write LSN:                   0/800C370 (Timeline: 1 - WAL File: 000000010000000000)

Continuous Backup status (Barman Cloud Plugin)
ObjectStore / Server name:           myproject-postgresql18-s3-store/epoc-1
First Point of Recoverability:       2026-04-06 23:19:39 CEST
Last Successful Backup:               2026-04-06 23:19:39 CEST
```

# Mise à jour

- CNPG : à chaud
- Version mineur : sans effort
- Version majeur : à tester
  - pg\_upgrade possible
  - pg\_dump & pg\_restore
  - Réplication logique

```
apiVersion: helm.cattle.io/v1
kind: HelmChart
metadata:
  name: cnpg
  namespace: kube-system
spec:
  repo: https://cloudnative-pg.github.io/charts
  chart: cloudnative-pg
  # Correspond to CloudNative PG version 1.28.1
  version: 0.27.1
  targetNamespace: cnpg-system
  createNamespace: true
  valuesContent: |-
    config:
      data:
        ENABLE_INSTANCE_MANAGER_INPLACE_UPDATES: "true"
```

Questions ?