

Multi-Master PostgreSQL Architectures in Cloud

Gülçin Yıldırım Jelínek



PGDay
Istanbul 2018



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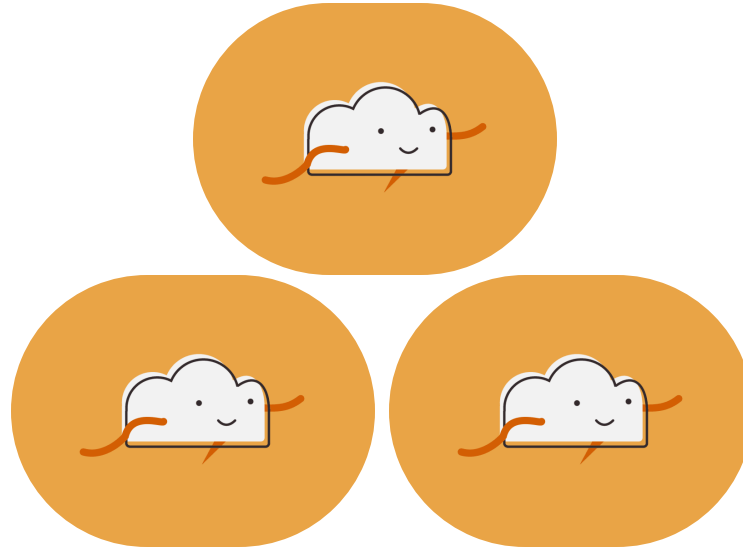


Agenda

- What is Multi-Master?
- Physical vs Logical Replication
- Postgres-BDR
- Multi-Master Architectures
- Multi-Master Postgres in Cloud (GDS)
- Our Experience with Cloud Postgres
- Conclusion
- Questions

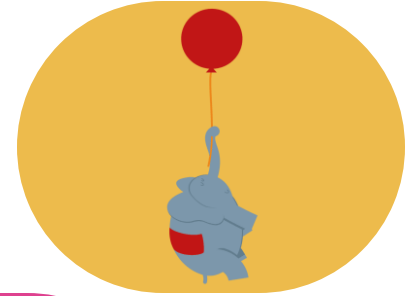


What is Multi-Master?



- Replicate writes between multiple masters
 - Asynchronous with conflicts
 - Conflict-free (consensus)

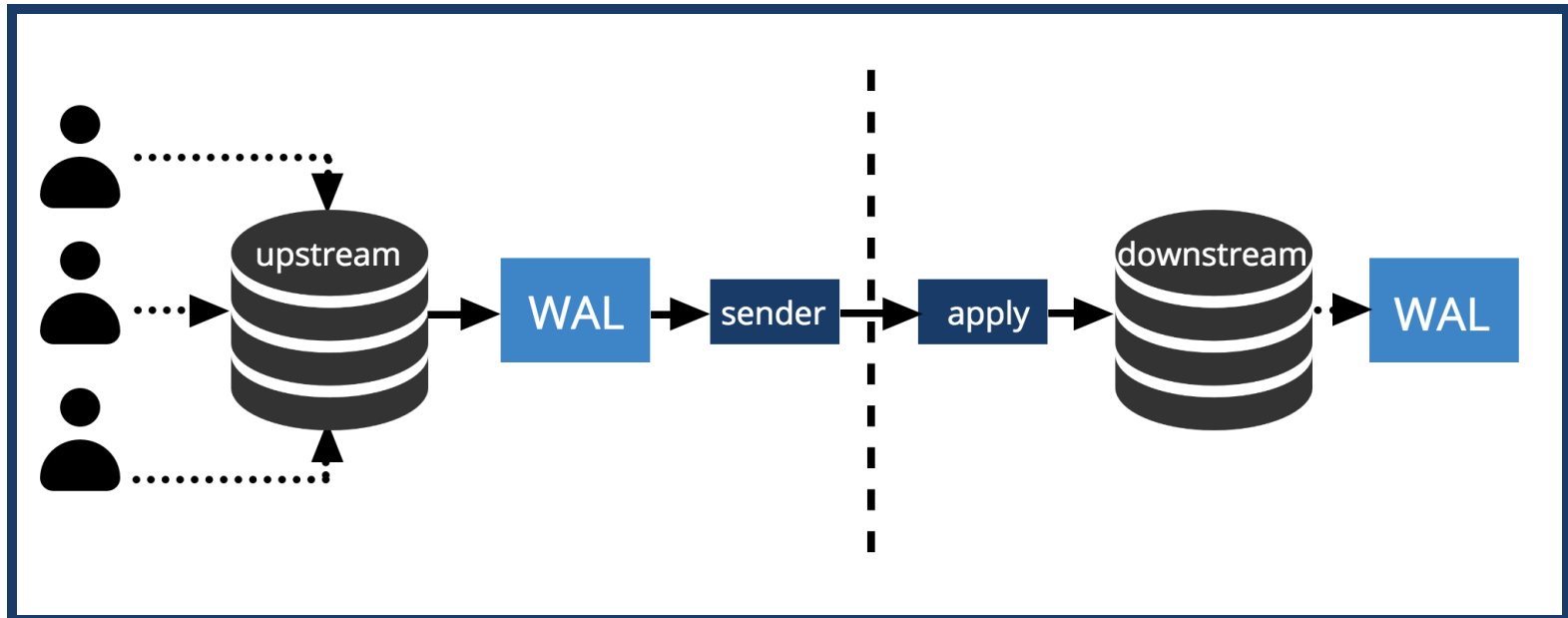
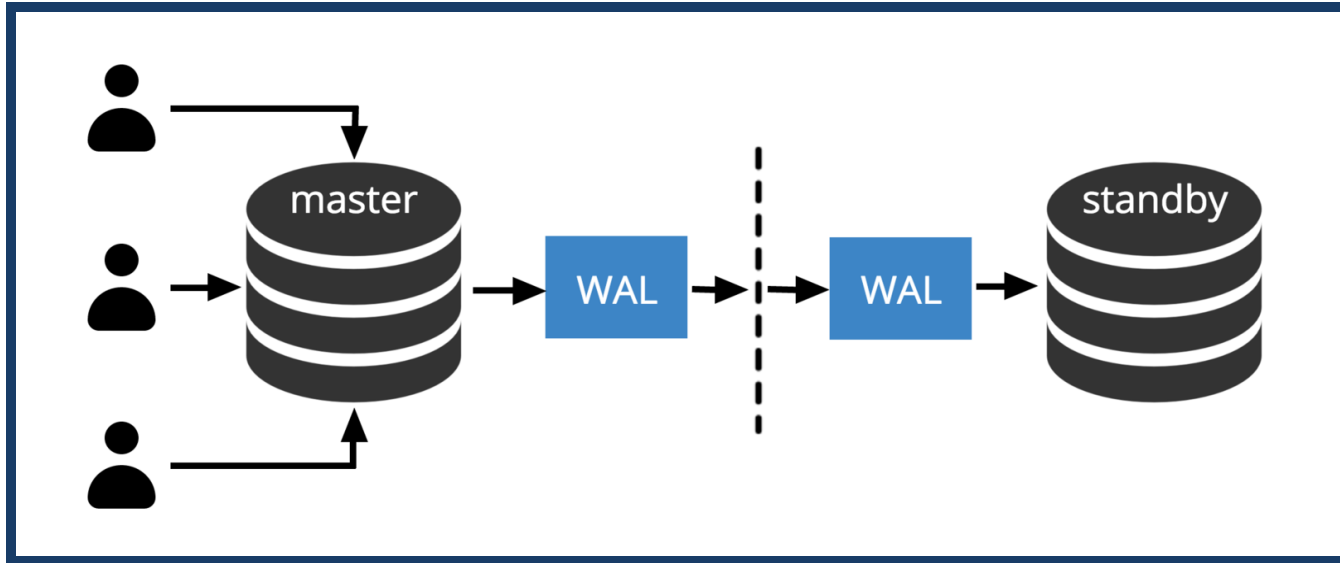
Physical vs Logical Replication



- Replay WAL
 - WAL cannot be changed
- Bit copy of upstream
 - All or nothing
 - Same major version
- Can't write to downstream

- Logical decoding
 - Extension API
 - Row changes
 - Committed changes
- Selective replication
- Cross-version
- Can write to all nodes

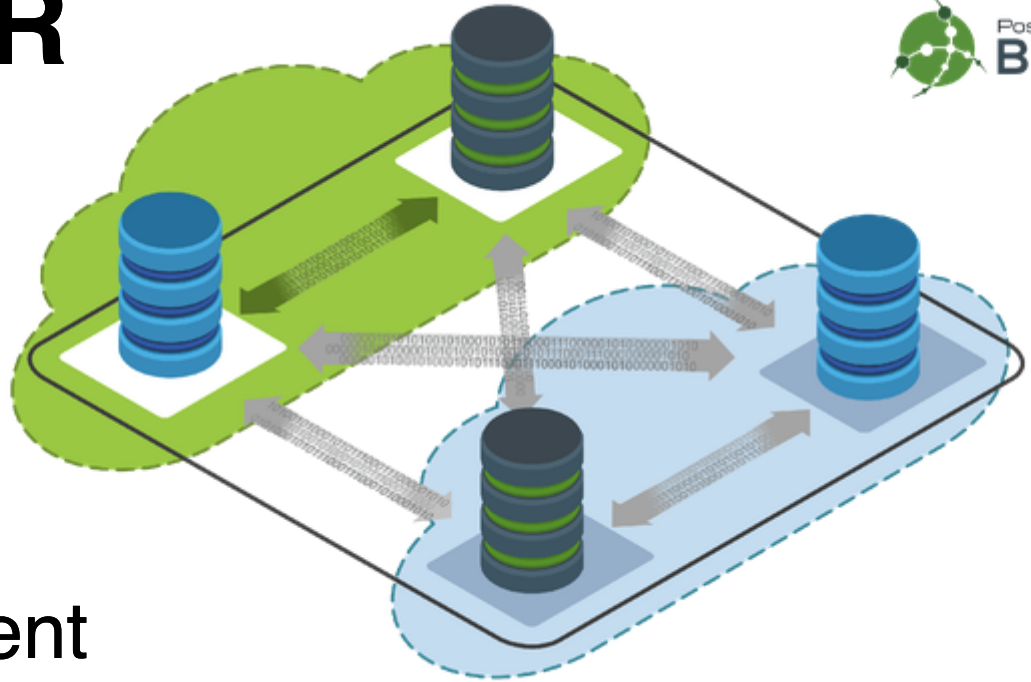
Physical vs Logical Replication



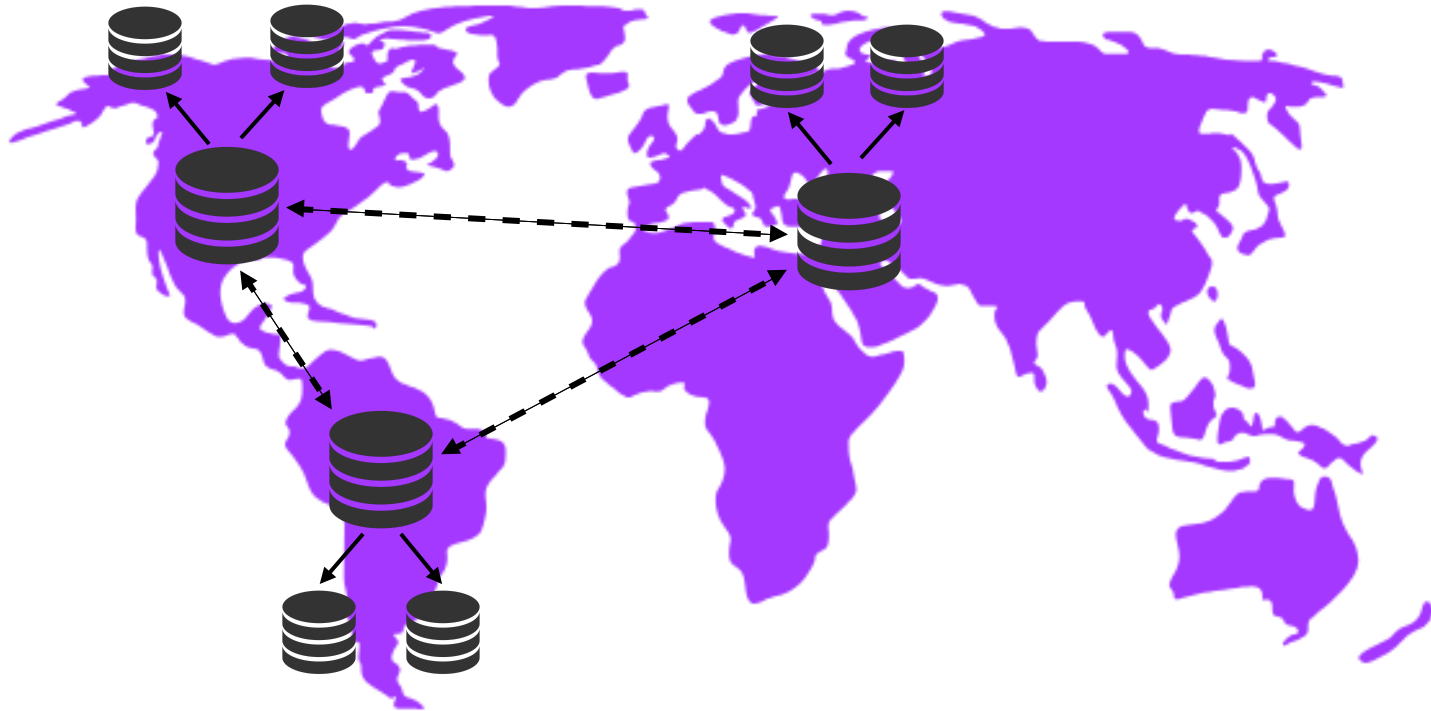
Postgres-BDR



- Multi-master
- Asynchronous
- Eventually consistent
 - Does not prevent concurrent writes
 - Optimistic conflict detection (after commit)
 - Automatic conflict resolution
- Used for Logical Replication development in PG



Multi-Master Architectures - I



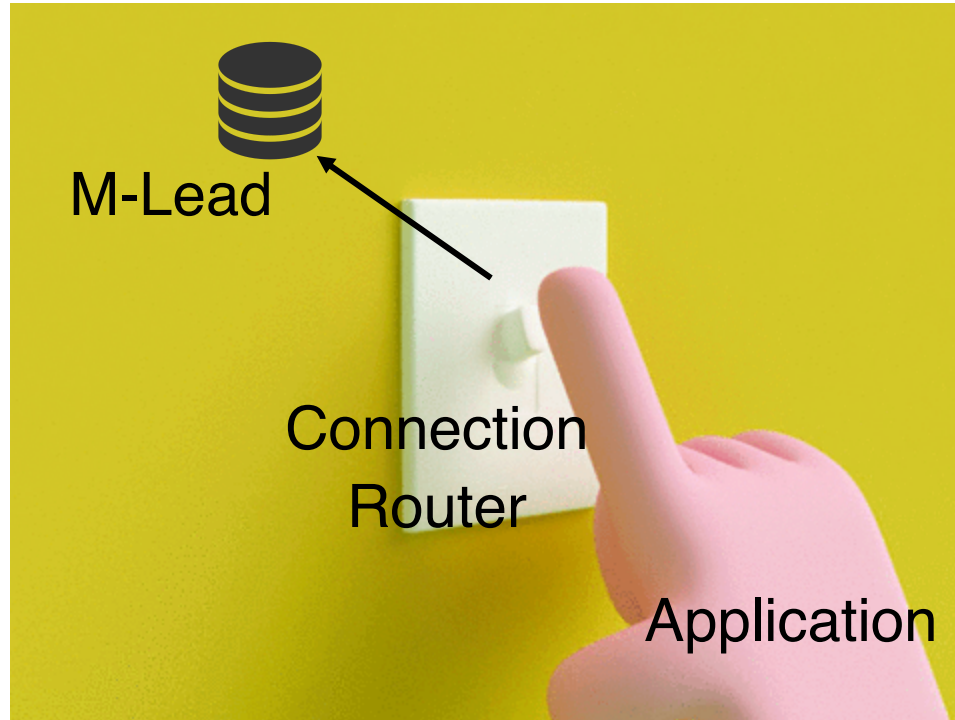
Geographically distributed cluster

Multi-Master Architectures - II



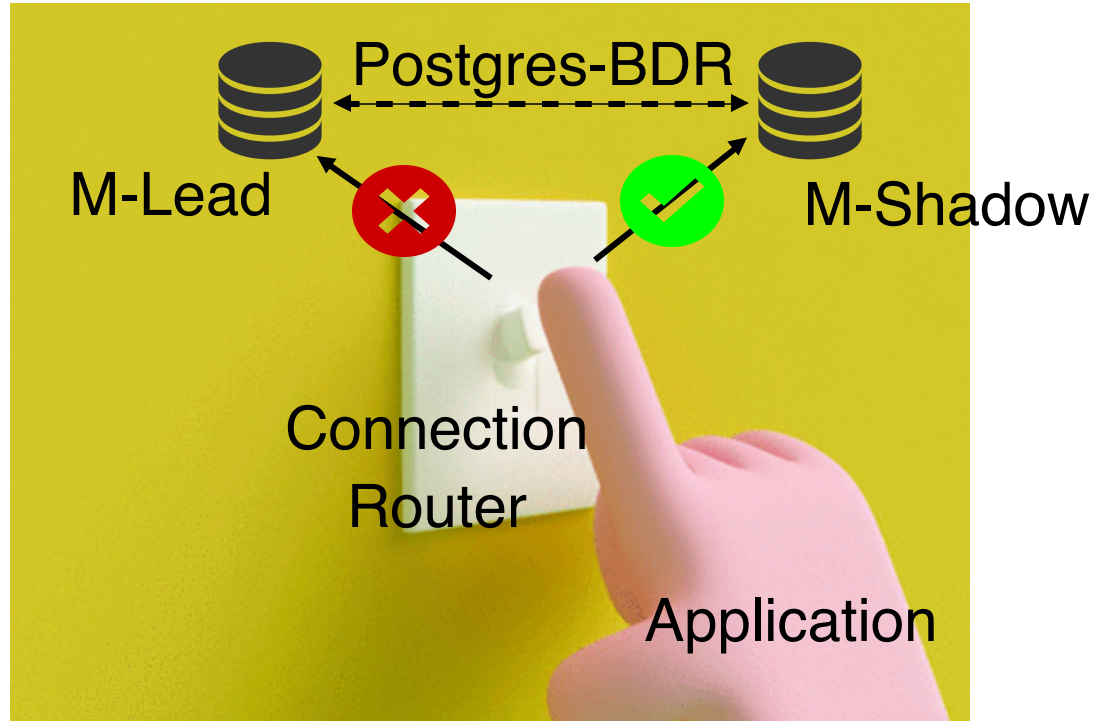
AlwaysOn Architecture

Multi-Master Architectures - II



AlwaysOn Architecture

Multi-Master Architectures - II

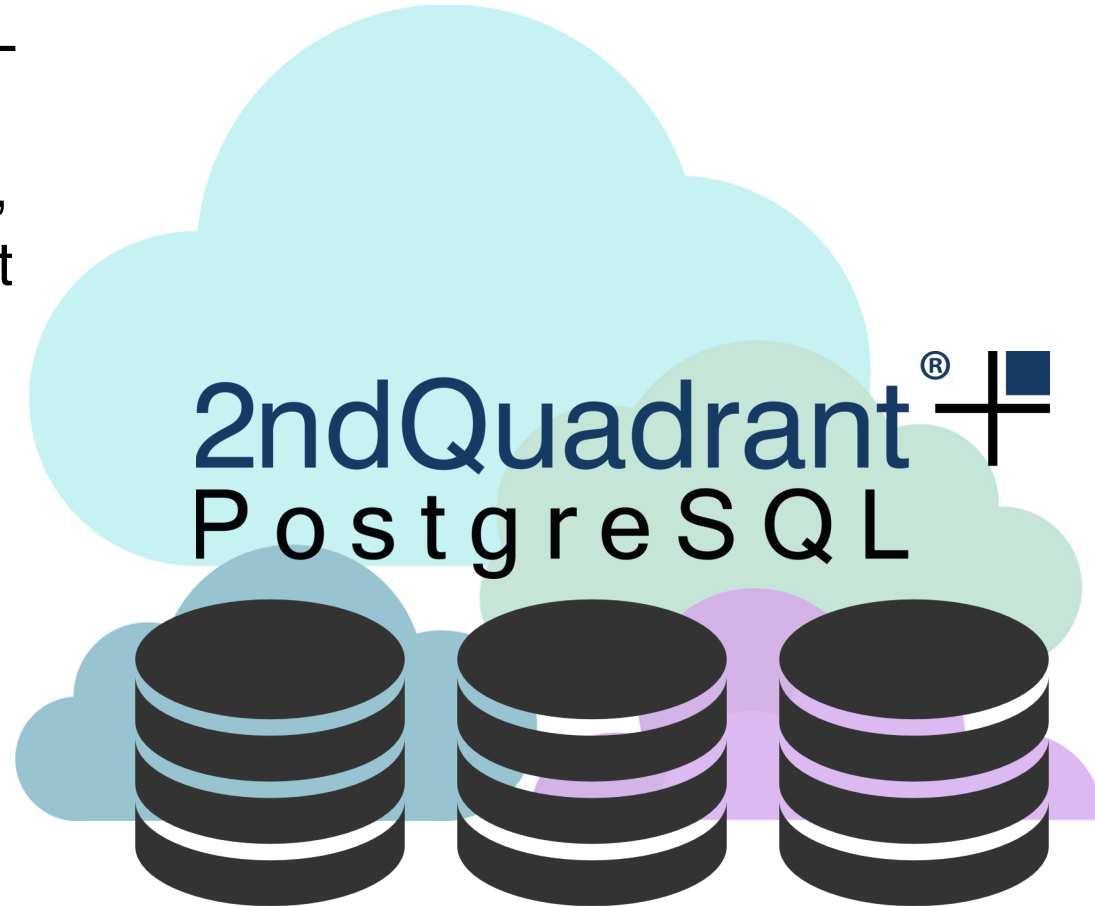


AlwaysOn Architecture

Global Database as a Service

Bundled up best PostgreSQL practices into our cloud service, with high-availability, and 24x7 support by the best PostgreSQL engineers!

- We develop
- We host
- We manage
- We support
- **YOU USE!**

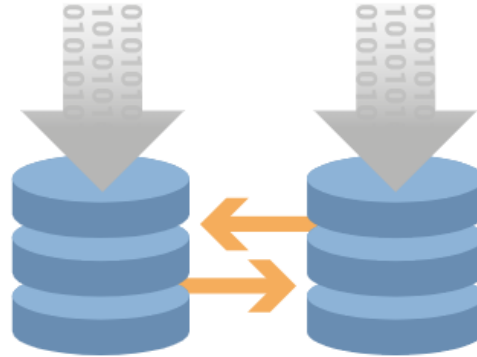


GDS Flavours



Single Master +

Single master in region of your choice. Best option to start with.



Multi Master +

3rd generation of BDR achieves efficiency and accuracy, ensuring very high availability of all nodes in a geographically distributed cluster.



AlwaysOn +

Shadow masters / standby nodes with auto failover allow a highly available environment catering to all possible issues impacting availability.

Single Master



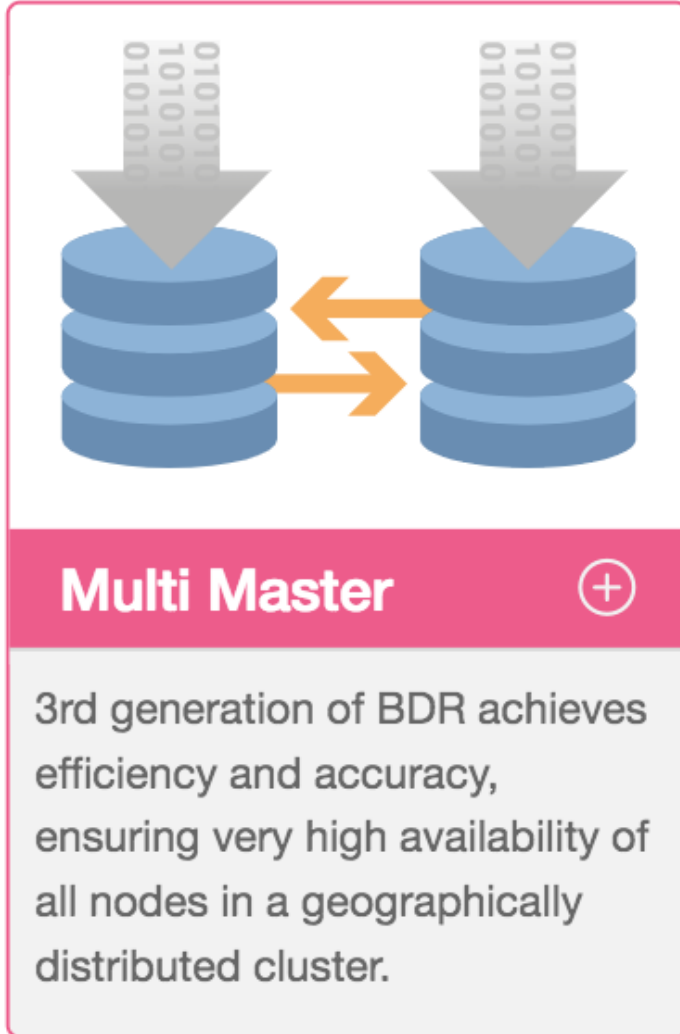
Single Master



Single master in region of your choice. Best option to start with.

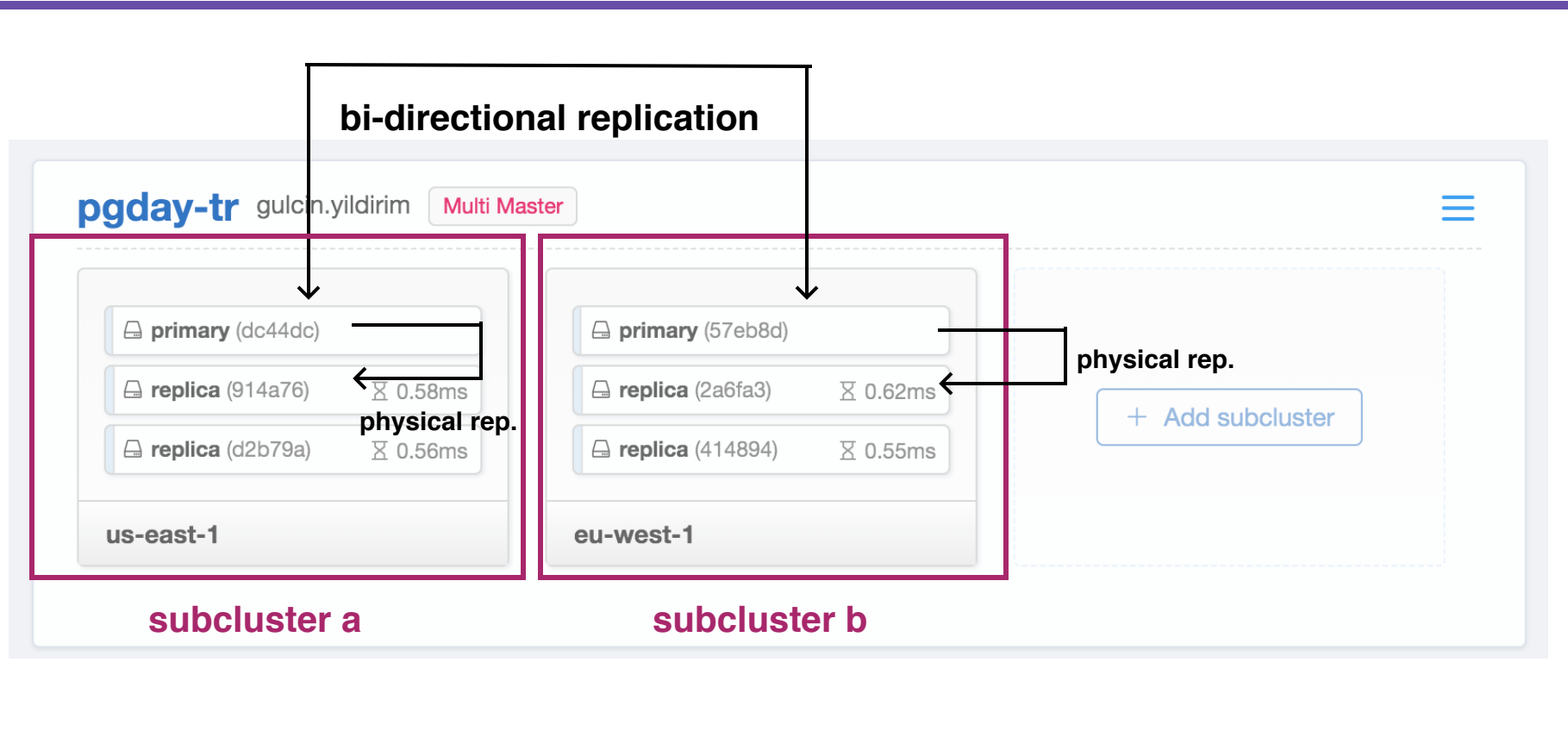
- Development
 - 1 primary database
 - No support
- Test
 - 1 primary database
 - 1 replica database
 - Gold Support
- Production
 - 1 primary database
 - 2 replica databases
 - Backups
 - Platinum Support

Multi Master



- Bi-Directional Replication with Postgres-BDR 3.0
- High availability
- Geographically distributed cluster
- Zero Downtime Upgrades
 - Different Postgres versions
- Flexibility
 - Different configuration
 - Different instance sizes (CPU, disk, memory etc)

Multi Master Architecture



geo cluster

AlwaysOn



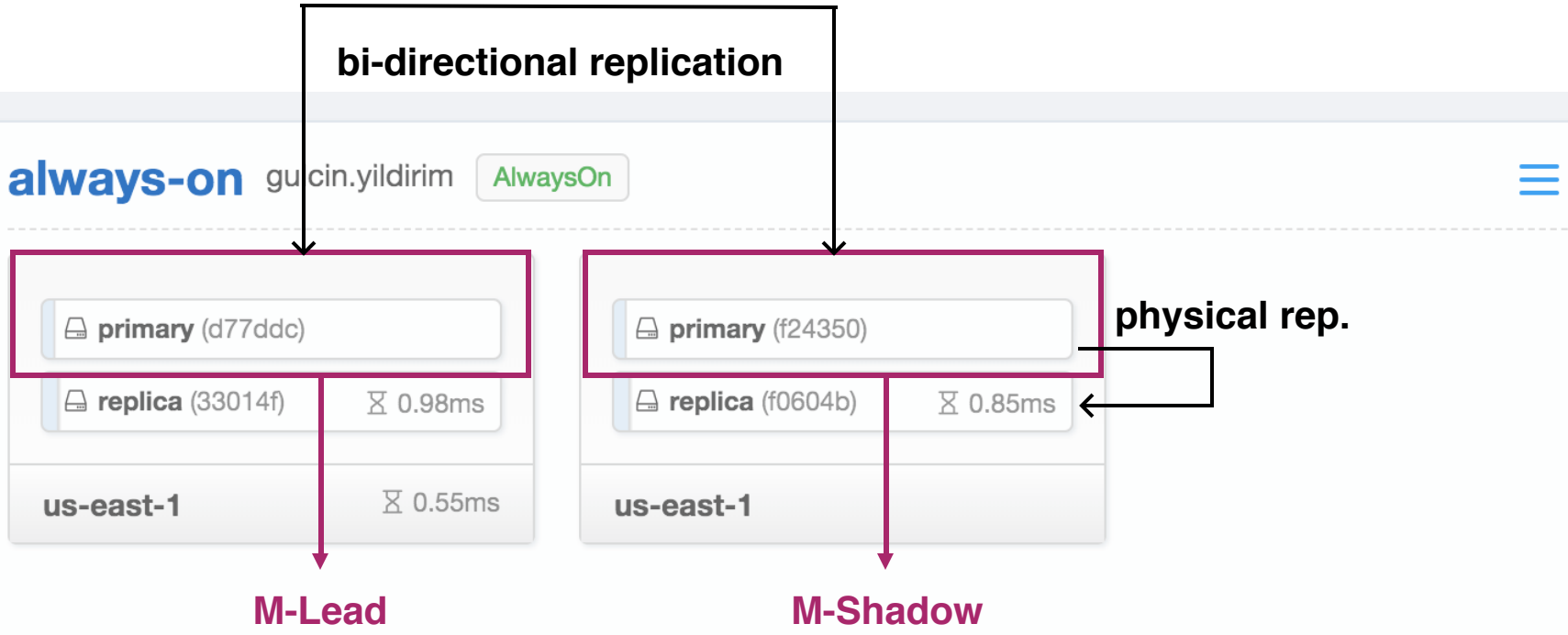
AlwaysOn



Shadow masters / standby nodes with auto failover allow a highly available environment catering to all possible issues impacting availability.

- Provides at least 4 Nines (99.99%) availability
- Deployed in single region with two different availability zones:
 - 2 BDR primary
 - 2 physical replica
 - Backup
- “Very High Availability” described in the BDR whitepaper.

AlwaysOn Architecture



How to Connect to your DB?

How to Connect to your DB?

1. Set your database password first
2. Choose the instance you want to connect
3. Choose one of the provided connection string types
4. Connect with your db client

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The screenshot displays the gds-bdr console interface. At the top, it shows the user 'gulcin.yildirim' and the instance type 'Multi Master'. Below this, there are several database instances listed, including 'primary (2a682c)', 'primary (a1f10b)', 'lica (5a9955)', and 'lica (dd2a3d)'. A modal window is open for the 'primary (2a682c)' instance, showing its status and connection options. The modal includes a 'Connection' section with a dropdown menu that has been opened, showing options: 'Copy IP address', 'Copy connection string', 'Copy JDBC URI', and 'Copy Keyword/Value string'. The 'Copy connection string' option is selected, and a tooltip shows the resulting connection string: `"postgres://admin@52.15.175.121:5432/gds_bdr?ssl=true&connect_timeout=10"`. The modal also displays system metrics: 'DISK USED' (0.9% of 15.6 GB), 'PUBLIC IP' (52.15.175.121), and 'CREATED' (Jul 11, 2018, 12:52 PM GMT+2). A '+ Add subcluster' button is visible in the background.

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How to Connect to your DB?

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2. Choose the instance you want to connect

```
apathetic:~ gulcin$ psql "postgres://admin@52.15.175.121:5432/gds_bdr?ssl=true&connect_timeout=10"
Password:
psql (10.3, server 10.4 (Ubuntu 10.4-2.pgdg16.04+1))
SSL connection (protocol: TLSv1.2, cipher: ECDHE-RSA-AES256-GCM-SHA384, bits: 256, compression: off)
Type "help" for help.

gds_bdr=>
```

The screenshot shows the AWS RDS console interface. On the left, a card for the instance 'primary (2a682c)' displays the following information:

- DISK USED:** 0.9% of 15.6 GB
- PUBLIC IP:** 52.15.175.121
- CREATED:** Jul 11, 2018, 12:52 PM GMT+2

A 'Connection' menu is open, showing options: 'Copy IP address', 'Copy connection string', 'Copy JDBC URI', and 'Copy Keyword/Value string'. The 'Copy connection string' option is selected, and a tooltip displays the connection string: `"postgres://admin@52.15.175.121:5432/gds_bdr?ssl=true&connect_timeout=10"`. In the background, other instance details like 'lica (5a9955)' and 'lica (dd2a3d)' are visible, along with a '+ Add subcluster' button.

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1. Set your database password first
2. Choose the instance you want to connect

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Type "help" for help.
```

```
gds_bdr=>
```

primary (2a682c)

DISK USED

0.9% of 15.6 GB

PUBLIC IP

52.15.175.121

CREATED

Jul 11, 2018, 12:52 PM GMT+2

Details

Settings

Connection >

Actions >

Copy IP address

Copy connection string

Copy JDBC URI

Copy Keyword/Value string

"postgres://admin@52.15.175.121:5432/gds_bdr?ssl=true&connect_timeout=10"

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"postgres://admin@52.15.175.121:5432/gds_bdr?ssl=true&connect_timeout=10"

Database Configuration

Settings



> Connections and Authentication

> Resource Usage & Tuning

▼ Replication

max_standby_streaming_delay:

Sets the maximum delay before canceling queries when a hot standby server is processing streamed WAL data.

> Reporting and Logging

> Client Connection Defaults

> User Timeouts

> Vacuum & Autovacuum

Save

Cancel

Database Configuration

Settings



> Connections and Authentication

> Resource Usage & Tuning

▼ Replication

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Sets the maximum delay before canceling queries when a hot standby server is processing streamed WAL data.

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> Vacuum & Autovacuum

Save

Cancel

Database Configuration

Settings

max_standby_

> Connections and Authentication

> Resource Usage & Tuning

▼ Replication

max_standby_streaming_delay: 30000

Sets the maximum delay before canceling queries when a hot standby server is processing streamed WAL data.

> Reporting and Logging

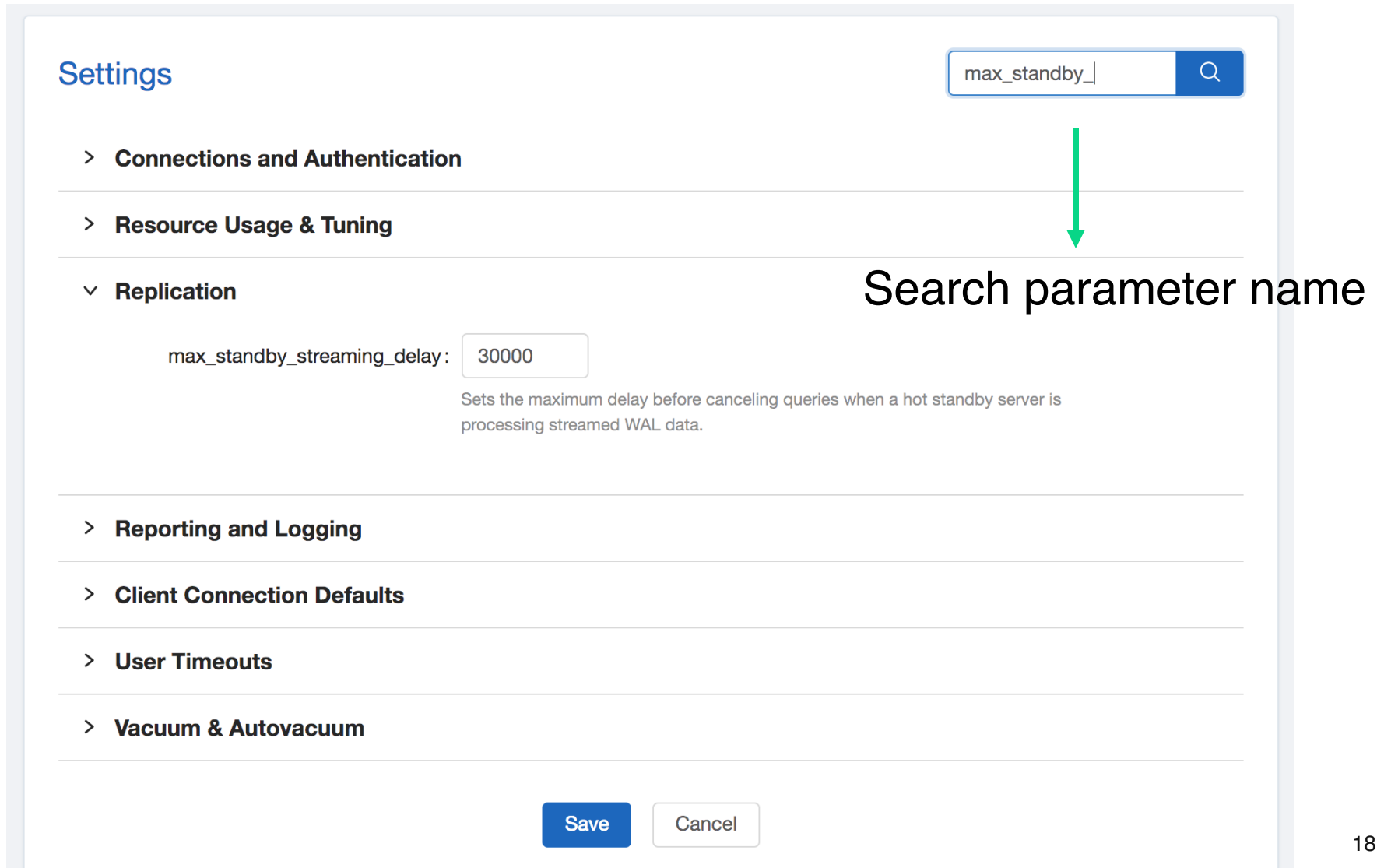
> Client Connection Defaults

> User Timeouts

> Vacuum & Autovacuum

Save Cancel

Search parameter name



Monitoring Dashboard

Clusters \ gds-bdr \ us-east-2 \ primary

Overview

Database

Queries

Replication

System

Last data less than a minute ago.

99.91%

Cache hit ratio

4

Active sessions

0

Deadlocks

...

Disk used

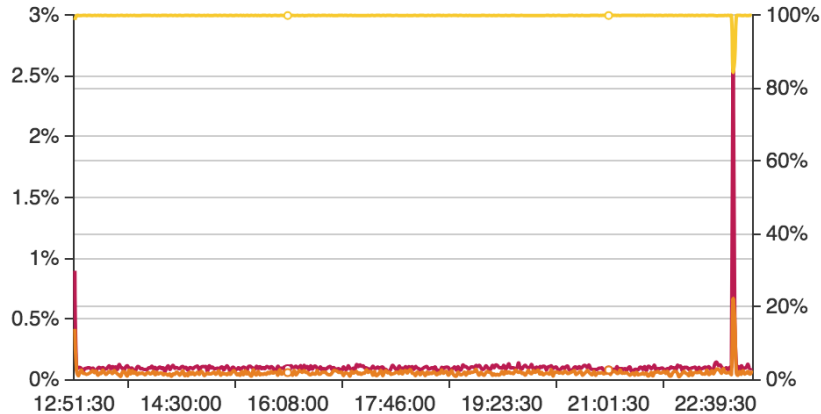
0.1%

CPU user

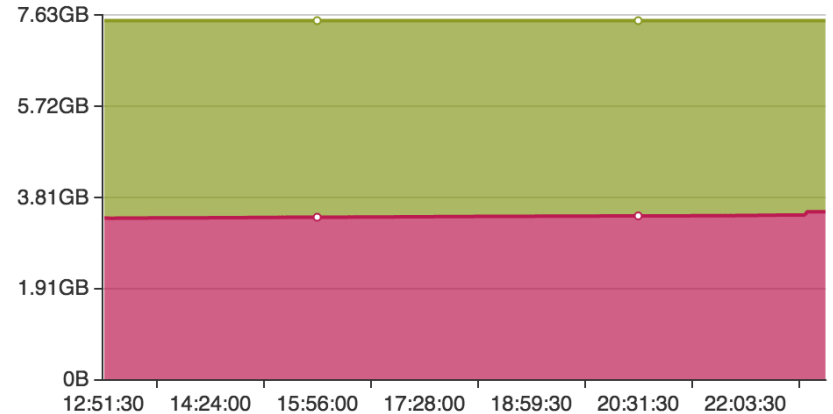
0.07%

CPU system

CPU



Memory



Dynamic Scaling

Dynamic Scaling

gds-bdr gulcin.yildirim

Multi Master



primary (2a682c)

replica (5351fd)

replica (5d8d99)

us-east-2

⌘ 11.26ms

primary (a1f10b)

replica (5a9955) ⌘ 1.65ms

replica (dd2a3d) ⌘ 1.11ms

us-east-1

+ Add subcluster

Dynamic Scaling

gds-bdr gulcin.yildirim **Multi Master**



primary (2a682c)

replica (5351fd)

replica (5d8d99)

us-east-2

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replica (dd2a3d) ⌘ 1.11ms

+ Add subcluster

us-east-2

Add subcluster

Region

us-east-2 (+)

us-east-1 (+)

eu-west-1 (✓)

us-west-2 (+)

vCPU and RAM

	vCPUs	Memory	Max IOPs
(+)	1	1 GB	3,000
(✓)	2	8 GB	16,000
(+)	2	15 GB	3,000
(+)	4	16 GB	16,000
(+)	4	31 GB	6,000

Summary

PostgreSQL 10 running at AWS as Multi Master used for Production.

Region:

- 1 subcluster in eu-west-1

Each subcluster will have:

- 1 primary database
- 2 replica databases
- backup

Instance specification:

- 2 vCPUs
- 8 GB RAM
- 100 IOPS
- 4 GB STORAGE

Logging



History

gds-m1 × test × harald ×
pgdayuk-multi-master × |

- 13 minutes ago ✓ **gds-m1**
gulcin.yildirim requested [new cluster](#)
July 11, 2018, 10:09 PM GMT+2
- 2 days ago ✓ **harald**
gulcin.yildirim requested [subcluster drop](#)
July 09, 2018, 5:49 PM GMT+2
- 2 days ago ✓ **harald**
gulcin.yildirim requested [new benchmark](#)
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gulcin.yildirim requested [change of password](#)
July 09, 2018, 5:41 PM GMT+2
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Logging



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Action log of all clusters

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Filter by cluster name

Benchmarks

Benchmarks

Benchmarks

Scale Factor

Time in seconds

Number of clients

Number of threads

Start Benchmark

Created

Status

-

July 11, 2018, 10:29 PM GMT+2

done

Benchmarks

Benchmarks

Scale Factor

1

Time in seconds

60

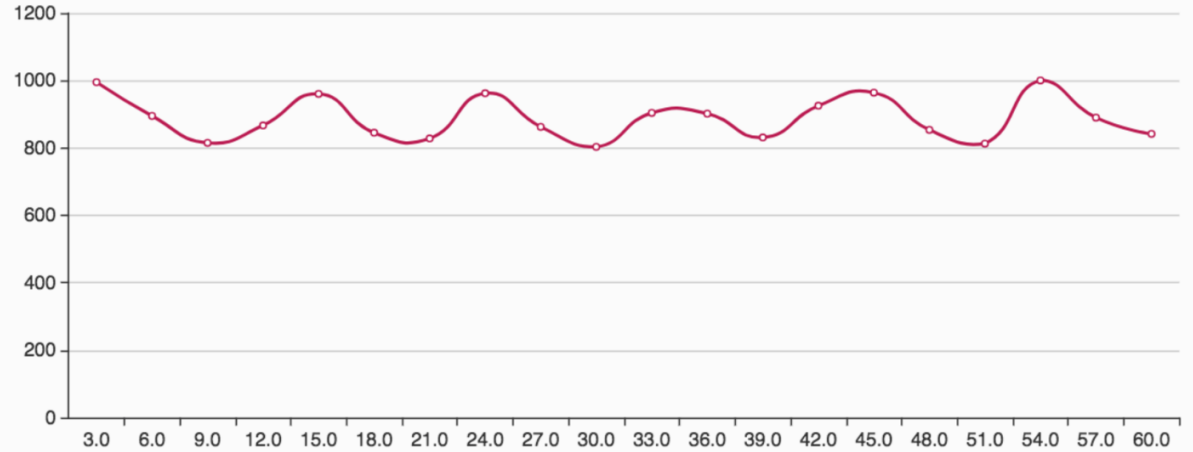
Created

-

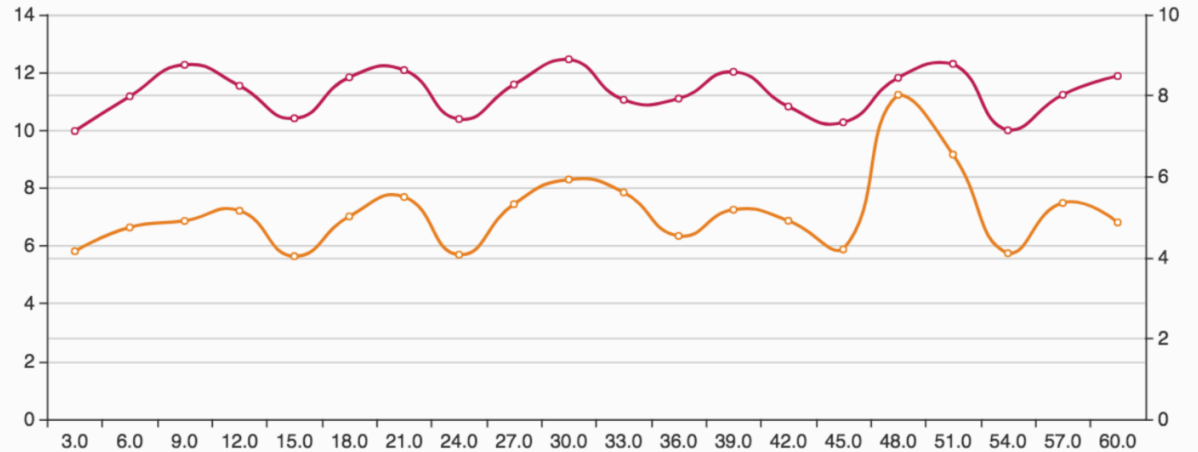
July 11, 2018, 10:29 PM GMT

Results

Transactions per second 887.827543



Latency 11.259 ms



Benchmarks

Benchmarks

TPS

Scale Factor

1

Time in second

60

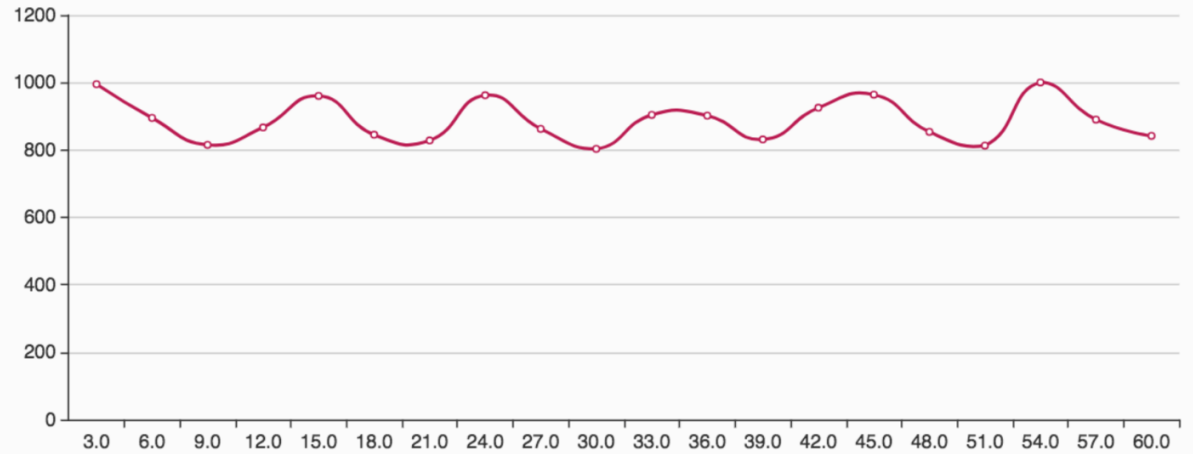
Created

-

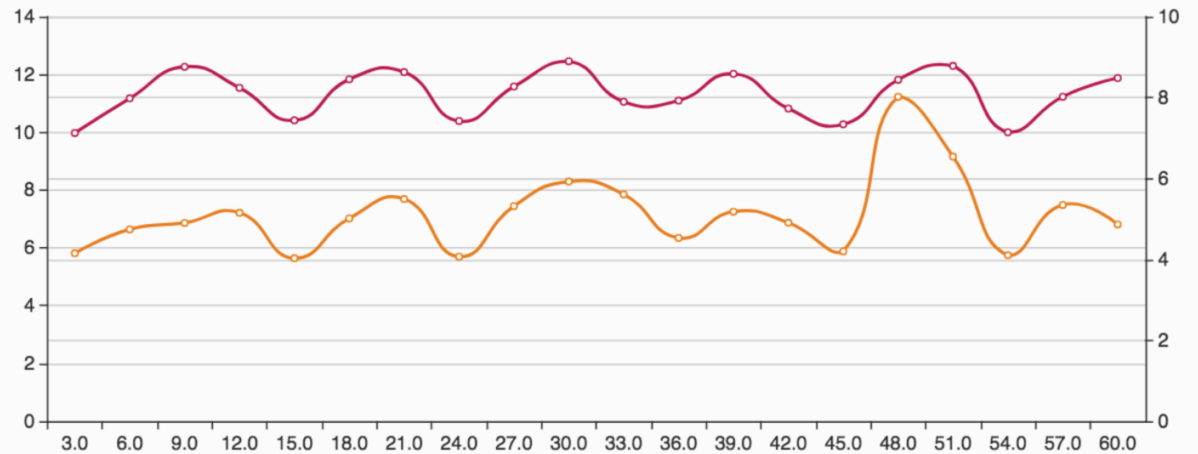
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Benchmarks

Benchmarks

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60

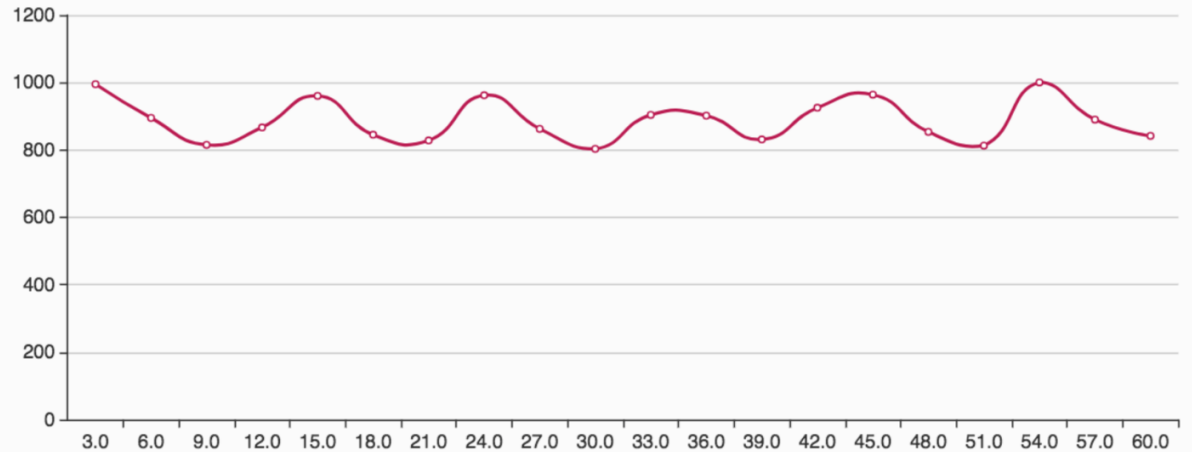
Created

-

July 11, 2018, 10:29 PM GMT

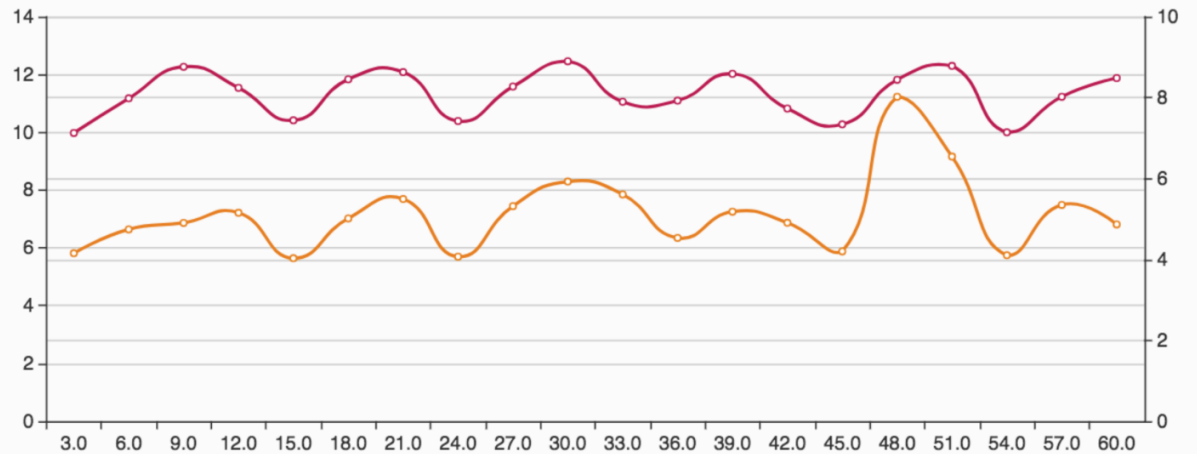
Results

Transactions per second 887.827543



Latency

Latency 11.259 ms



Security



Authenticate with 2ndQuadrant SSO



SSL connections only

```
"postgres://admin@52.15.175.121:5432/gds_bdr?  
ssl=true&connect_timeout=10"
```



Encrypted Data at Rest



No SUPERUSER



VPC Peering



IP Whitelisting

Automated Backups

Automated Backups

The screenshot displays a PostgreSQL Multi Master cluster configuration. The cluster is named "pgday-tr" and is managed by "gulcin.yildirim". It is a "Multi Master" configuration. The cluster is split into two availability zones: "us-east-1" and "eu-west-1".

us-east-1 Zone:

- primary (dc44dc)
- replica (914a76) with a lag of 0.86ms
- replica (d2b79a) with a lag of 0.78ms

eu-west-1 Zone:

- primary (57eb8d)
- replica (2a6fa3) with a lag of 1.69ms
- replica (414894) with a lag of 1.7ms

A dropdown menu is open over the "eu-west-1" zone, showing the following options:

- Benchmarks
- Set password
- Backups
- BDR settings
- Service files
- History
- Drop cluster

There is also a "+ Add subcl" button visible in the background.

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Automated Backups

pgday-tr gulcin.yildirim Multi Master

us-east-1

- primary (dc44dc)
- replica (914a76) ⌚ 0.86ms
- replica (d2b79a) ⌚ 0.78ms

eu-west-1

- primary (57eb8d)
- replica (2a6fa3) ⌚ 1.69ms
- replica (414894) ⌚ 1.7ms

- Benchmarks
- Set password
- Backups**
- BDR settings
- Service files
- History
- Drop cluster

Backups

Filter...

Restore cluster Schedule backups

Type	Created At	Status	Name
A	September 18, GMT+3	failed	base_00000001000000000000000006
A	September 18, GMT+3	finished	base_00000001000000000000000006

us-east-1 (b24cd0)

eu-west-1 (c16604)

Automated Backups

pgday-tr gulcin.yildirim **Multi Master**

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- primary (dc44dc)
- replica (914a76) ⌚ 0.86ms
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eu-west-1

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- replica (2a6fa3) ⌚ 1.69ms
- replica (414894) ⌚ 1.7ms

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Backups

Filter...

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Automated Backups

pgday-tr gulcin.yildirim Multi Master

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us-east-1

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replica (414894) 1.7ms
eu-west-1

- Benchmarks
- Set password
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Backups

Filter...

finished
failed ✓

us-east-1 (b24cd0)
eu-west-1 (c16604)

finished eu-west-1 (c16604)

Restore cluster Schedule backups

Name
base_00000001000000000000000000000000
base_00000001000000000000000000000000

Filter backups by status
and cluster

Scheduled Backups

Schedule backups ✕

Base backup every: All Mon Tue Wed Thu Fri Sat Sun

Keep for:

Start at: (UTC)
11:10 GMT+03:00

Scheduled Backups

Schedule backups ✕

Base backup every: All Mon Tue Wed Thu Fri Sat Sun

Keep for: ▾

Start at: 🕒 (UTC)
11:10 GMT+03:00

Scheduled Backups


Schedule backups ×

Base backup every: All Mon Tue Wed Thu Fri Sat Sun

Keep for:

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Backup schedule



Scheduled Backups


Schedule backups ×

Base backup every: All Mon Tue Wed Thu Fri Sat Sun

Keep for:

Start at: (UTC)
11:10 GMT+03:00

Backup schedule



Scheduled Backups

Schedule backups ×

Base backup every: All Mon Tue Wed Thu Fri Sat Sun

Keep for:

Start at: (UTC)
11:10 GMT+03:00


Backup schedule **Backup retention**

Point-in-Time Recovery

Restore cluster ✕

This will create new cluster with the same configuration from the backup time you choose bellow.

Subcluster: us-east-1 (b24cd0)
 eu-west-1 (c16604)


* Time:  (UTC)
Sep 18, 2018, 22:51:14 GMT+03:00

Point-in-Time Recovery

Restore cluster ✕

This will create new cluster with the same configuration from the backup time you choose bellow.

Subcluster: us-east-1 (b24cd0)
 eu-west-1 (c16604)


* Time:  (UTC)
Sep 18, 2018, 22:51:14 GMT+03:00


Point-in-Time Recovery

Restore cluster ✕

This will create new cluster with the same configuration from the backup time you choose bellow.

Subcluster: us-east-1 (b24cd0)
 eu-west-1 (c16604)

* Time:  (UTC)
Sep 18, 2018, 22:51:14 GMT+03:00


Pick time

Documentation

Documentation

GDS comes in three flavours:

- **Single Master** (offers physical streaming replication)
- **Multi-Master** (offers BDR and physical streaming replication)
- **Always On** (offers BDR in a very highly available setup)

GDS Deployment Types

GDS Single Master has 3 deployment types:

- **Development:** Useful for development purposes
- **Test:** Useful for testing/staging your setup before going production
- **Production:** Best fit for production use, comes with Platinum Support and HA

GDS Multi-Master has one type and you can use it for all deployments. You will have 2 standby servers for each BDR primary server you created. The design enforces high availability starting with the initial configuration. You will also get 2ndQuadrant Diamond Support (the highest level) by creating a Multi-Master.

GDS Always On is designed to provide at least 4 Nines Availability (%99.99) on BDR architectures.

How to Start?

You can login to GDS through our Customer Portal, once you are authorized you will be able to create clusters. Start by clicking "Create new cluster" at the top right of the main page.

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Docs (WiP)

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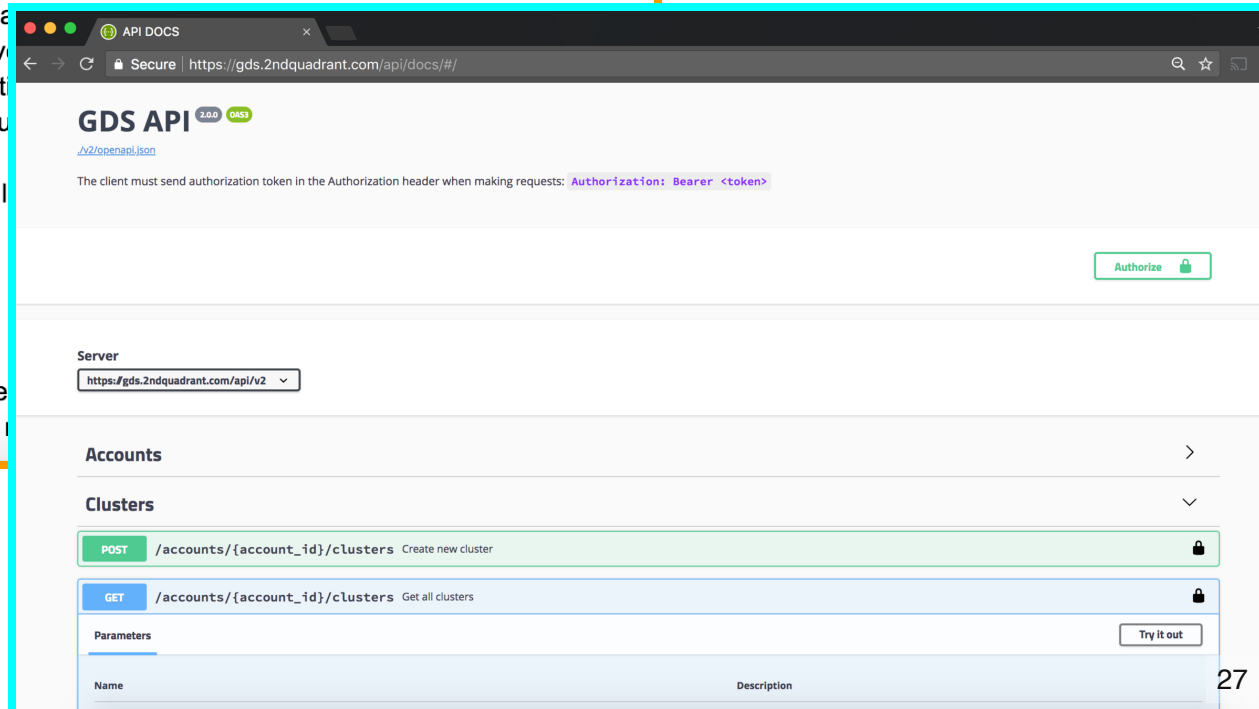
GDS Multi-Master has one type and you can have standby servers for each BDR primary server for high availability starting with the initial configuration. Platinum Support (the highest level) by creating a Multi-Master.

GDS Always On is designed to provide at least two active architectures.

How to Start?

You can login to GDS through our Customer Portal to create clusters. Start by clicking "Create New Cluster"

Docs (WiP)



The screenshot shows a web browser window displaying the GDS API documentation. The page title is "GDS API" with version "3.0.0" and "GDS3" tags. The URL is "https://gds.2ndquadrant.com/api/docs/#/". Below the title, there is a link to "v2/openapi.json" and a note that the client must send an authorization token in the Authorization header. There is an "Authorize" button. The main content area shows a "Server" dropdown menu with "https://gds.2ndquadrant.com/api/v2" selected. Below that, there are sections for "Accounts" and "Clusters". The "Clusters" section is expanded, showing a "POST" endpoint for creating a new cluster and a "GET" endpoint for getting all clusters. There is a "Try it out" button for the GET endpoint. The bottom of the page shows a table with columns for "Name" and "Description".

Documentation

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GDS Multi-Master has one type and you can have standby servers for each BDR primary server for high availability starting with the initial configuration. Platinum Support (the highest level) is available by creating a Multi-Master setup.

GDS Always On is designed to provide at least one primary server in all architectures.

How to Start?

You can login to GDS through our Customer Portal to create clusters. Start by clicking "Create new cluster"

Docs (WiP)

Interactive API docs

API DOCS

Secure | https://gds.2ndquadrant.com/api/docs/#/

GDS API

[v2/openapi.json](#)

The client must send authorization token in the Authorization header when making requests: `Authorization: Bearer <token>`

Authorize

Server

Accounts

Clusters

POST /accounts/{account_id}/clusters Create new cluster

GET /accounts/{account_id}/clusters Get all clusters

Parameters

Try it out

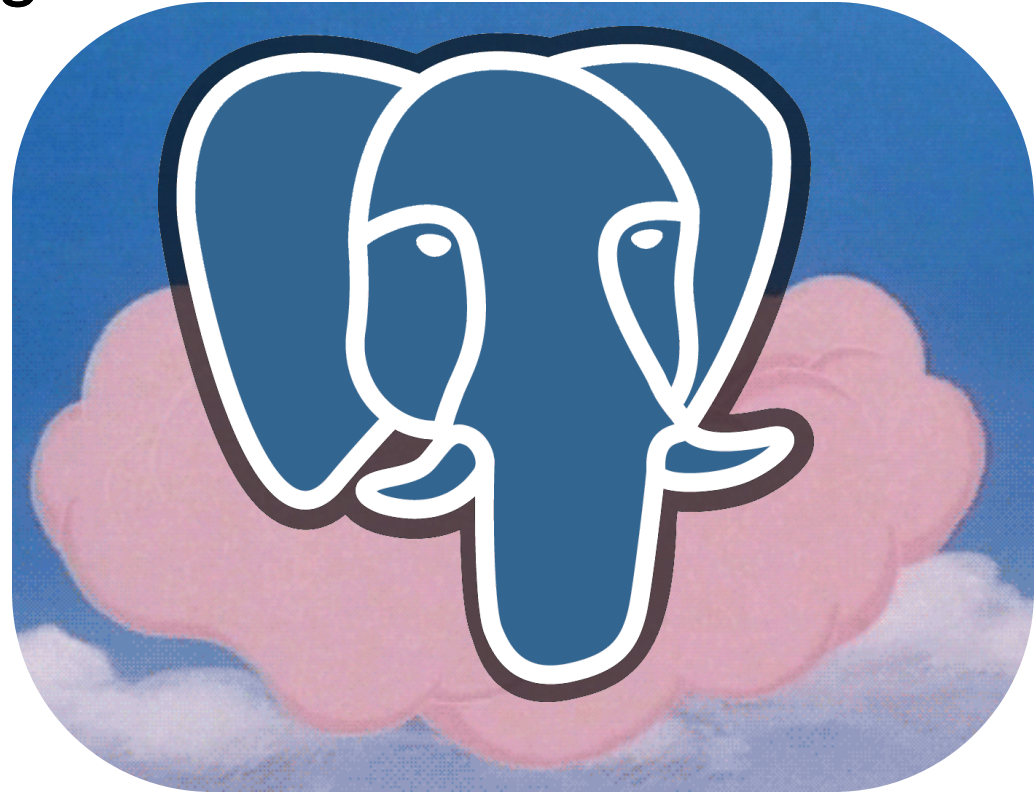
Name	Description
------	-------------

Postgres Cloud Manager



Conclusion

- Postgres in Cloud is a go!
- Multi-Master adds new possibilities
- It's possible to create your own cloud independent of the platform
- Automation enables easy management
- Postgres Support applies to Cloud!



2ndQuadrant[®] +
PostgreSQL

Teşekkürler!



Questions?