You forgot to put the WHERE in the DELETE?

Martín Marqués

2ndQuadrant

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1. Introduction
2. What are backups for
3. Backup types
4. Backups considerations
5. Recovering
6. Finally
7. Question
What are we going to talk about

- What backups are for
- Different ways to backup postgres databases
- Disaster scenarios
- Recovery options
- Final notes
Introduction

What are backups for

Backup types

Backups considerations

Recovering

Finally

Question
What are backups for?

- Recover from disasters
- Spin-up replicas
- Create development environments
- Archive can serve as a WAL hub
Types of disasters to recover from

- Server irrecoverable
- Table gone
- Data gone
- Corruption
Types of disasters to recover from

- Server irrecoverable → DC catches fire/gets flooded
- Table gone → Devops drops/truncates a table
- Data gone → Yesterdays deploy has a bug
- Corruption → HW corrupts data
Introduction
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Backup types
Backups considerations
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Backup types

- Logical backups
  - pg_dump
  - pglogical
  - in-core logical replication
Backup types

- Logical backups
  - pg_dump
  - pglogical
  - in-core logical replication

- Physical backups
  - Basebackup + WAL files
    - External OS apps: rsync, tar, etc.
    - pg_basebackup
    - Specific postgres tools
  - Standby: sync, async, delayed
Logical Backups

- Use `pg_dump` for taking backups
- Use `pg_restore` to restore the backup
Logical Backups

**Pros**
- Extremely robust
- Backups are forward compatible
- Partial recovery is an option
- Flexible backup and recovery options
Logical Backups

**Pros**
- Extremely robust
- Backups are forward compatible
- Partial recovery is an option
- Flexible backup and recovery options

**Cons**
- Holds a snapshot for the whole time `pg_dump` runs
- Recovers to snapshot taken, no PITR
Logical Backups

pg_dumpall -g | psql -h remote_host -p 5433
SET
SET
SET
CREATE ROLE
ALTER ROLE
CREATE ROLE
ALTER ROLE
ERROR: role "postgres" already exists
ALTER ROLE
Logical Backups

$ pg_dump -Fc martin -f martin.dmp -Z 7

$ ls -l martin.dmp
-rw-r--r--. 1 postgres postgres 5207257 oct 17 11:14 martin.dmp

$ pg_restore -C -d postgres -j 4 -p 5433 martin.dmp
Physical backups

- Using OS/Storage tools
  - Configure WAL archiving
  - Starts with `pg_start_backup()`
  - Do a filesystem backup with: `rsync`, `tar`, `storage` snapshot, etc.
  - Ends with `pg_stop_backup()`
Physical Backups

- Using OS/Storage tools
  - Pros
    - Doesn’t hold a postgres snapshot
    - Point in time recovery
    - Incremental backups are possible
    - Versatility of compression options
    - Possible to do work in parallel
  - Cons
    - Need to restore the whole cluster
    - Requires manual scripting or tool
Physical backups

- **Using** `pg_basebackup`
  
  ```
  $ pg_basebackup -h hoth -p 5432 -X stream -R -c fast -P -D ~/11/data
  735619/735619 kB (100%), 1/1 tablespace
  ```
Physical Backups

- Using `pg_basebackup`
  - Pros
    - Doesn’t hold a postgres snapshot
    - Can do point in time recovery
    - Doesn’t require operating system access to server
  - Cons
    - Need to restore the whole cluster
    - Can’t do incremental backups
    - Backup work can not be done in parallel (WIP patch)
    - Doesn’t backup configuration files outside PGDATA
How does it work

+----> Basebackup
  |
  ++-- WAL archiving
  |
  |---------------------------------------------
  +++

time 1 2 3 4 5 6
How does it work

```
Incident <---+
    |        
    X-------
```

```
time  1  2  3  4  5  6
```
How does it work

+----> Recover basebackup
  |        +---> Recovery target
  |        |    
  |        | ==-------------------------o
Replay archived WALs

time 1 2 3 4 5 6
Standby: sync, async, delayed

- Create a replica from a physical backup
- **Configure** `primary_conninfo, recovery_min_apply_delay, synchronous_commit and synchronous_standby_names`
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Conditions a backup needs

- Finish successfully
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- Finish successfully
- Located in a remote location
Conditions a backup needs

- Finish successfully
- Located in a remote location
- Backup and restore process is documented/automated
Conditions a backup needs

- Finish successfully
- Located in a remote location
- Backup and restore process is documented/automated
- A restore was attempted successfully
Schrodinger’s Backup

“The condition of any backup is unknown until a restore is attempted.”
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Server gone

Server irrecoverable
"UPGRADE SHOULD HAVE LIMITED TRAFFIC IMPACT"

DATA CENTER BURNS DOWN
Server gone - Option 1

- Pick the standby with highest LSN and promote it
- Re-configure other standbys to connect to new primary
- Recover, if possible, the old primary as a new standby
Server gone - Option 2

- Bring up a new server
- Recover latest base backup
- Replay all available archived WALs
Server gone

Table gone / Data gone

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Table/Data gone - Option 1, delayed standby

- Check if the data is still in the delayed standby
- If it is, pause replay
- Extract the missing data from this standby
- Resume replay
- Apply/merge recovered data on primary node
**Table/Data gone - Option 2, delayed standby**

- Check if the data is still in the delayed standby
- If it is, pause replay
- Set `recovery_target_time` to a time before the incident
- Set `recovery_target_action` to `promote`
- Resume replay
- Provides less downtime
- Simpler
- There could be more data loss

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Table/Data gone - Option 3, using logical backup

- Extract missing data from a `pg_dump` backup
- Apply/merge recovered data on primary node
- There may be data loss

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Table/Data gone - Option 4

- Recover a physical base backup on new server
- Use `recovery_target_time` to recover up to before the disaster
  - Extract missing data and apply on primary node
  - Promote the recovered backup as the new primary

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Server gone

Data corruption

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Data Corruption, FS corruption, missing files

- Almost always only option is a physical backup recovery
- Recover base backup
- Replay WALs to a consistent state, or an LSN at which the missing files are available
- Verify if a good version of the corrupt or missing file is present
- Keep replaying WALs if needed and repeat previous step
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Conclusions

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- A delayed standby could provide lower RTO in case of disaster
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- Use some automated tool
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- A delayed standby could provide lower RTO in case of disaster
- You can achieve RPO zero by streaming WALs instead of using `archive_command`
Conclusions

- Take backups!
- Use some automated tool
- Standbys can serve as backups
- Always test your backs by recovering
- A delayed standby could provide lower RTO in case of disaster
- You can achieve RPO zero by streaming WALs instead of using `archive_command`
- Security first: encrypt your backups
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