How to achieve the scalability, high availability, and elastic ability of your database infrastructure on Kubernetes

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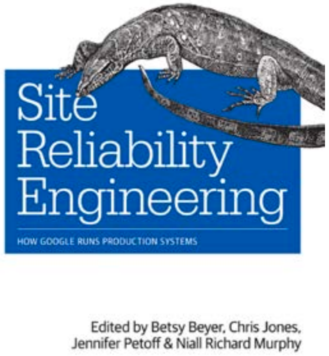
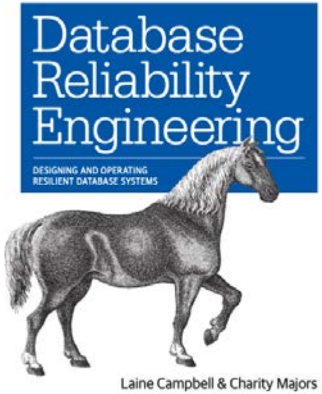
Content

- ✓ SRE & SLA & DBRE
- ✓ The new needs for a database on the cloud
- ✓ Idea & architecture
- ✓ Handling SQL
- ✓ Demo

SRE & SLA & DBRE

- ✓ Database Reliability Engineering (DBRE) is basically a subset of Site Reliability Engineering (SRE)
- ✓ Stateless service VS stateful service (Persistence & status)
- ✓ SLA (Service Level Agreement) & SLO (Service Level Objectives) & SLI (Service Level Indicators)


Site
Reliability
Engineering
HOW GOOGLE RUNS PRODUCTION SYSTEMS
Edited by Betsy Beyer, Chris Jones,
Jennifer Petoff & Niall Richard Murphy



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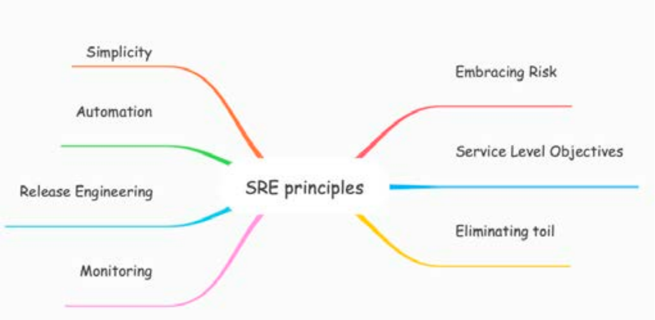
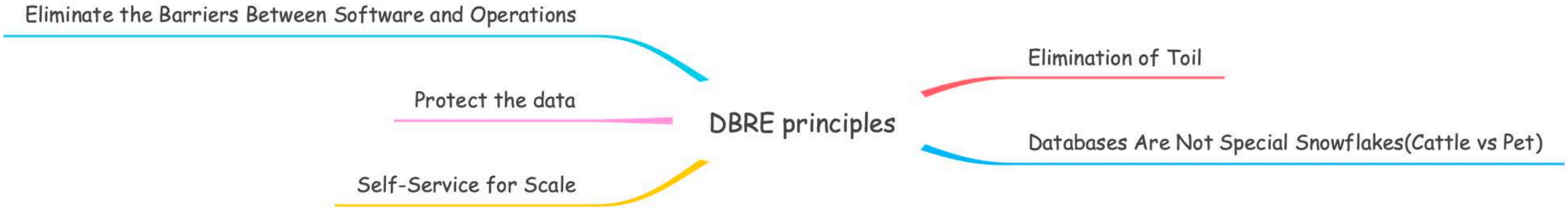
New needs for databases



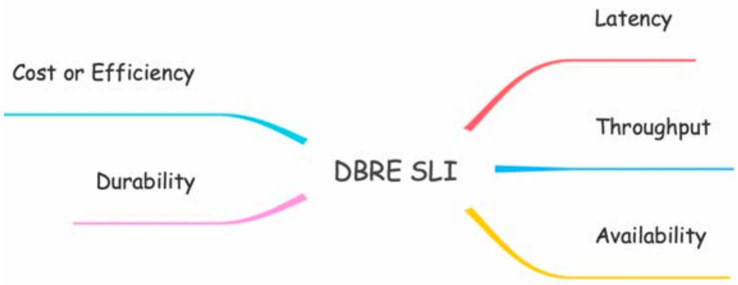
SRE principles

- Simplicity
- Automation
- Release Engineering
- Monitoring
- Embracing Risk
- Service Level Objectives
- Eliminating toil



DBRE principles

- Eliminate the Barriers Between Software and Operations
- Protect the data
- Self-Service for Scale
- Elimination of Toil
- Databases Are Not Special Snowflakes(Cattle vs Pet)



DBRE SLI

- Cost or Efficiency
- Durability
- Latency
- Throughput
- Availability

The needs for a database on the cloud

- ✓ Large data to manage
- ✓ Efficient queries
- ✓ Data security
- ✓ Traffic governance
- ✓ Elastic scaling
- ✓ Backup & recovery
- ✓ Metrics
- ✓ Portability
- ✓ Out-of-the-box deployment

→

Data Sharding

HA & read/write splitting & traffic strategy

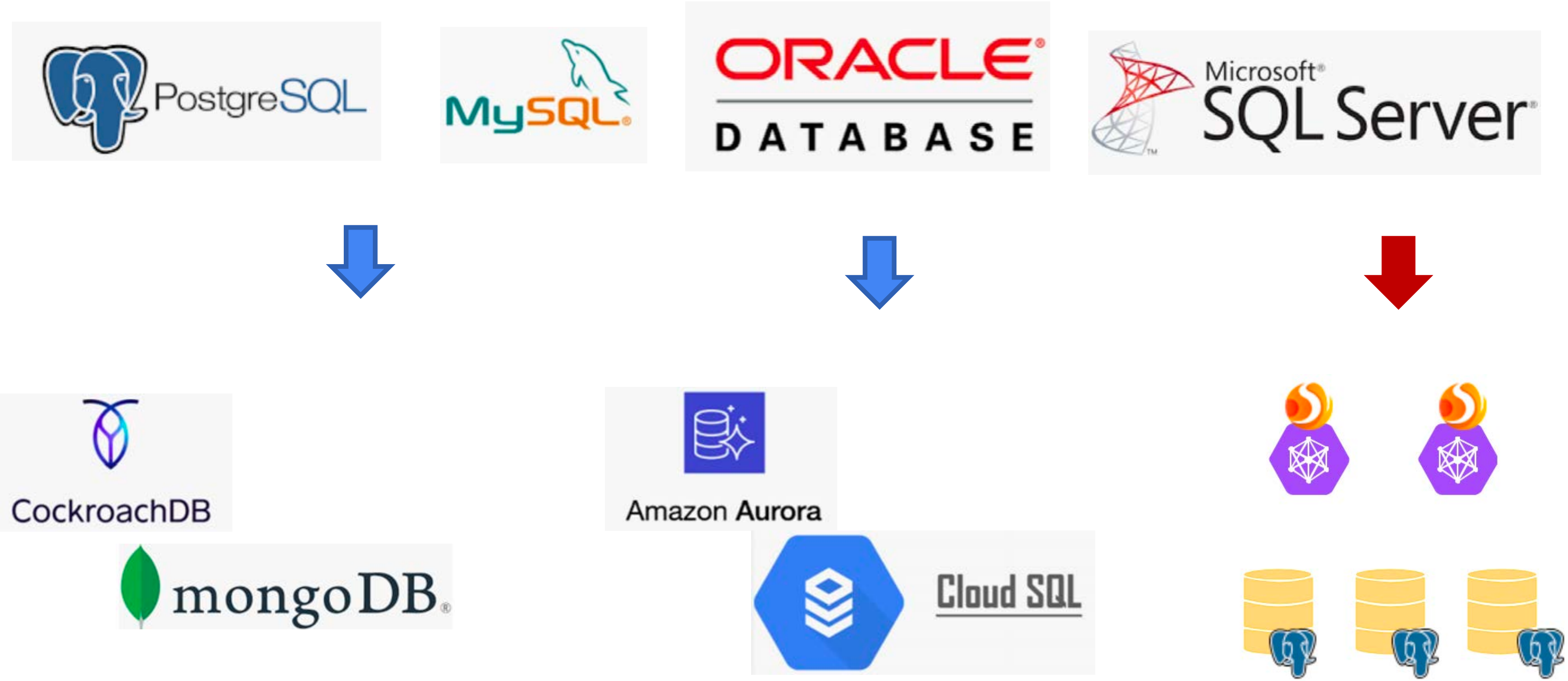
Data Encryption

Monitor

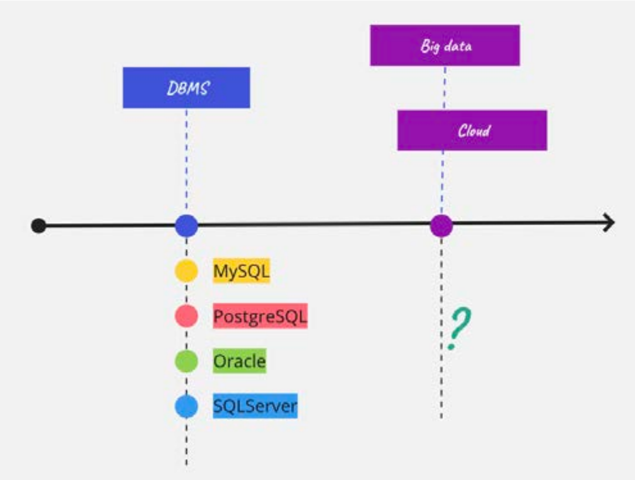
Reshard for computing nodes and storage nodes

Helm & Operator on Kubernetes

Monolithic database on the cloud

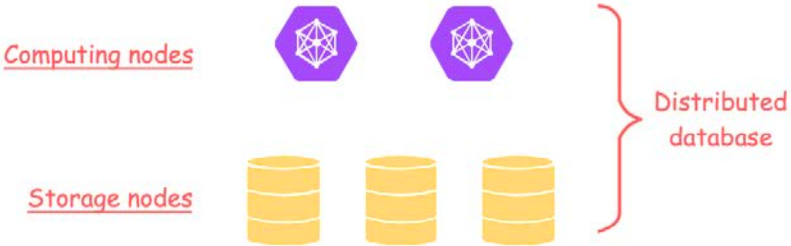


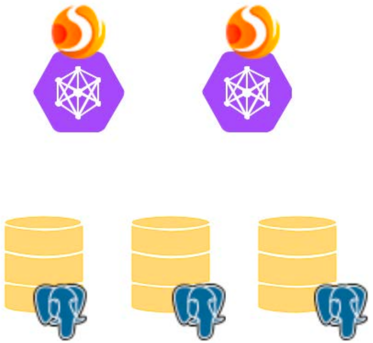
Benefits

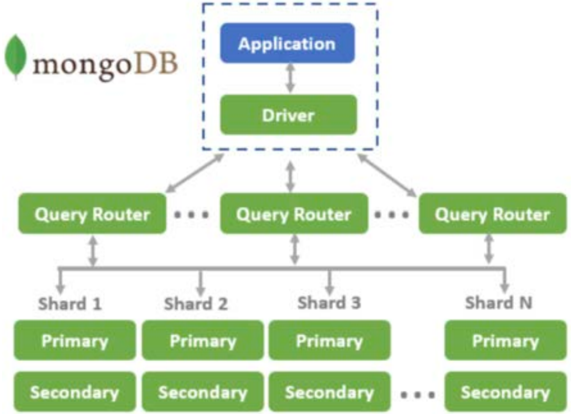


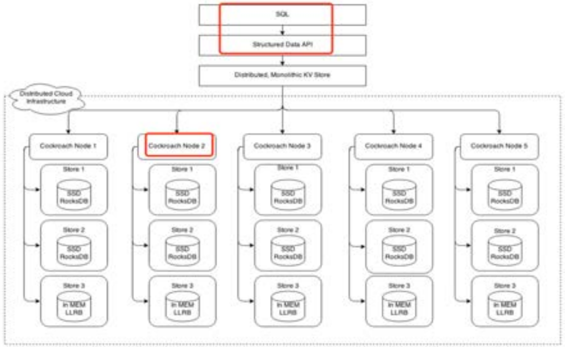
- ✓ Leverage the existing databases
- ✓ Upgrade it into a distributed database at low cost
- ✓ SQL audit & Traffic governance & Elastic scaling
- ✓ Solve the headache of moving database into Kubernetes
- ✓ Out-of-the-box deployment
- ✓ No lock-in

Distributed database









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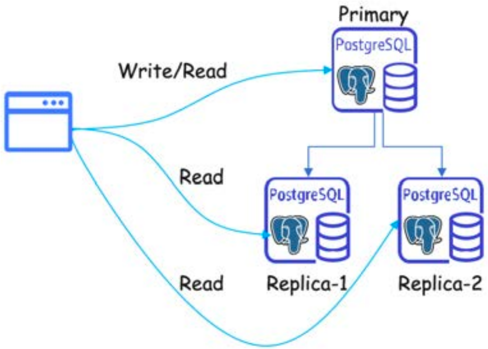
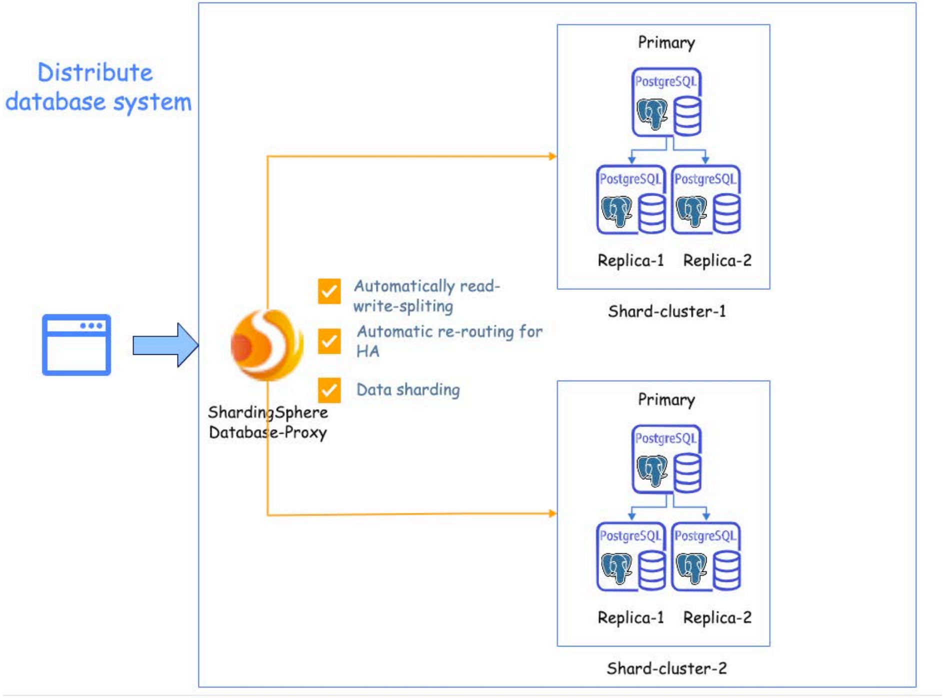
Application -> Database

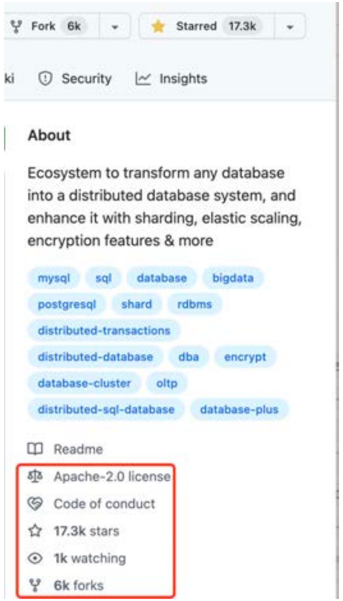


Before



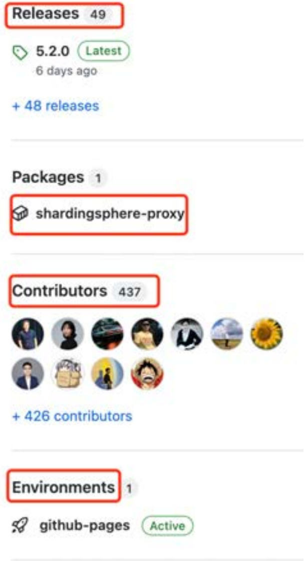
After

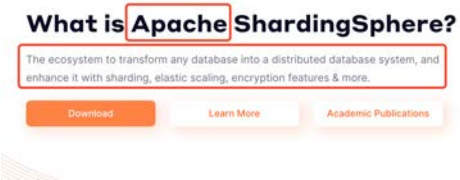
Apache ShardingSphere



About

Ecosystem to transform any database into a distributed database system, and enhance it with sharding, elastic scaling, encryption features & more

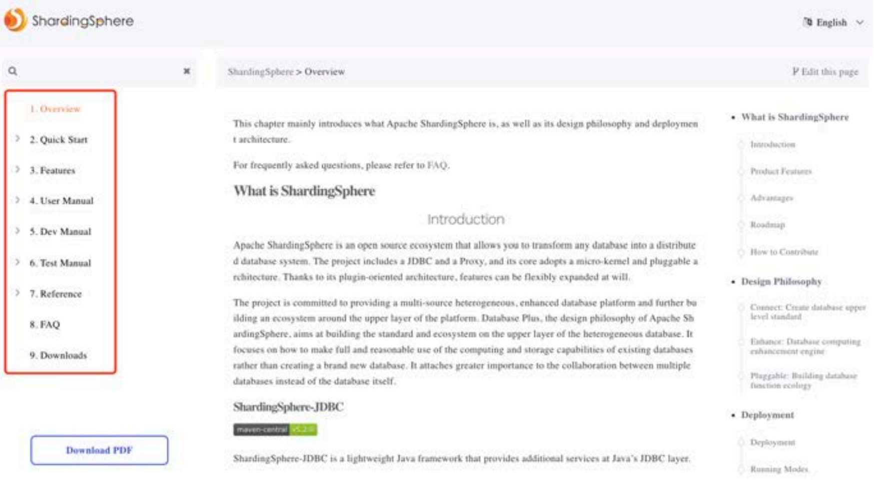




What is Apache ShardingSphere?

The ecosystem to transform any database into a distributed database system, and enhance it with sharding, elastic scaling, encryption features & more.

ShardingSphere



This chapter mainly introduces what Apache ShardingSphere is, as well as its design philosophy and deployment architecture.

For frequently asked questions, please refer to FAQ.

What is ShardingSphere

Introduction

Apache ShardingSphere is an open source ecosystem that allows you to transform any database into a distributed database system. The project includes a JDBC and a Proxy, and its core adopts a micro-kernel and pluggable architecture. Thanks to its plugin-oriented architecture, features can be flexibly expanded at will.

The project is committed to providing a multi-source heterogeneous, enhanced database platform and further building an ecosystem around the upper layer of the platform. Database Plus, the design philosophy of Apache ShardingSphere, aims at building the standard and ecosystem on the upper layer of the heterogeneous database. It focuses on how to make full and reasonable use of the computing and storage capabilities of existing databases rather than creating a brand new database. It attaches greater importance to the collaboration between multiple databases instead of the database itself.

ShardingSphere-JDBC

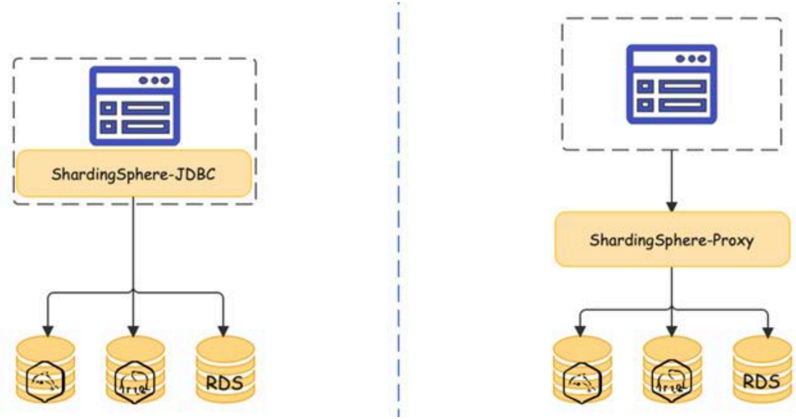
ShardingSphere-JDBC is a lightweight Java framework that provides additional services at Java's JDBC layer.

ShardingSphere clients

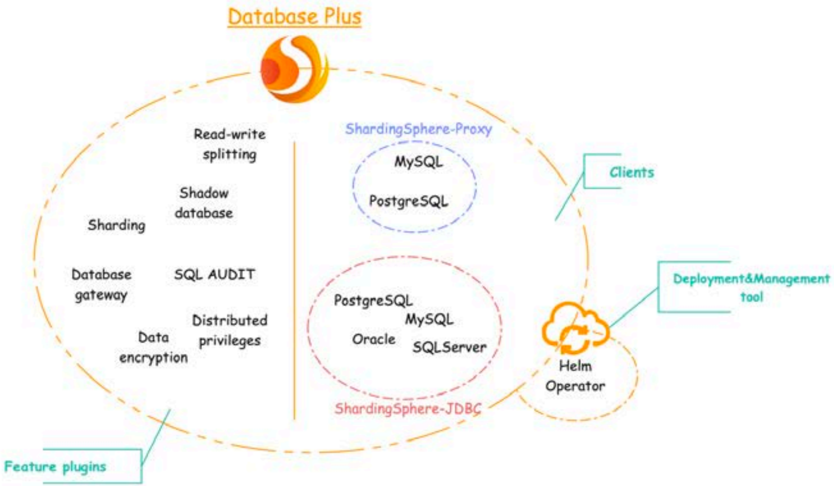
Database Plus

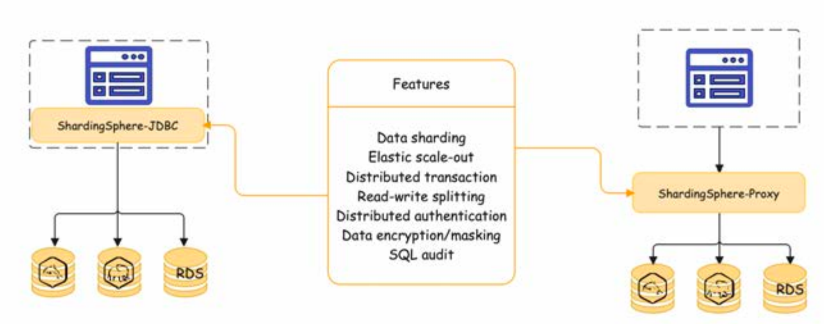
What is Apache ShardingSphere?

The ecosystem to transform any database into a distributed database system, and enhance it with sharding, elastic scaling, encryption features & more.

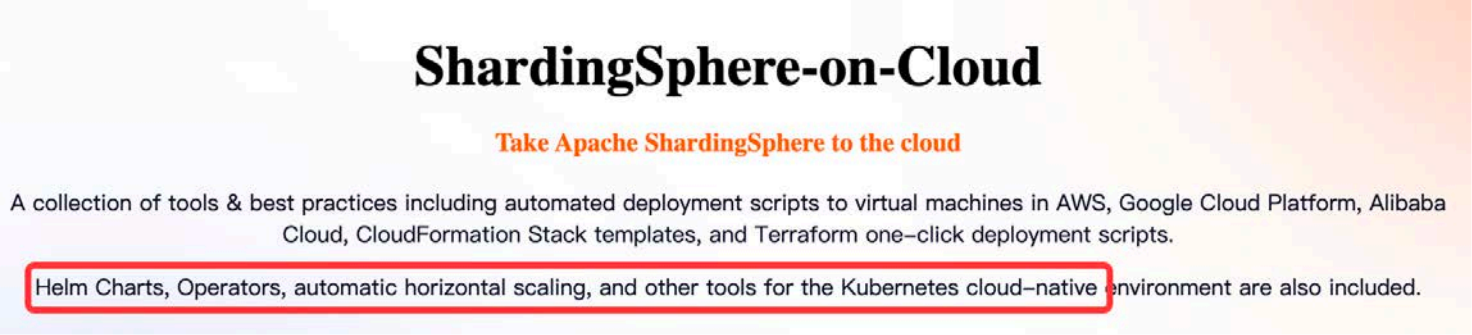


ShardingSphere features





ShardingSphere on Cloud

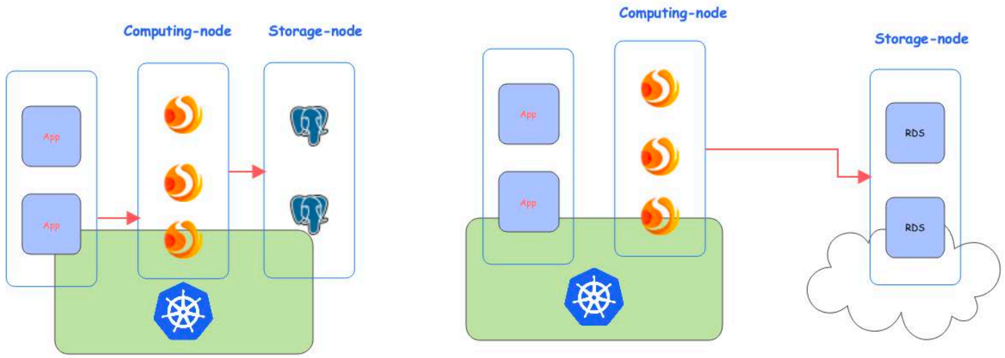


ShardingSphere-on-Cloud

Take Apache ShardingSphere to the cloud

A collection of tools & best practices including automated deployment scripts to virtual machines in AWS, Google Cloud Platform, Alibaba Cloud, CloudFormation Stack templates, and Terraform one-click deployment scripts.

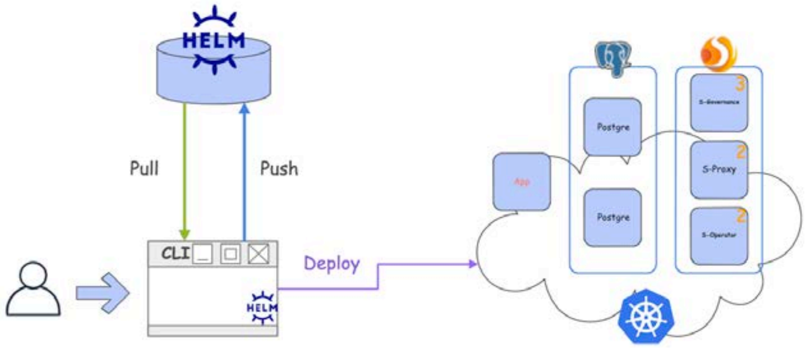
Helm Charts, Operators, automatic horizontal scaling, and other tools for the Kubernetes cloud-native environment are also included.



https://shardingsphere.apache.org/oncloud/

Demo

ShardingSphere-Chart	Deployment & Upgrate of ShardingSphere
ShardingSphere-Operator-Chart	HA & Elastic scale-out base CPU metric of ShardingSphere
PostgreSQL-Chart	Deployment of PostgreSQL



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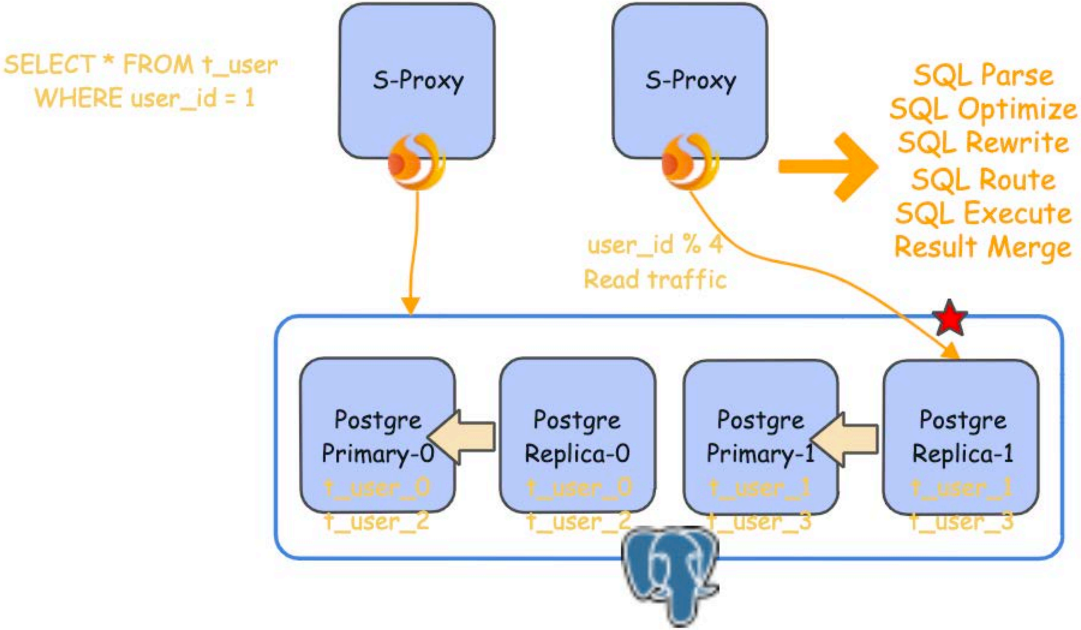
https://github.com/apache/shardingsphere-on-cloud

The handling process of one SQL

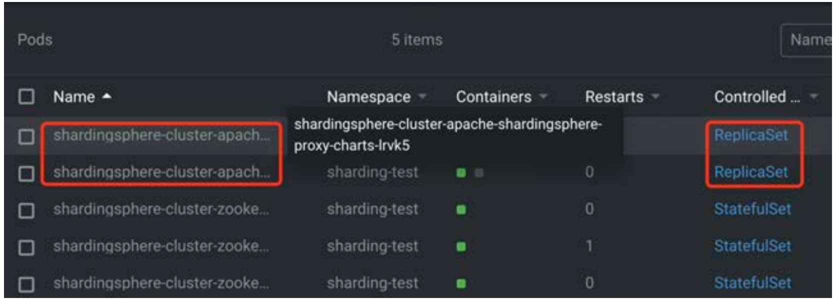


The demo show

1. Deploy two PostgreSQL (Storage node) clusters made of a primary node and a replica
2. Deploy two ShardingSphere-Proxy (Computing node) and ShardingSphere-governance
3. Add PostgreSQL resources and their relationship into ShardingSphere-Proxy
4. Create sharding table t_user on ShardingSphere-Proxy
5. Show the metadata of this distributed database system
6. INSERT data for test on ShardingSphere-Proxy
7. Preview SELECT routing result
8. Execute SELECT query

Step 1, 2,

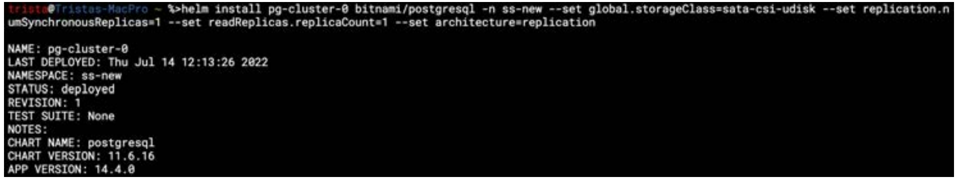
```
git clone https://github.com/apache/shardingsphere-on-cloud
cd charts/shardingsphere-operator-cluster
helm dependency build
helm install shardingsphere-cluster shardingsphere-operator-cluster -n sharding-test
```



Pods 5 items Name

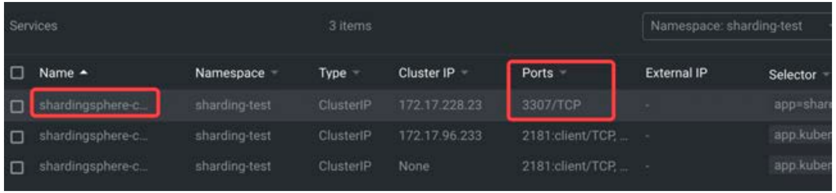
□	Name ▲	Namespace	Containers	Restarts	Controlled ...
□	shardingsphere-cluster-apach...				ReplicaSet
□	shardingsphere-cluster-apach...	sharding-test	🟩 ⬜	0	ReplicaSet
□	shardingsphere-cluster-zooke...	sharding-test	🟩	0	StatefulSet
□	shardingsphere-cluster-zooke...	sharding-test	🟩	1	StatefulSet
□	shardingsphere-cluster-zooke...	sharding-test	🟩	0	StatefulSet

shardingsphere-cluster-apache-shardingsphere-proxy-charts-lrvk5



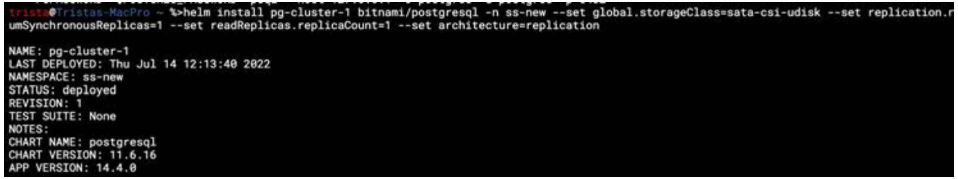
```
trista@Tristas-MacPro ~ %>helm install pg-cluster-0 bitnami/postgresql -n ss-new --set global.storageClass=sata-csi-udisk --set replication.n
umSynchronousReplicas=1 --set readReplicas.replicaCount=1 --set architecture=replication

NAME: pg-cluster-0
LAST DEPLOYED: Thu Jul 14 12:13:26 2022
NAMESPACE: ss-new
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
CHART NAME: postgresql
CHART VERSION: 11.6.16
APP VERSION: 14.4.0
```



Services 3 items Namespace: sharding-test

□	Name ▲	Namespace	Type	Cluster IP	Ports	External IP	Selector
□	shardingsphere-c...	sharding-test	ClusterIP	172.17.228.23	3307/TCP	-	app=shar
□	shardingsphere-c...	sharding-test	ClusterIP	172.17.96.233	2181:client/TCP, ...	-	app.kuber
□	shardingsphere-c...	sharding-test	ClusterIP	None	2181:client/TCP, ...	-	app.kuber



```
trista@Tristas-MacPro ~ %>helm install pg-cluster-1 bitnami/postgresql -n ss-new --set global.storageClass=sata-csi-udisk --set replication.r
umSynchronousReplicas=1 --set readReplicas.replicaCount=1 --set architecture=replication

NAME: pg-cluster-1
LAST DEPLOYED: Thu Jul 14 12:13:40 2022
NAMESPACE: ss-new
STATUS: deployed
REVISION: 1
TEST SUITE: None
NOTES:
CHART NAME: postgresql
CHART VERSION: 11.6.16
APP VERSION: 14.4.0
```

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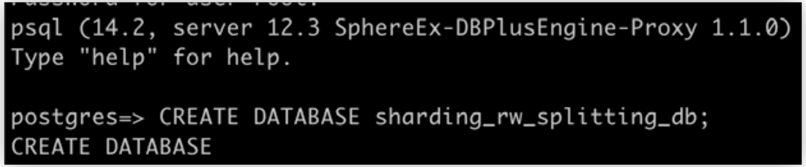
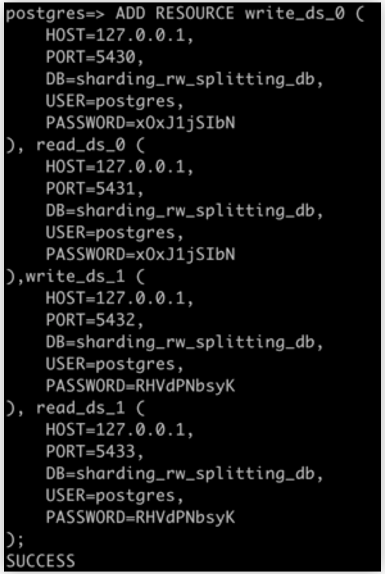
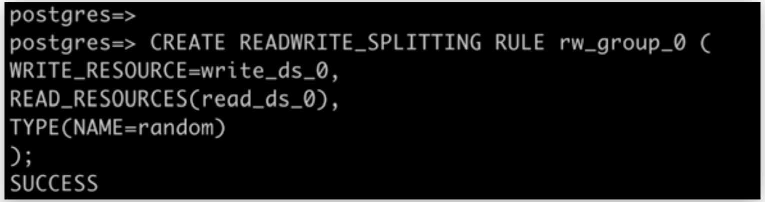
Step 3, 4, 5



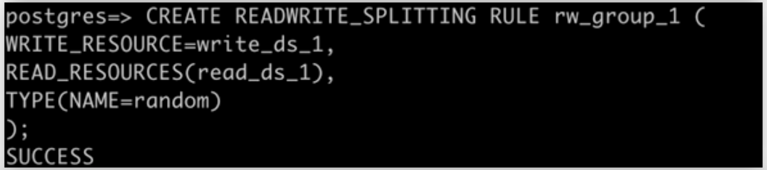
```
Password for user root:
psql (14.2, server 12.3 SphereEx-DBPlusEngine-Proxy 1.1.0)
Type "help" for help.

postgres=> CREATE DATABASE sharding_rw_splitting_db;
CREATE DATABASE
```



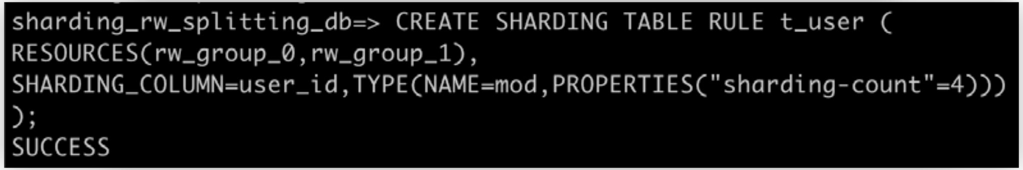
```
postgres=> ADD RESOURCE write_ds_0 (
    HOST=127.0.0.1,
    PORT=5430,
    DB=sharding_rw_splitting_db,
    USER=postgres,
    PASSWORD=xOxJ1jSIbN
), read_ds_0 (
    HOST=127.0.0.1,
    PORT=5431,
    DB=sharding_rw_splitting_db,
    USER=postgres,
    PASSWORD=xOxJ1jSIbN
),write_ds_1 (
    HOST=127.0.0.1,
    PORT=5432,
    DB=sharding_rw_splitting_db,
    USER=postgres,
    PASSWORD=RHVdPNbsyK
), read_ds_1 (
    HOST=127.0.0.1,
    PORT=5433,
    DB=sharding_rw_splitting_db,
    USER=postgres,
    PASSWORD=RHVdPNbsyK
);
SUCCESS
```



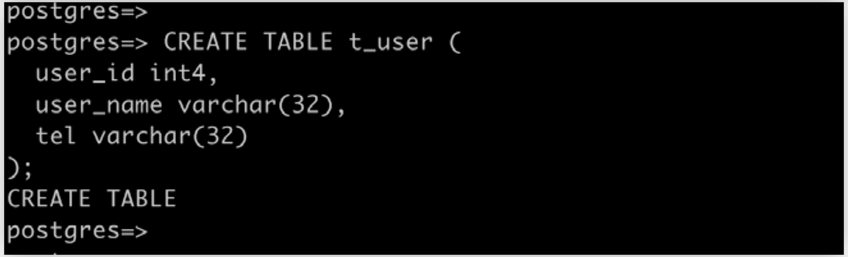
```
postgres=>
postgres=> CREATE READWRITE_SPLITTING RULE rw_group_0 (
WRITE_RESOURCE=write_ds_0,
READ_RESOURCES(read_ds_0),
TYPE(NAME=random)
);
SUCCESS
```



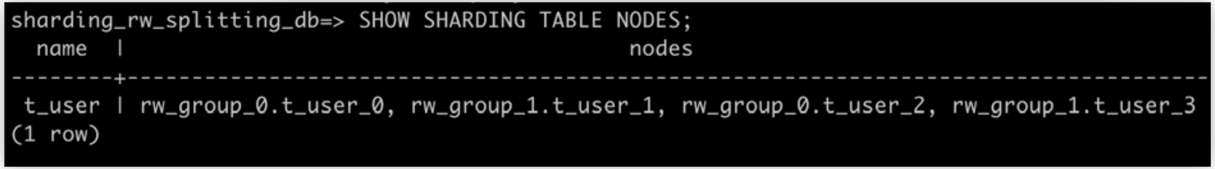
```
postgres=> CREATE READWRITE_SPLITTING RULE rw_group_1 (
WRITE_RESOURCE=write_ds_1,
READ_RESOURCES(read_ds_1),
TYPE(NAME=random)
);
SUCCESS
```



```
sharding_rw_splitting_db=> CREATE SHARDING TABLE RULE t_user (
RESOURCES(rw_group_0,rw_group_1),
SHARDING_COLUMN=user_id,TYPE(NAME=mod,PROPERTIES("sharding-count"=4)))
);
SUCCESS
```



```
postgres=>
postgres=> CREATE TABLE t_user (
  user_id int4,
  user_name varchar(32),
  tel varchar(32)
);
CREATE TABLE
postgres=>
```



```
sharding_rw_splitting_db=> SHOW SHARDING TABLE NODES;
  name  |                                   nodes
--------+-----------------------------------------------------------------------------------
 t_user | rw_group_0.t_user_0, rw_group_1.t_user_1, rw_group_0.t_user_2, rw_group_1.t_user_3
(1 row)
```

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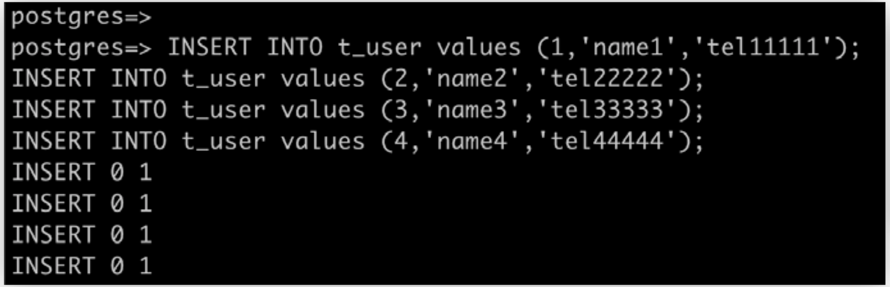
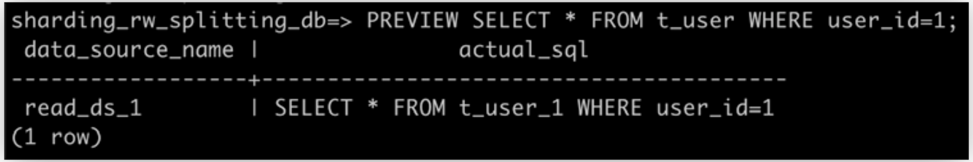
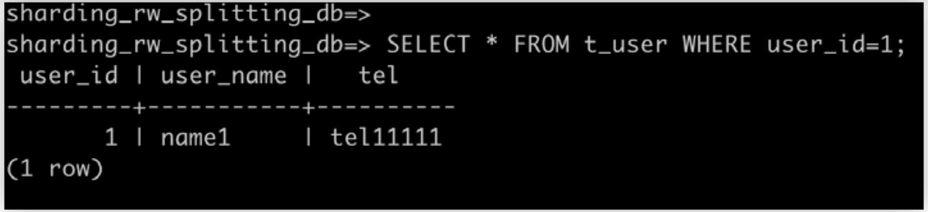
Step 6, 7, 8



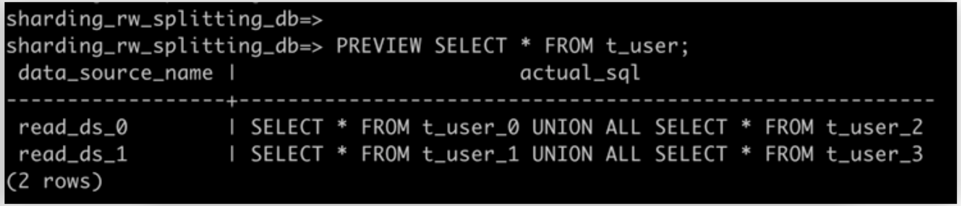
```
postgres=>
postgres=> INSERT INTO t_user values (1,'name1','tel11111');
INSERT INTO t_user values (2,'name2','tel22222');
INSERT INTO t_user values (3,'name3','tel33333');
INSERT INTO t_user values (4,'name4','tel44444');
INSERT 0 1
INSERT 0 1
INSERT 0 1
INSERT 0 1
```



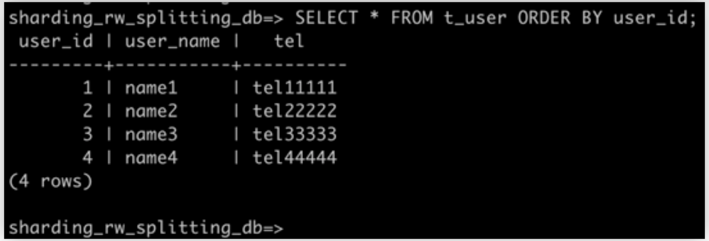
```
sharding_rw_splitting_db=> PREVIEW SELECT * FROM t_user WHERE user_id=1;
 data_source_name |               actual_sql
------------------+---------------------------------------
 read_ds_1        | SELECT * FROM t_user_1 WHERE user_id=1
(1 row)
```



```
sharding_rw_splitting_db=>
sharding_rw_splitting_db=> SELECT * FROM t_user WHERE user_id=1;
 user_id | user_name |   tel
---------+-----------+----------
       1 | name1     | tel11111
(1 row)
```



```
sharding_rw_splitting_db=>
sharding_rw_splitting_db=> PREVIEW SELECT * FROM t_user;
 data_source_name |                        actual_sql
------------------+--------------------------------------------------------
 read_ds_0        | SELECT * FROM t_user_0 UNION ALL SELECT * FROM t_user_2
 read_ds_1        | SELECT * FROM t_user_1 UNION ALL SELECT * FROM t_user_3
(2 rows)
```



```
sharding_rw_splitting_db=> SELECT * FROM t_user ORDER BY user_id;
 user_id | user_name |   tel
---------+-----------+----------
       1 | name1     | tel11111
       2 | name2     | tel22222
       3 | name3     | tel33333
       4 | name4     | tel44444
(4 rows)

sharding_rw_splitting_db=>
```

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Thanks!
Any questions?

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