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PostgreSQL

PostgreSQL Foreign Data Wrappers (pg_fdw)

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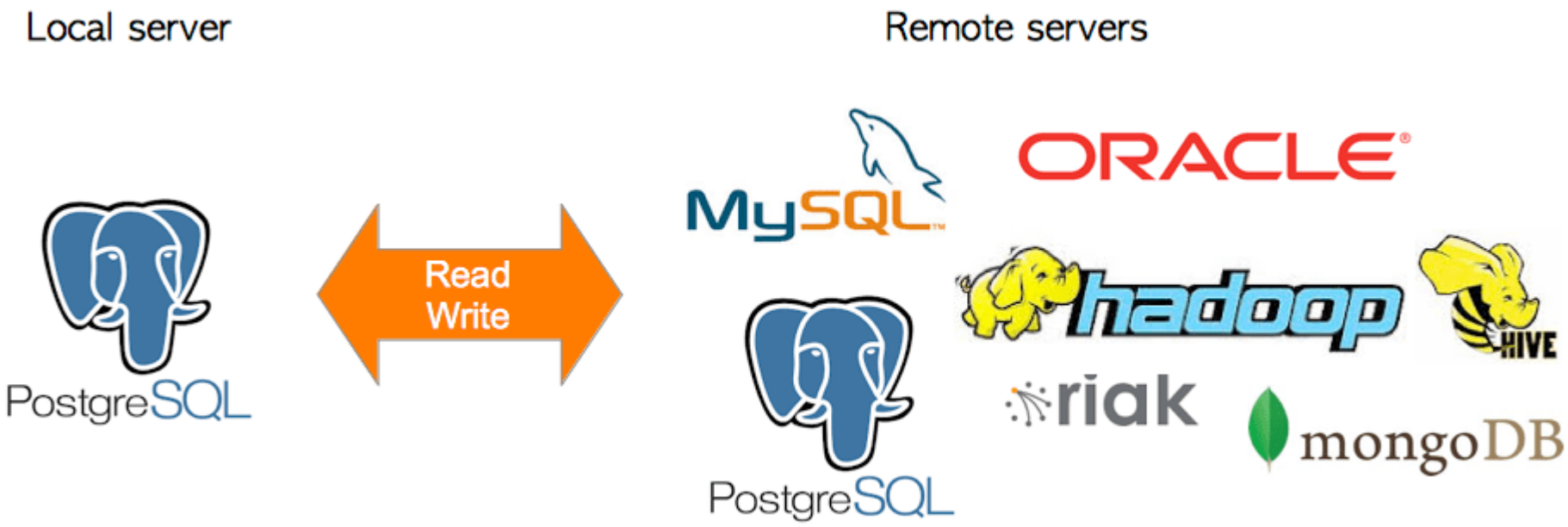
Objectives

- Foreign Data Wrappers(FDW)简介与特性
- Postgres_FDW部署
- FDW执行原理
- 本地外部表操作

Foreign Data Wrappers

- Foreign Data Wrappers (FDW)



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FDW部署

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- 部署FDW（在客户端部署）

1、编译postgres_fdw
cd /soft/postgresql-12.2/contrib/postgres_fdw

make

make install

2、安装postgres_fdw (哪个database上使用，就在哪个database上安装）

create extension postgres_fdw;

FDW部署

- 部署FDW（续）

3、创建fdw服务器

```
CREATE SERVER pgdb FOREIGN DATA WRAPPER postgres_fdw
    OPTIONS (host 'pg2',port '1922',dbname 'testdb');
```

Host：远程主机名、ip地址
Port：远程数据库监听端口
Dbname：远程服务器名字

4、授权

```
GRANT USAGE ON FOREIGN SERVER pgdb TO pg_fdw1;
```

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FDW部署

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- 部署FDW（续）

5、创建用户映射（本地用户与远程用户映射）

```
CREATE USER MAPPING FOR pg_fdw1 SERVER pgdb
        OPTIONS (user 'scott', password 'tiger');
```

user：远程数据库用户
password：用户密码

6、创建FDW表（以pg_fdw1用户创建）

```
GRANT USAGE ON FOREIGN SERVER pgdb TO scott_pg;
```

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FDW部署

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- 部署FDW（续）

6、创建FDW表（以pg_fdw1用户创建）

```
CREATE FOREIGN TABLE emp_fdw (
 EMPNO      int ,
 ENAME      VARCHAR(10),
 JOB        VARCHAR(9),
 MGR        int,
 HIREDATE   date,
 SAL        float4,
 COMM       float4,
 DEPTNO     int
) SERVER pgdb OPTIONS (schema_name 'public', table_name 'emp');
```

Schema_name：public，特定schema用户创建的表，则写该schema名字
Table_name：需要访问的表表名

FDW部署

- 部署FDW（续）

7、创建FDW表（以pg_fdw1用户创建）

```
CREATE FOREIGN TABLE dept_fdw (
deptno integer,
dname  character varying(14),
loc    character varying(13)
)SERVER pgdb OPTIONS (schema_name ‘public', table_name 'dept');;
```

Schema_name：public，特定schema用户创建的表，则写该schema名字
Table_name：需要访问的表表名

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FDW部署

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- 部署FDW（续）

8、访问FDW表（以pg_fdw1用户访问）

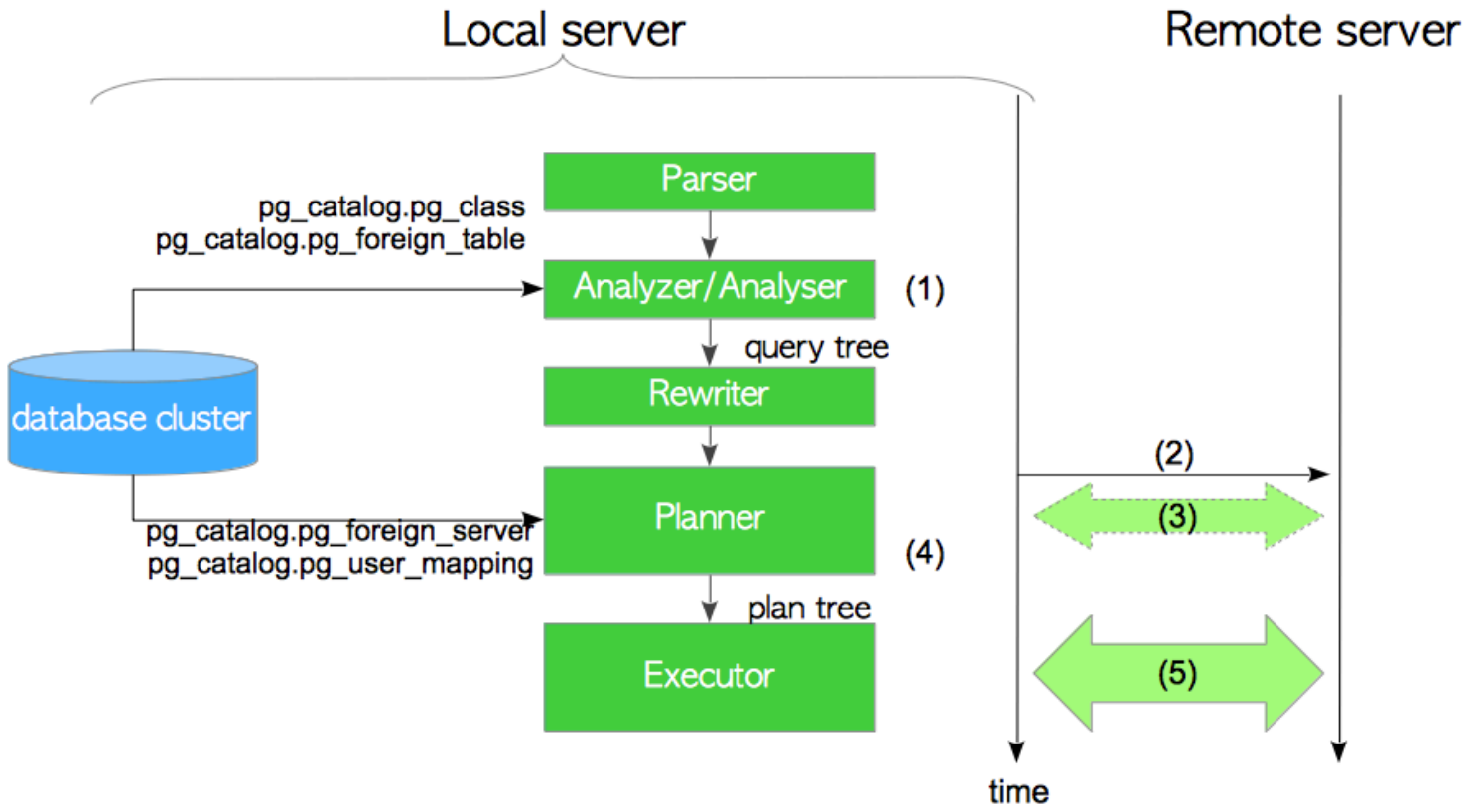
```
SELECT *  FROM emp_fdw;

SELECT * FROM dept_fdw;
```

*访问FDW表的语法与访问本地表一样。

FDW原理

- FDW执行流程



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FDW原理

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- FDW执行流程

1、Creating a Query Tree（访问pg_catalog.pg_class和pg_catalog.pg_foreign_table）

2、Connecting to the Remote Server（使用libpq库）

3、Creating a Plan Tree Using EXPLAIN Commands (Optional)（访问pg_catalog.pg_user_mapping和pg_catalog.pg_foreign_server）

4、Deparesing（postgres_fdw从通过解析和分析创建的查询树中重新创建一个纯文本文件，在PostgreSQL中称为deparsing。）

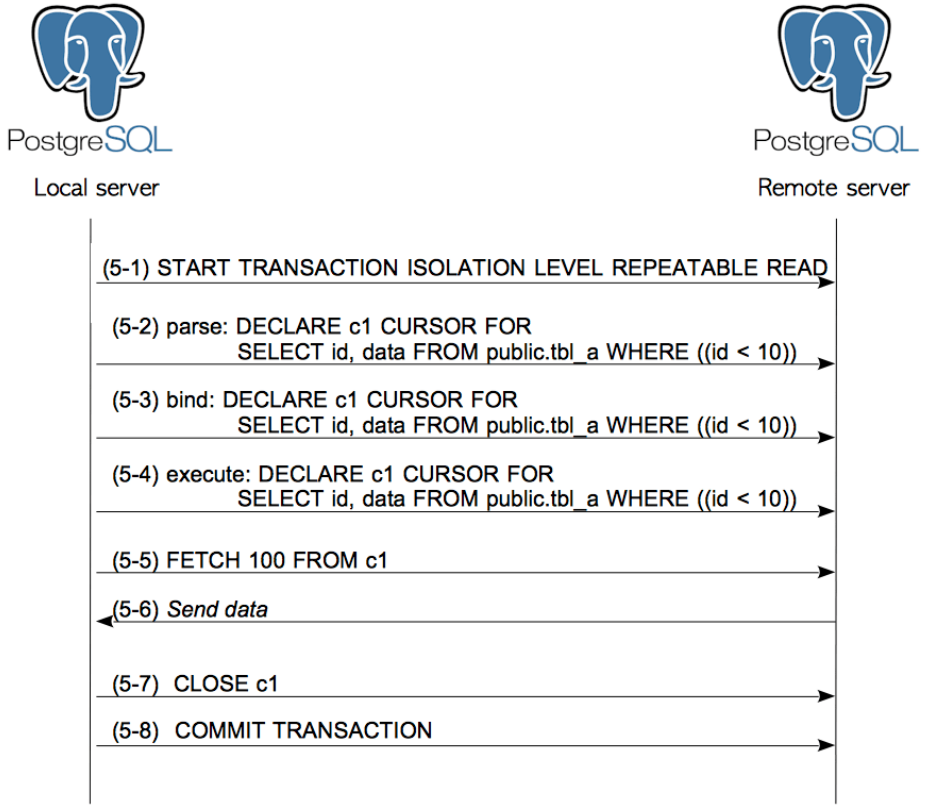
5、Sending SQL Statements and Receiving Result

FDW原理

- FDW执行流程（PG-PG）

在远程服务器端打开日志，可以查看到访问流程：

```
log_destination = 'csvlog'
logging_collector = on
log_directory = 'pg_log
log_filename = 'postgresql-%Y-%m-%d'
log_truncate_on_rotation = off
log_rotation_age = 1d
log_rotation_size = 0
log_error_verbosity = verbose
log_statement = all
```



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FDW原理

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- 版本演进

各个版本功能演进

Version	Description
9.3	postgres_fdw module is released.
9.6	• Consider performing sorts on the remote server. • Consider performing joins on the remote server. • When feasible, perform UPDATE or DELETE entirely on the remote server. • Allow the fetch size to be set as a server or table option.
10	Push aggregate functions to the remote server, when possible.

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FDW原理

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- 执行DML操作（PG-PG支持DML操作，其它不支持）

PostgreSQL_FDW不会检测死锁

```
localdb=# -- Client A
localdb=# BEGIN;
BEGIN
localdb=# UPDATE tbl_local SET data = 0 WHERE
id = 1;
UPDATE 1
localdb=# UPDATE tbl_remote SET data = 0
WHERE id = 1;
UPDATE 1
```

```
localdb=# -- Client B
localdb=# BEGIN;
BEGIN
localdb=# UPDATE tbl_remote SET data = 0
WHERE id = 1;
UPDATE 1
localdb=# UPDATE tbl_local SET data = 0
WHERE id = 1;
UPDATE 1
```

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FDW原理

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- 多表查询

Version 9.6以前版本

```
localdb=# EXPLAIN verbose SELECT * FROM tbl_a AS a, tbl_b AS b WHERE a.id = b.id AND a.id
< 200;
                              QUERY PLAN
-----------------------------------------------------------------------
 Merge Join  (cost=532.31..700.34 rows=10918 width=16)
   Merge Cond: (a.id = b.id)
   ->  Sort  (cost=200.59..202.72 rows=853 width=8)
         Sort Key: a.id
         ->  Foreign Scan on tbl_a a  (cost=100.00..159.06 rows=853 width=8)
   ->  Sort  (cost=331.72..338.12 rows=2560 width=8)
         Sort Key: b.id
         ->  Foreign Scan on tbl_b b  (cost=100.00..186.80 rows=2560 width=8)
(8 rows)
```

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FDW原理

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- 多表查询

（PG-PG）如果使用ALTER SERVER命令将use_remote_estimate选项设置为on，则计划器将通过执行EXPLAIN命令向远程服务器查询计划的成本，此时连接操作在远程进行，提高性能。

```
ALTER SERVER pgdb OPTIONS (use_remote_estimate 'on');

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```

```
localdb=# EXPLAIN verbose SELECT * FROM tbl_a AS a, tbl_b AS b WHERE a.id = b.id AND a.id < 200;
                        QUERY PLAN
-----------------------------------------------------------
 Foreign Scan  (cost=134.35..244.45 rows=80 width=16)
   Relations: (public.tbl_a a) INNER JOIN (public.tbl_b b)
(2 rows)
```

FDW原理

- 排序操作

在9.5或更早版本中：

```
localdb=# EXPLAIN verbose SELECT * FROM tbl_a AS a WHERE a.id < 200 ORDER BY a.id;
                              QUERY PLAN
-----------------------------------------------------------------------
 Sort  (cost=200.59..202.72 rows=853 width=8)
   Sort Key: id
   ->  Foreign Scan on tbl_a a  (cost=100.00..159.06 rows=853 width=8)
(3 rows)
```

FDW原理

- 排序操作

在9.6或以后版本中：

```
localdb=# EXPLAIN verbose SELECT * FROM tbl_a AS a WHERE a.id < 200 ORDER BY a.id;
                          QUERY PLAN
---------------------------------------------------------------
 Foreign Scan on tbl_a a  (cost=100.00..167.46 rows=853 width=8)
(1 row)
```

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FDW原理

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- 聚组函数操作

在9.6或更早版本中：

```
localdb=# EXPLAIN verbose SELECT AVG(data) FROM tbl_a AS a WHERE a.id < 200;
                          QUERY PLAN
---------------------------------------------------------------------
 Aggregate  (cost=168.50..168.51 rows=1 width=4)
   ->  Foreign Scan on tbl_a a  (cost=100.00..166.06 rows=975 width=4)
(2 rows)
```

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FDW原理

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- 聚组函数操作

在10或以后版本中：

```
localdb=# EXPLAIN verbose SELECT AVG(data) FROM tbl_a AS a WHERE a.id < 200;
                        QUERY PLAN
-----------------------------------------------------
 Foreign Scan  (cost=102.44..149.03 rows=1 width=32)
   Relations: Aggregate on (public.tbl_a a)
(2 rows)
```

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本地外部表

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- 本地外部表

1、--添加扩展
CREATE EXTENSION file_fdw;

2、--创建SERVER FOR file
create server pg_file_server foreign data wrapper file_fdw;

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本地外部表

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- 本地外部表

```
3、--创建外部表，与外部文件结构一致
create foreign table emp_file_fdw
            (EMPNO int,
            ENAME varchar(10),
            JOB varchar(9),
            MGR int,
            HIREDATE DATE,
            SAL int,
            COMM int,
            DEPTNO int)
server pg_file_server
options(filename '/home/postgres/emp.csv',format 'csv',header 'true',delimiter ',');
```

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总结

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- Postgres_FDW部署
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练习

- 1、配置postgresql.conf, 开启csvlog. 开启log statement=all.
- 2、创建file_fdw插件
- 3、使用file_fdw创建postgresql日志csv文件的外部表, 并使用SQL分析csv文件的内容.

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