FOSDEM 2021, FEB 6-7, ONLINE

PostgreSQL Architectures in Production

Dimitri Fontaine
PostgreSQL Major Contributor

The Art of PostgreSQL

Turn Thousands of Lines
of Code into Simple Queries

A BOOK ABOUT POSTGRESQL BY DIMITRI FONTAINE

PostgreSQL for developers

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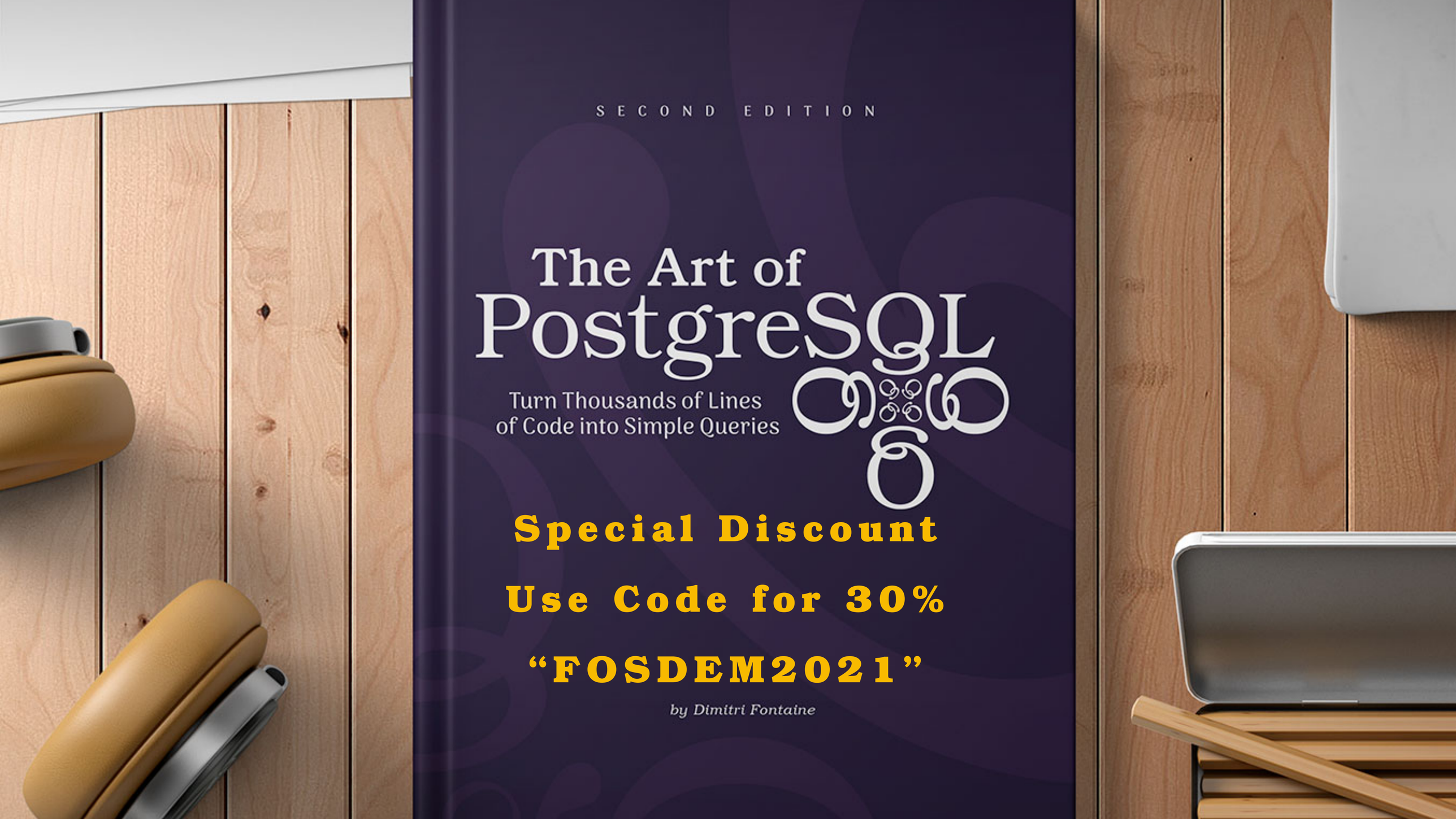
SECOND EDITION
The Art of
PostgreSQL
Turn Thousands of Lines
of Code into Simple Queries
Special Discount
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“FOSDEM2021”
by Dimitri Fontaine

POSTGRES BUILD 2020, DEC 8-9, ONLINE

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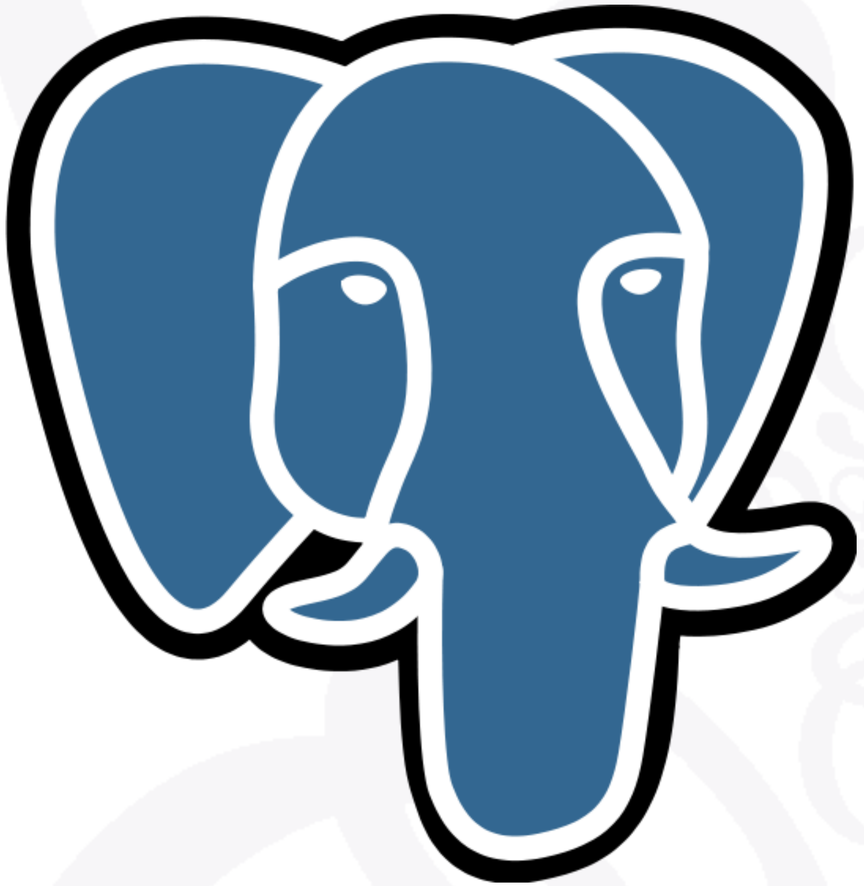


PostgreSQL

The World's Most Advanced Open Source Relational Database

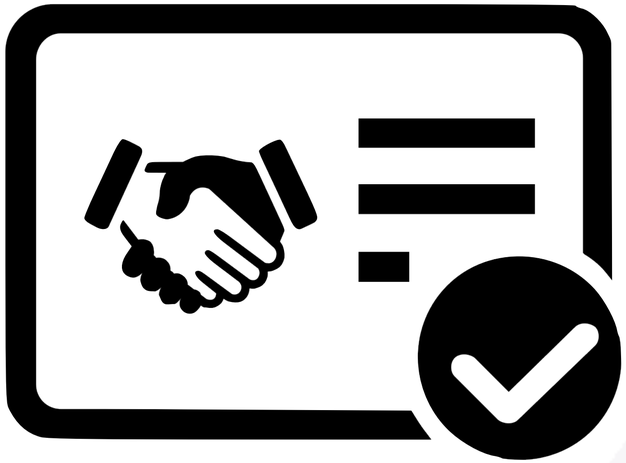
Architectures

Production Components and Dependencies

in Production

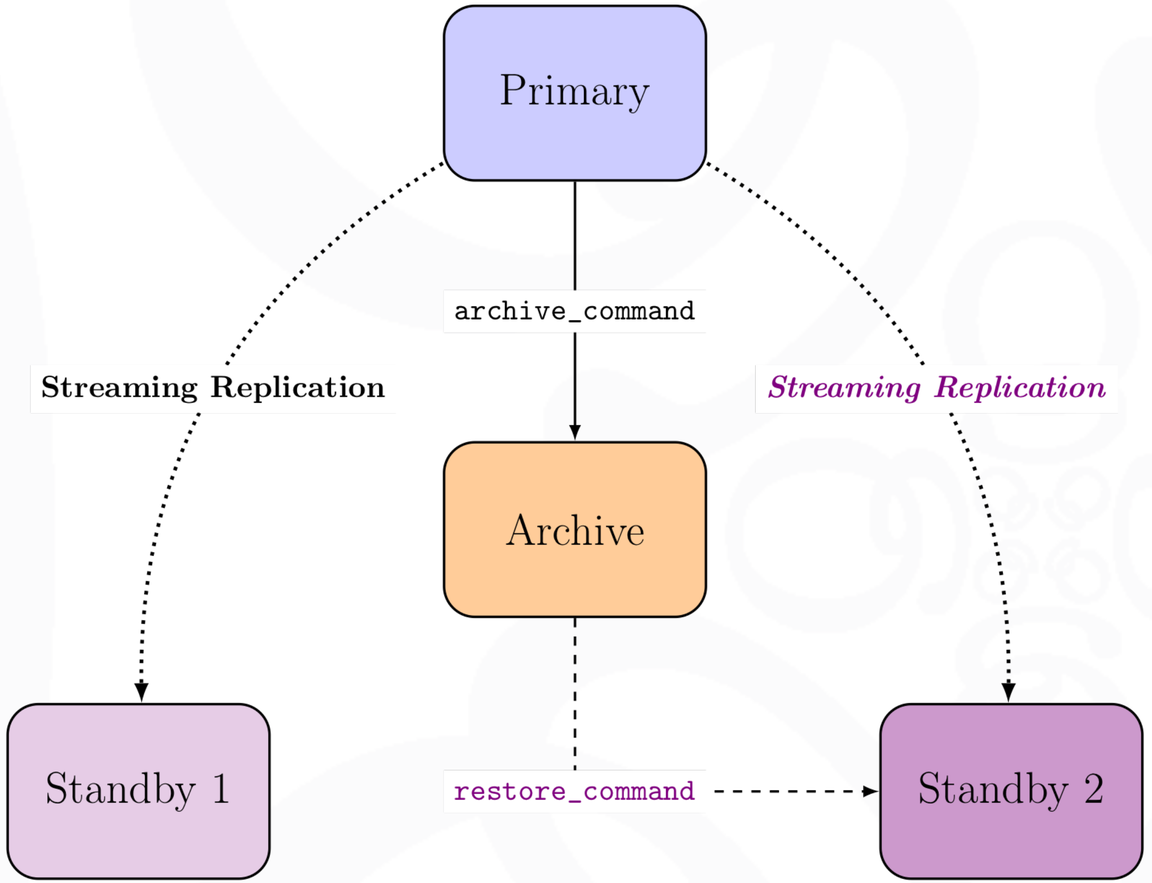
This is happening live!

Availability: Service & Data



High Availability

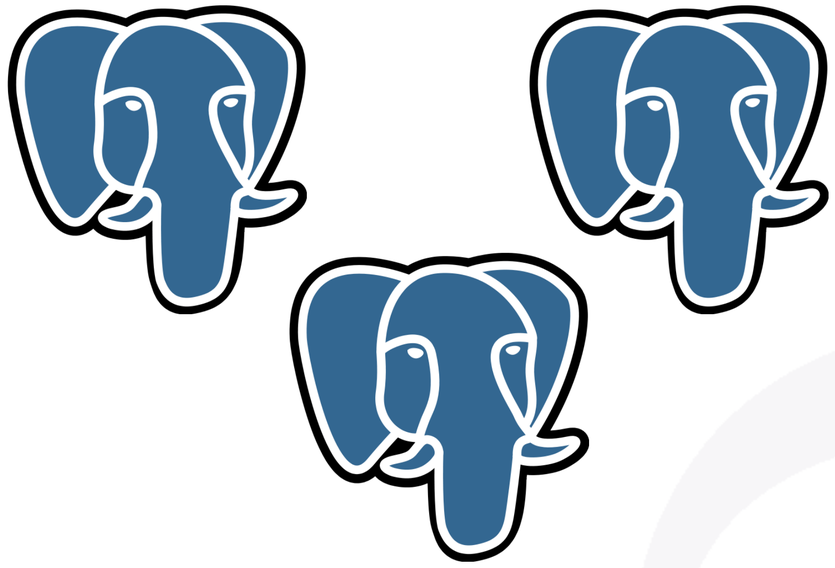
- *Maintain **service***
  - *Failover*
  - *Automated?*
- *Maintain **data***
  - *Disaster Recovery*
  - *Streaming Replication*



Classic Postgres Architecture

Using Streaming Replication with Two Standby Nodes to enable Service and Data Availability

Postgres Failover

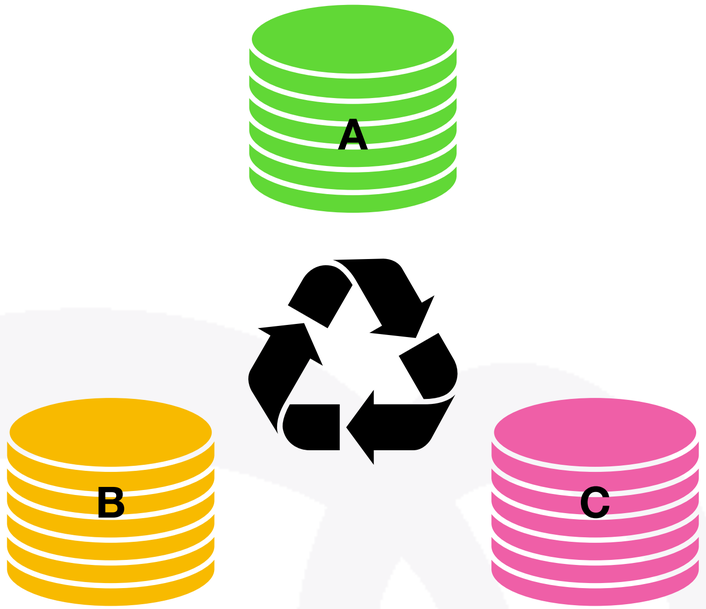


Included in Postgres

- *Streaming Replication*
  - Sync or Async
  - Per transaction setting
    - ALTER ROLE vip

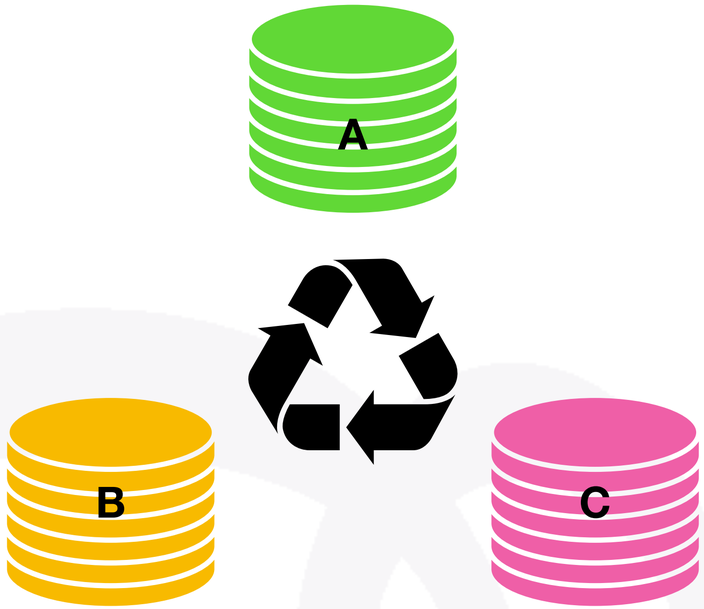
      SET synchronous_commit

      TO ‘remote_apply’;
    - ALTER ROLE … SET …
    - ALTER DATABASE … SET …



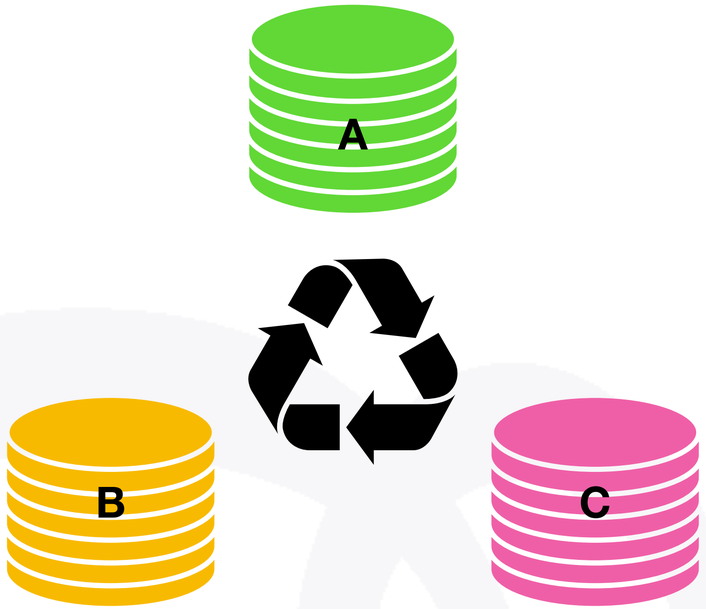
Included in Postgres

- *Online Streaming changes*
  - *Replication Slots*
  - pg_basebackup
  - pg_rewind
  - Fast forward
    - Cascading Replication
  - Online Standby Promotion



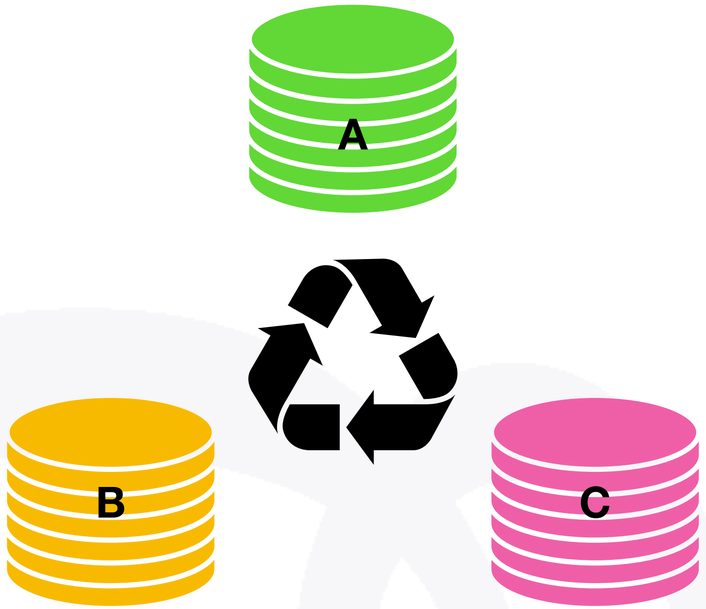
Included in Postgres

- *Disaster Recovery basics: PITR*
- *Setup a “standby” with a target*
- *Archiving provided separately*



Included in Postgres

- *Client Side HA*
  - Multi-Host Connection String
  - Client still has to **reconnect** when connection is lost, of course




```
postgres://hostA:5502,hostB:5503,hostC:5501/dbname?target_session_attrs=read-write&sslmode=require
```

Not included in Postgres

- **Archiving**
  - Base Backups
  - WAL Archiving
  - Retention setup for Disaster Recovery

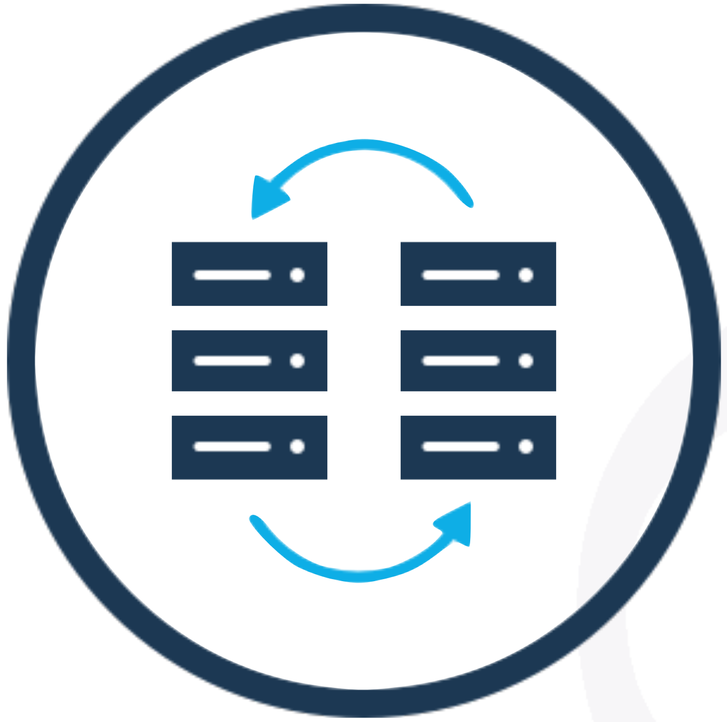
Not included in Postgres

- *Online "**Membership**" changes*
- *Idea that **roles are DYNAMIC***
  - Ensure retention during failover
    - For WALs
    - And for base backups
  - Automated node role changes
- *Restart to reconnect to new primary*

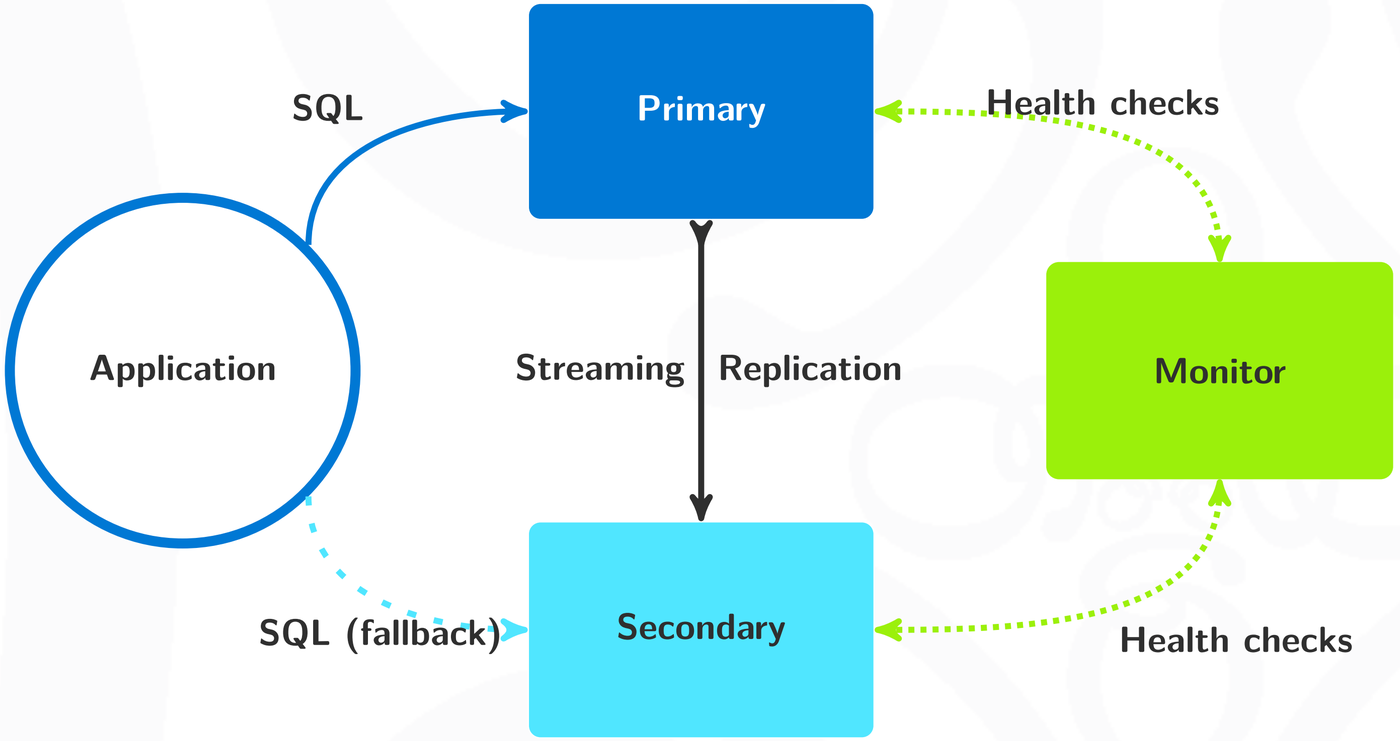
Not included in Postgres

- *Configuration Management*
  - postgresql.conf
  - pg_hba.conf
  - *Some setting change require a restart*
- *Extension Management*
- *Postgres Upgrades*
  - Minor upgrade (scheduled restarts)
  - Major upgrades

Automated Failover



pg_auto_failover



Single Standby

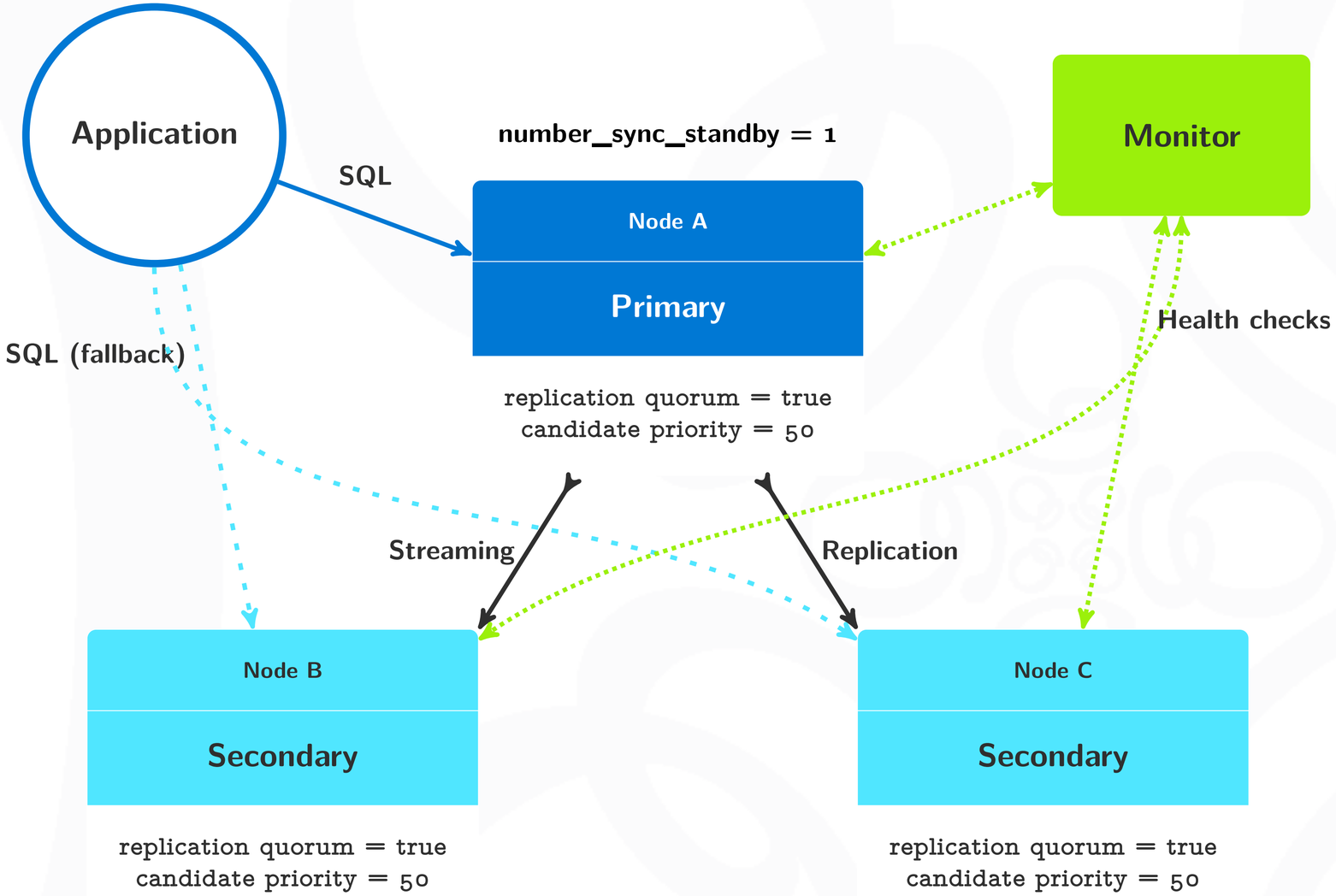
Only provides failover, no HA

Single Standby

```
$ pg_autoctl create monitor –auth trust –self-signed-ssl –run
```

```
$ pg_autoctl create postgres                          \
      –auth trust                                     \
      –self-signed-ssl.                               \
      –monitor postgres://host/pg_auto_failover       \
      –run
```

```
$ pg_autoctl create postgres                          \
      –auth trust                                     \
      –self-signed-ssl.                               \
      –monitor postgres://host/pg_auto_failover       \
      –run
```

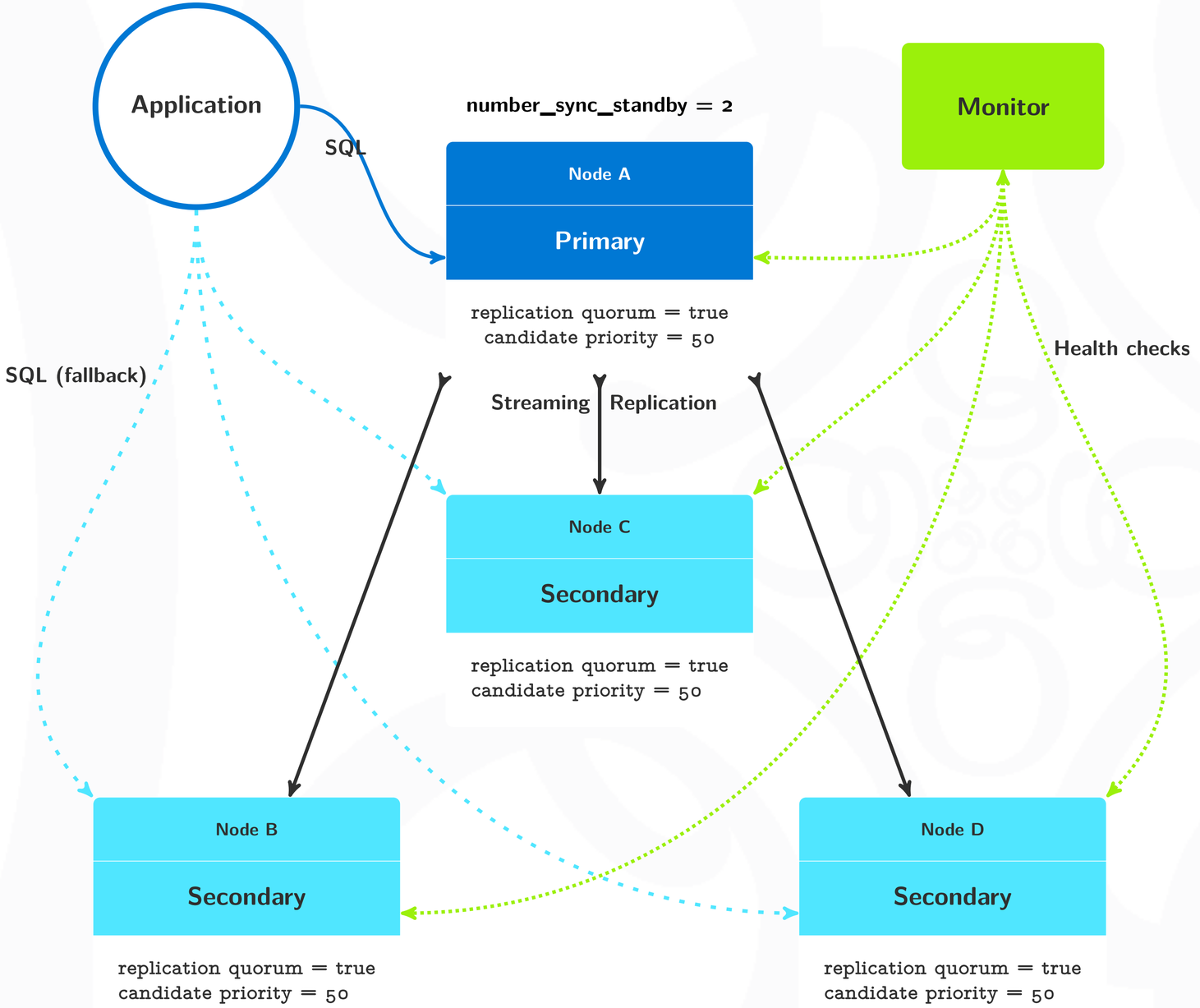


Two Standby Nodes

Allows to implement HA

Two Standby Nodes

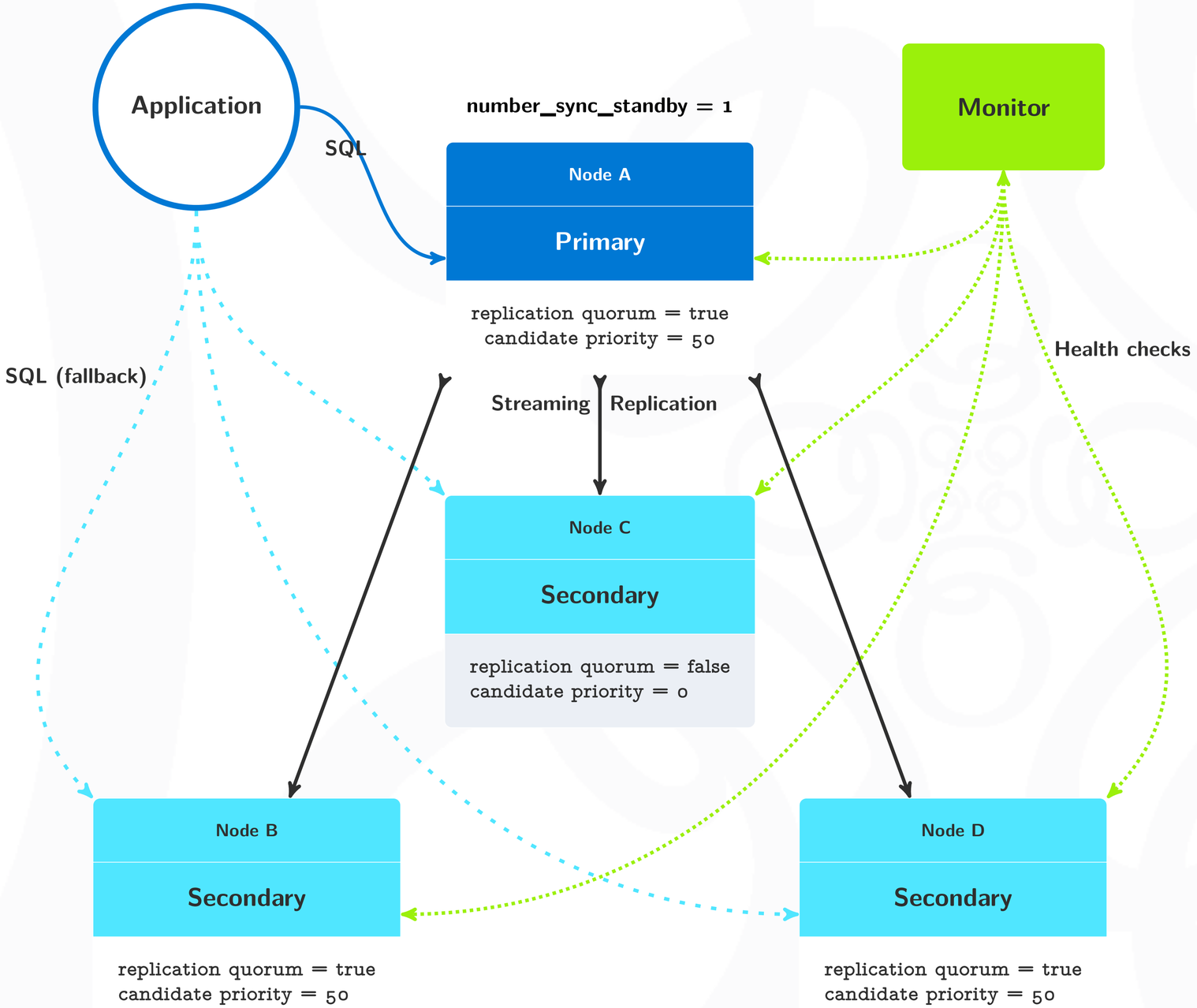
```
$ pg_autoctl create postgres                          \
      —auth trust                                     \
      —self-signed-ssl.                               \
      —monitor postgres://host/pg_auto_failover       \
      —run
```



Three Standby Nodes

Three Standby Nodes

```
$ pg_autoctl create postgres                          \
      —auth trust                                     \
      —self-signed-ssl.                               \
      —monitor postgres://host/pg_auto_failover       \
      —run
```



Three Standby Nodes, one async

Three Standby Nodes, One Async

```
$ pg_autoctl create postgres                          \
      —auth trust                                     \
      —self-signed-ssl.                               \
      —monitor postgres://host/pg_auto_failover       \
      —replication-quorum false                       \
      —candidate-priority 0                           \
      —run
```

```
$ pg_autoctl set node candidate-priority 0
$ pg_autoctl set node replication-quorum false
```

Included in pg_auto_failover

- *Streaming Replication*
  - *Replication slots*
  - *Maintained on standby nodes*
- *Easy setup including SSL certificates*
- *Dynamic settings, online changes*

```
$ pg_autoctl create postgres
```

Included in pg_auto_failover

- *Online “**Membership**” changes*
- *Idea that **roles are DYNAMIC***
  - Ensure retention during failover
    - For WALs
    - And for base backups
  - Automated HBA editing

```
$ pg_autoctl show uri
$ pg_autoctl show state
$ pg_autoctl get formation settings
```

Included in pg_auto_failover

- *Online membership changes*
- *Online formation setting changes*
- *Maintenance operations*

```
$ pg_autoctl set node candidate-priority 0
$ pg_autoctl set node replication-quorum false
$ pg_autoctl set formation number-sync-standbys 2
```

```
$ pg_autoctl enable maintenance
$ pg_autoctl disable maintenance
```

Included in pg_auto_failover

- *Network split detection / protection*
- *Active monitoring and role changes*
  - *Automated and manual Failover*
  - *Including manual Switchover*
  - *Including manual choice of target node*

```
$ pg_autoctl perform failover
$ pg_autoctl perform switchover
$ pg_autoctl perform promotion –name node_d
```

Not included in pg_auto_failover ***yet***

- *Archiving and Disaster Recovery*
- *Configuration Management*
  - postgresql.conf
  - pg_hba.conf
  - *Some setting change require a restart*
- *Extension Management*
- *Postgres Upgrades*
  - Minor upgrade (scheduled restarts)
  - Major upgrades

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Ask Me Two Questions!

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Citus Data, Microsoft

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