PostgreSQL 17: How to Backup and Restore Using pg_basebackup on the Same Host

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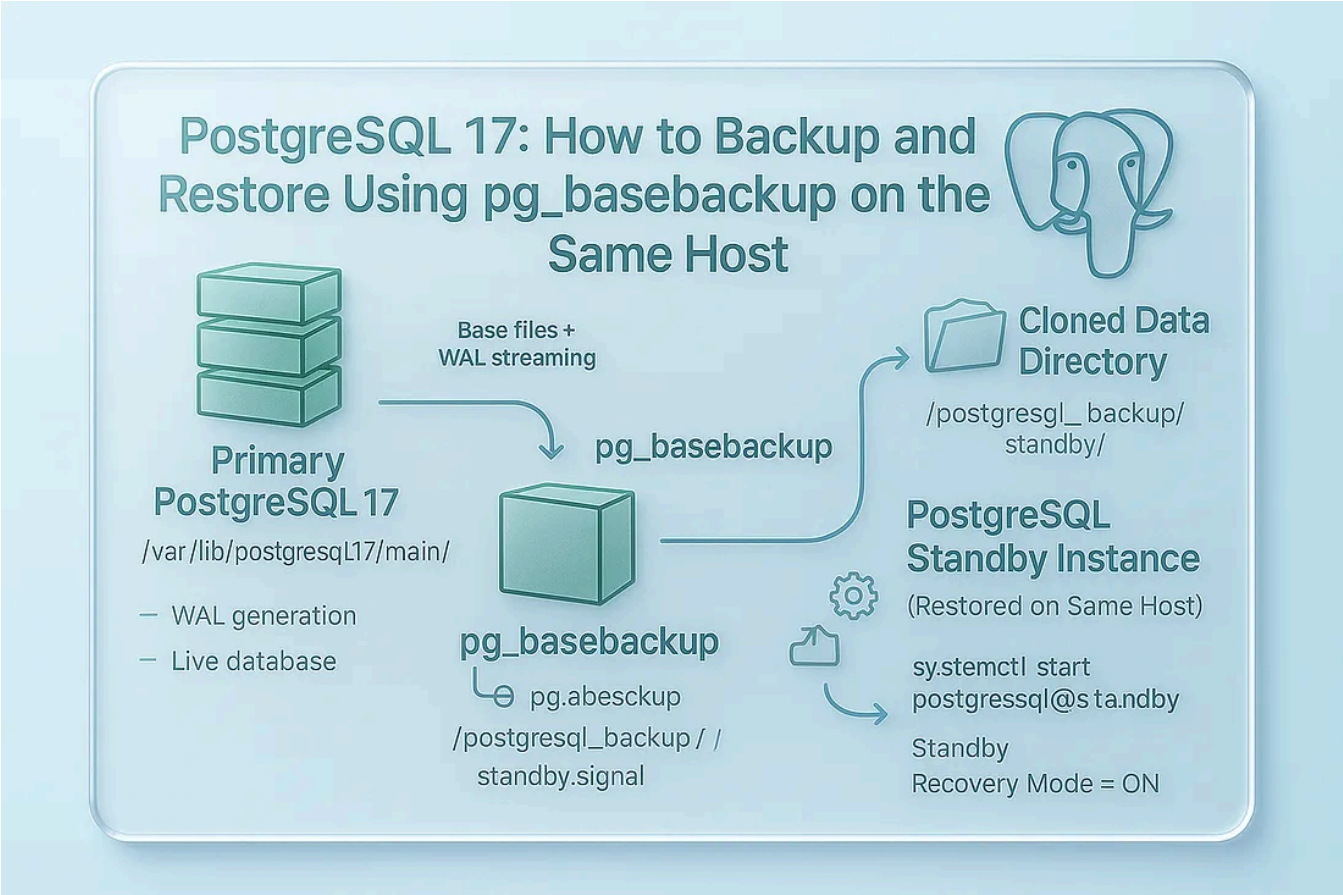

🛡 PostgreSQL 17: How to Backup and Restore Using pg_basebackup on the Same Host

When managing PostgreSQL databases, ensuring a **reliable, consistent, and fast backup strategy** is essential for any production environment. One of the most

efficient tools available natively within PostgreSQL is `pg_basebackup`.

This guide walks you through everything you need to know about using `pg_basebackup` to perform a **full backup and restore** operation **on the same host.** Whether you're preparing for disaster recovery, building replication, or setting up Point-in-Time Recovery (PITR), `pg_basebackup` should be part of your toolkit.

🔎 Why Use `pg_basebackup`?

`pg_basebackup` is a PostgreSQL-native utility designed to take **binary-level, physical backups** of the database cluster. Here's why it's so widely recommended:

✅ 1. Zero Downtime Backups

You can run `pg_basebackup` while PostgreSQL is actively running. Thanks to PostgreSQL's Write-Ahead Logging (WAL) system, the tool can stream all changes happening during the backup to ensure consistency.

No need to stop your database. Your applications and users won't even notice.

✅ 2. PITR & Replication-Ready

When used with WAL streaming (`-X` flag) or WAL archiving, `pg_basebackup` enables:

- **Point-in-Time Recovery** (PITR): Rewind your database to any moment after the backup.
- **Standby Initialization:** The backup can be used to set up a streaming replica (standby node) for high availability.

It automatically generates the `standby.signal` file (if using `-R` flag), preparing the backup directory for replication mode.

✅ 3. Cluster-Wide Coverage

Unlike `pg_dump`, which backs up **individual databases** (logical backup), `pg_basebackup` backs up the **entire cluster** including:

- All user databases
- Global objects (roles, tablespaces)
- Configuration files
- WAL segments
- Replication metadata

This is a **complete snapshot** of everything inside your PostgreSQL instance.

✅ 4. Perfect for Cloud-Based PostgreSQL

Running PostgreSQL on **AWS EC2, Azure VM, GCP Compute Engine**, or on-premise Linux servers? `pg_basebackup` is ideal because:

- It can be automated with cron or shell scripts.
- It doesn't require third-party software.
- It can be used as part of an HA or DR setup with minimal configuration.

Whether you're backing up a 1GB test instance or a multi-terabyte production node, `pg_basebackup` scales gracefully.

🔧 Prerequisites Before Using `pg_basebackup`

Before jumping into backup/restore steps, make sure your system meets the following conditions:

✅ PostgreSQL 17 Installed & Running

Check if PostgreSQL is installed and running:

```
psql --version
sudo systemctl status postgresql-17
```

You should see something like:

```
[postgres@ip-172-31-20-155 ~]$ psql --version
psql (PostgreSQL) 17.5
[postgres@ip-172-31-20-155 ~]$


[postgres@ip-172-31-20-155 ~]$ sudo systemctl status postgresql-17
● postgresql-17.service - PostgreSQL 17 database server
     Loaded: loaded (/usr/lib/systemd/system/postgresql-17.service; enabled; pr
     Active: active (running) since Fri 2025-06-27 17:00:27 UTC; 7h ago
 Invocation: 0594acf74fad4411b78da3700cb1e647
       Docs: https://www.postgresql.org/docs/17/static/
    Process: 74444 ExecStartPre=/usr/pgsql-17/bin/postgresql-17-check-db-dir ${
   Main PID: 74450 (postgres)
      Tasks: 8 (limit: 5687)
     Memory: 37.7M (peak: 41.3M)
        CPU: 13.578s
     CGroup: /system.slice/postgresql-17.service
             ├─74450 /usr/pgsql-17/bin/postgres -D /var/lib/pgsql/17/data/
             ├─74451 "postgres: logger "
             ├─74452 "postgres: checkpointer "
             ├─74453 "postgres: background writer "
             ├─74455 "postgres: walwriter "
             ├─74456 "postgres: autovacuum launcher "
             ├─74457 "postgres: archiver failed on 000000010000000200000035"
             └─74458 "postgres: logical replication launcher "

Jun 27 17:00:27 ip-172-31-20-155.ec2.internal systemd[1]: Starting postgresql-1
Jun 27 17:00:27 ip-172-31-20-155.ec2.internal postgres[74450]: 2025-06-27 17:00
Jun 27 17:00:27 ip-172-31-20-155.ec2.internal postgres[74450]: 2025-06-27 17:00
Jun 27 17:00:27 ip-172-31-20-155.ec2.internal systemd[1]: Started postgresql-17
[postgres@ip-172-31-20-155 ~]$
```

✅ Sample Database (Optional)

To verify the effectiveness of your backup, it's useful to load a sample database like `dvdrental`.

Install wget in you linux machine

```
[postgres@ip-172-31-20-155 ~]$ sudo yum install wget -y
Updating Subscription Management repositories.
Unable to read consumer identity

This system is not registered with an entitlement server. You can use "rhc" or

Last metadata expiration check: 3:16:56 ago on Fri Jun 27 21:10:15 2025.
Dependencies resolved.
================================================================================
 Package                                 Architecture
================================================================================
Installing:
 wget                                    x86_64

Transaction Summary
================================================================================
Install  1 Package

Total download size: 807 k
Installed size: 3.3 M
Downloading Packages:
```


```
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :
  Installing       : wget-1.24.5-5.el10.x86_64
  Running scriptlet: wget-1.24.5-5.el10.x86_64
Installed products updated.

Installed:
  wget-1.24.5-5.el10.x86_64

Complete!
[postgres@ip-172-31-20-155 ~]$
```

You can download it from https://neon.com/postgresql/postgresql-getting-started/postgresql-sample-database and restore it using:

```
wget https://neon.com/postgresqltutorial/dvdrental.zip
```

Output:

```
[postgres@ip-172-31-20-155 ~]$ wget https://neon.com/postgresqltutorial/dvdrent
--2025-06-28 00:28:58--  https://neon.com/postgresqltutorial/dvdrental.zip
Resolving neon.com (neon.com)... 76.76.21.21
Connecting to neon.com (neon.com)|76.76.21.21|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 550906 (538K) [application/zip]
Saving to: ‘dvdrental.zip’

dvdrental.zip                                       100%[=====================

2025-06-28 00:28:58 (113 MB/s) - ‘dvdrental.zip’ saved [550906/550906]

[postgres@ip-172-31-20-155 ~]$


[postgres@ip-172-31-20-155 ~]$ ls -ltr
total 540
drwx------. 4 postgres postgres     51 Jun 21 16:18 17
-rw-r--r--. 1 postgres postgres 550906 Jun 27 19:08 dvdrental.zip
[postgres@ip-172-31-20-155 ~]$

[postgres@ip-172-31-20-155 ~]$ unzip dvdrental.zip
Archive:  dvdrental.zip
  inflating: dvdrental.tar


[postgres@ip-172-31-20-155 ~]$ ls -ltr
total 3312
-rw-r--r--. 1 postgres postgres 2835456 May 12  2019 dvdrental.tar
drwx------. 4 postgres postgres      51 Jun 21 16:18 17
-rw-r--r--. 1 postgres postgres  550906 Jun 27 19:08 dvdrental.zip
```

Create dvdrental database and restore

```
createdb dvdrental


postgres=# \l+

    Name     |  Owner   | Encoding | Locale Provider | Collate |  Ctype  | Loca
-------------+----------+----------+-----------------+---------+---------+-----
 dvdrental   | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
 metrics_lab | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
 postgres    | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
 template0   | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
             |          |          |                 |         |         |
 template1   | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
             |          |          |                 |         |         |
(5 rows)

postgres=#




[postgres@ip-172-31-20-155 ~]$
[postgres@ip-172-31-20-155 ~]$ pg_restore -d dvdrental /var/lib/pgsql/dvdrental
[postgres@ip-172-31-20-155 ~]$
```

```
pg_restore -d dvdrental -v  /var/lib/pgsql/dvdrental.tar
```

This will populate the server with realistic test data to validate backup integrity.

```
[postgres@ip-172-31-20-155 ~]$ pg_restore -d dvdrental -v  /var/lib/pgsql/dvdre
pg_restore: connecting to database for restore
pg_restore: creating TYPE "public.mpaa_rating"
pg_restore: creating DOMAIN "public.year"
pg_restore: creating FUNCTION "public._group_concat(text, text)"
pg_restore: creating FUNCTION "public.film_in_stock(integer, integer)"
pg_restore: creating FUNCTION "public.film_not_in_stock(integer, integer)"
pg_restore: creating FUNCTION "public.get_customer_balance(integer, timestamp w
pg_restore: creating FUNCTION "public.inventory_held_by_customer(integer)"
pg_restore: creating FUNCTION "public.inventory_in_stock(integer)"
pg_restore: creating FUNCTION "public.last_day(timestamp without time zone)"
pg_restore: creating FUNCTION "public.last_updated()"
pg_restore: creating SEQUENCE "public.customer_customer_id_seq"
pg_restore: creating TABLE "public.customer"
```

```
pg_restore: creating FUNCTION "public.rewards_report(integer, numeric)"
pg_restore: creating AGGREGATE "public.group_concat(text)"
pg_restore: creating SEQUENCE "public.actor_actor_id_seq"
pg_restore: creating TABLE "public.actor"
pg_restore: creating SEQUENCE "public.category_category_id_seq"
pg_restore: creating TABLE "public.category"
pg_restore: creating SEQUENCE "public.film_film_id_seq"
pg_restore: creating TABLE "public.film"
pg_restore: creating TABLE "public.film_actor"
pg_restore: creating TABLE "public.film_category"
pg_restore: creating VIEW "public.actor_info"
pg_restore: creating SEQUENCE "public.address_address_id_seq"
pg_restore: creating TABLE "public.address"
pg_restore: creating SEQUENCE "public.city_city_id_seq"
pg_restore: creating TABLE "public.city"
pg_restore: creating SEQUENCE "public.country_country_id_seq"
pg_restore: creating TABLE "public.country"
pg_restore: creating VIEW "public.customer_list"
pg_restore: creating VIEW "public.film_list"
pg_restore: creating SEQUENCE "public.inventory_inventory_id_seq"
pg_restore: creating TABLE "public.inventory"
pg_restore: creating SEQUENCE "public.language_language_id_seq"
pg_restore: creating TABLE "public.language"
pg_restore: creating VIEW "public.nicer_but_slower_film_list"
pg_restore: creating SEQUENCE "public.payment_payment_id_seq"
pg_restore: creating TABLE "public.payment"
pg_restore: creating SEQUENCE "public.rental_rental_id_seq"
pg_restore: creating TABLE "public.rental"
pg_restore: creating VIEW "public.sales_by_film_category"
pg_restore: creating SEQUENCE "public.staff_staff_id_seq"
pg_restore: creating TABLE "public.staff"
pg_restore: creating SEQUENCE "public.store_store_id_seq"
pg_restore: creating TABLE "public.store"
pg_restore: creating VIEW "public.sales_by_store"
pg_restore: creating VIEW "public.staff_list"
pg_restore: processing data for table "public.actor"
pg_restore: processing data for table "public.address"
pg_restore: processing data for table "public.category"
pg_restore: processing data for table "public.city"
pg_restore: processing data for table "public.country"
pg_restore: processing data for table "public.customer"
pg_restore: processing data for table "public.film"
pg_restore: processing data for table "public.film_actor"
pg_restore: processing data for table "public.film_category"
pg_restore: processing data for table "public.inventory"
pg_restore: processing data for table "public.language"
pg_restore: processing data for table "public.payment"
pg_restore: processing data for table "public.rental"
pg_restore: processing data for table "public.staff"
pg_restore: processing data for table "public.store"
pg_restore: executing SEQUENCE SET actor_actor_id_seq
pg_restore: executing SEQUENCE SET address_address_id_seq
pg_restore: executing SEQUENCE SET category_category_id_seq
```

```
pg_restore: executing SEQUENCE SET city_city_id_seq
pg_restore: executing SEQUENCE SET country_country_id_seq
pg_restore: executing SEQUENCE SET customer_customer_id_seq
pg_restore: executing SEQUENCE SET film_film_id_seq
pg_restore: executing SEQUENCE SET inventory_inventory_id_seq
pg_restore: executing SEQUENCE SET language_language_id_seq
pg_restore: executing SEQUENCE SET payment_payment_id_seq
pg_restore: executing SEQUENCE SET rental_rental_id_seq
pg_restore: executing SEQUENCE SET staff_staff_id_seq
pg_restore: executing SEQUENCE SET store_store_id_seq
pg_restore: creating CONSTRAINT "public.actor actor_pkey"
pg_restore: creating CONSTRAINT "public.address address_pkey"
pg_restore: creating CONSTRAINT "public.category category_pkey"
pg_restore: creating CONSTRAINT "public.city city_pkey"
pg_restore: creating CONSTRAINT "public.country country_pkey"
pg_restore: creating CONSTRAINT "public.customer customer_pkey"
pg_restore: creating CONSTRAINT "public.film_actor film_actor_pkey"
pg_restore: creating CONSTRAINT "public.film_category film_category_pkey"
pg_restore: creating CONSTRAINT "public.film film_pkey"
pg_restore: creating CONSTRAINT "public.inventory inventory_pkey"
pg_restore: creating CONSTRAINT "public.language language_pkey"
pg_restore: creating CONSTRAINT "public.payment payment_pkey"
pg_restore: creating CONSTRAINT "public.rental rental_pkey"
pg_restore: creating CONSTRAINT "public.staff staff_pkey"
pg_restore: creating CONSTRAINT "public.store store_pkey"
pg_restore: creating INDEX "public.film_fulltext_idx"
pg_restore: creating INDEX "public.idx_actor_last_name"
pg_restore: creating INDEX "public.idx_fk_address_id"
pg_restore: creating INDEX "public.idx_fk_city_id"
pg_restore: creating INDEX "public.idx_fk_country_id"
pg_restore: creating INDEX "public.idx_fk_customer_id"
pg_restore: creating INDEX "public.idx_fk_film_id"
pg_restore: creating INDEX "public.idx_fk_inventory_id"
pg_restore: creating INDEX "public.idx_fk_language_id"
pg_restore: creating INDEX "public.idx_fk_rental_id"
pg_restore: creating INDEX "public.idx_fk_staff_id"
pg_restore: creating INDEX "public.idx_fk_store_id"
pg_restore: creating INDEX "public.idx_last_name"
pg_restore: creating INDEX "public.idx_store_id_film_id"
pg_restore: creating INDEX "public.idx_title"
pg_restore: creating INDEX "public.idx_unq_manager_staff_id"
pg_restore: creating INDEX "public.idx_unq_rental_rental_date_inventory_id_cust
pg_restore: creating TRIGGER "public.film film_fulltext_trigger"
pg_restore: creating TRIGGER "public.actor last_updated"
pg_restore: creating TRIGGER "public.address last_updated"
pg_restore: creating TRIGGER "public.category last_updated"
pg_restore: creating TRIGGER "public.city last_updated"
pg_restore: creating TRIGGER "public.country last_updated"
pg_restore: creating TRIGGER "public.customer last_updated"
pg_restore: creating TRIGGER "public.film last_updated"
pg_restore: creating TRIGGER "public.film_actor last_updated"
pg_restore: creating TRIGGER "public.film_category last_updated"
pg_restore: creating TRIGGER "public.inventory last_updated"
```

```
pg_restore: creating TRIGGER "public.language last_updated"
pg_restore: creating TRIGGER "public.rental last_updated"
pg_restore: creating TRIGGER "public.staff last_updated"
pg_restore: creating TRIGGER "public.store last_updated"
pg_restore: creating FK CONSTRAINT "public.customer customer_address_id_fkey"
pg_restore: creating FK CONSTRAINT "public.film_actor film_actor_actor_id_fkey"
pg_restore: creating FK CONSTRAINT "public.film_actor film_actor_film_id_fkey"
pg_restore: creating FK CONSTRAINT "public.film_category film_category_category
pg_restore: creating FK CONSTRAINT "public.film_category film_category_film_id_
pg_restore: creating FK CONSTRAINT "public.film film_language_id_fkey"
pg_restore: creating FK CONSTRAINT "public.address fk_address_city"
pg_restore: creating FK CONSTRAINT "public.city fk_city"
pg_restore: creating FK CONSTRAINT "public.inventory inventory_film_id_fkey"
pg_restore: creating FK CONSTRAINT "public.payment payment_customer_id_fkey"
pg_restore: creating FK CONSTRAINT "public.payment payment_rental_id_fkey"
pg_restore: creating FK CONSTRAINT "public.payment payment_staff_id_fkey"
pg_restore: creating FK CONSTRAINT "public.rental rental_customer_id_fkey"
pg_restore: creating FK CONSTRAINT "public.rental rental_inventory_id_fkey"
pg_restore: creating FK CONSTRAINT "public.rental rental_staff_id_key"
pg_restore: creating FK CONSTRAINT "public.staff staff_address_id_fkey"
pg_restore: creating FK CONSTRAINT "public.store store_address_id_fkey"
pg_restore: creating FK CONSTRAINT "public.store store_manager_staff_id_fkey"
[postgres@ip-172-31-20-155 ~]$
```

✅ Linux Host Access (e.g., EC2, Localhost)

This tutorial assumes:

- You're using a **Linux-based server**
- You're logged in as or have sudo access to the **`postgres`** system user
- You have access to the `pg_basebackup` binary

Confirm it's installed:

```
which pg_basebackup
```

Output example:

```
[postgres@ip-172-31-20-155 ~]$ which pg_basebackup
/usr/bin/pg_basebackup
[postgres@ip-172-31-20-155 ~]$
```

✅ PostgreSQL Superuser or Replication Role

The user running `pg_basebackup` must:

- Have `REPLICATION` privilege in PostgreSQL
- Be able to connect to the local server via TCP/IP or socket

You can check user roles:

```
\du
```

And the role should include:

```
Role name | Attributes
----------+-------------------------
replicator | Replication, Login
```

Make sure the role can connect by setting the appropriate entries in `pg_hba.conf`:

```
# Allow local replication connections
local   replication   all                 trust
```

Reload PostgreSQL after changes:

```
sudo systemctl reload postgresql
```

With all prerequisites checked, you're now ready to **perform a full backup and restore** using `pg_basebackup`, which we'll cover in the next step.

> 💡 Tip: Use this setup not just for disaster recovery, but also to clone databases for development, testing, or analytics workloads — all without impacting the production instance.

🛠 Step-by-Step Backup & Restore Using `pg_basebackup` in PostgreSQL 17

When it comes to ensuring PostgreSQL is both **resilient and recoverable**, `pg_basebackup` is the default tool DBAs trust for full, binary-level backups. To use it effectively, especially for **point-in-time recovery (PITR)** or setting up a **replica**, it's essential to configure **WAL archiving** properly.

Let's walk through the first two steps to prepare PostgreSQL 17 for safe and restorable backups.

✅ Step 1: Verify Your PostgreSQL 17 Environment

Before taking any backup, it's good practice to confirm your database configuration and understand your WAL (Write-Ahead Logging) settings.

🔍 Connect to the PostgreSQL Instance

First, switch to the PostgreSQL system user and open a psql session:

```
sudo su - postgres
psql
```

Once you're inside the `psql` shell, run the following diagnostics:

View the Current Data Directory

```
SHOW data_directory;
```

This displays the full path where PostgreSQL stores all its data files. For version 17, it typically looks like:

```
/var/lib/pgsql/17/data
```

This directory will later be your **source** for backup, and understanding its location is critical before using `pg_basebackup` .

List Databases

```
\l
```

This shows a list of databases present in the cluster. Make sure your production or sample databases (like `dvdrental`) are active and online.

🔸 Check Tablespaces

```
\db+
```

Tablespaces can point to additional physical locations outside the default `data_directory`. If you use tablespaces, `pg_basebackup` will back them up too — but you must ensure those paths are accessible and writable.

🔸 Review Archive-Related Settings

```
SELECT name, setting, unit
FROM pg_settings
WHERE name LIKE 'archive%';
```

This outputs values like:

```
archive_mode     | off        |
archive_command  | (empty)    |
archive_timeout  | 0          |
```

If `archive_mode` is `off`, and `archive_command` is empty — **your database isn't ready for WAL archiving**, and backups won't support PITR or replica creation.

Let's fix that next.

🔧 Step 2: Enable WAL Archiving in PostgreSQL 17

WAL (Write-Ahead Logging) is the heart of PostgreSQL's durability and crash recovery. To back up the database **in a way that allows replaying changes**, WAL segments must be archived externally using an archive command.

📝 Edit the PostgreSQL Configuration File

Exit `psql`, and edit the `postgresql.conf` file located inside your PostgreSQL 17 data directory:

```
sudo vi /var/lib/pgsql/17/data/postgresql.conf
```

Locate or add the following lines:

```
archive_mode = on
archive_timeout = 300
archive_command = 'test ! -f /var/lib/pgsql/17/data/pg_wal/%f && cp %p /var/lib
```

Let's break it down:

- **`archive_mode = on`**
  Activates the archiving process, instructing PostgreSQL to allow `archive_command` execution.
- **`archive_timeout = 300`**
  This forces PostgreSQL to switch and archive WAL files every 5 minutes, even if they're not full. It's useful for ensuring WAL availability in low-traffic systems.
- **`archive_command = '...'`**
  Defines the shell command used to copy completed WAL segments.
- `%p` = path to the WAL file to be archived
- `%f` = file name only
  The `test ! -f` part prevents overwriting if the WAL file already exists in the target directory.

📁 Create the Archive Directory

You must ensure the archive destination exists and has proper permissions:

```
sudo mkdir -p /var/lib/pgsql/17/backups/pg_wal
sudo chown postgres:postgres /var/lib/pgsql/17/backups/pg_wal
```

```
[root@ip-172-31-92-215 ~]# sudo mkdir -p /var/lib/pgsql/17/backups/pg_wal
[root@ip-172-31-92-215 ~]#
[root@ip-172-31-92-215 ~]# sudo chown postgres:postgres /var/lib/pgsql/17/backu
[root@ip-172-31-92-215 ~]#
```

Without this step, `archive_command` will silently fail or raise permission errors in the logs.

🔄 Restart PostgreSQL 17

Once the configuration is updated and the archive directory is ready, apply the changes:

```
sudo systemctl restart postgresql-17
```

Verify the status:

```
sudo systemctl status postgresql-17
```

And tail the PostgreSQL logs to confirm WAL archiving is working:

```
sudo journalctl -u postgresql-17 -f
```

You should see log lines such as:

```
archiver: archived WAL file "000000010000000000000A1"
```

✅ At This Point

Your PostgreSQL 17 setup is now ready for:

- Hot backups using `pg_basebackup`
- PITR (Point-In-Time Recovery)
- Initializing standby replicas

🧰 Step 3: Take a Full Cluster Backup with `pg_basebackup` in PostgreSQL 17

Now that WAL archiving is enabled and PostgreSQL 17 is correctly configured, you're ready to take a **consistent, binary-level backup** using `pg_basebackup`.

Unlike logical backups (`pg_dump`), `pg_basebackup` gives you a complete snapshot of the **entire PostgreSQL data directory**, making it ideal for disaster recovery, cloning, or setting up standby replicas.

🎯 What `pg_basebackup` Does

- Captures the full data directory, including user data, system catalogs, configuration files, and WAL files.
- Supports **streaming WAL** so your backup is consistent even while the server is running.
- Works with both **compressed and uncompressed** formats.

Let's explore both options:

🔹 Option 1: Compressed Backup (Tar + Gzip)

This option is useful when:

- You have limited disk space.
- You want to archive backups offsite (e.g., S3, GCS).
- You prefer smaller files for faster transfer.

🧱 Step 1: Create Backup Directory

```
sudo mkdir -p /var/lib/pgsql/pg_backup
sudo chown postgres:postgres /var/lib/pgsql/pg_backup
```

```
[root@ip-172-31-92-215 ~]# sudo mkdir -p /var/lib/pgsql/pg_backup
[root@ip-172-31-92-215 ~]#
```

```
[root@ip-172-31-92-215 ~]# sudo chown postgres:postgres /var/lib/pgsql/pg_backu
[root@ip-172-31-92-215 ~]#
```

This ensures the directory is writable by the `postgres` user.

🚀 Step 2: Run the Compressed Backup Command

```
pg_basebackup \
  -h localhost \
  -p 5432 \
  -U postgres \
  -D /var/lib/pgsql/pg_backup \
  -Ft \
  -z \
  -Xs \
  -P
```

```
[postgres@ip-172-31-92-215 ~]$ pg_basebackup \
  -h localhost \
  -p 5432 \
  -U postgres \
  -D /var/lib/pgsql/pg_backup \
  -Ft \
  -z \
  -Xs \
  -P
Password:
38520/38520 kB (100%), 1/1 tablespace
[postgres@ip-172-31-92-215 ~]$
[postgres@ip-172-31-92-215 ~]$
```

Let’s break down what each flag means:

Flag Description `-h` Host to connect to (`localhost` since we're backing up the local DB) `-p` Port where PostgreSQL is running (default: 5432) `-U` PostgreSQL user with replication privileges (`postgres`) `-D` Destination directory for the backup files `-Ft` Format as tar archive `-z` Gzip compress the archive `-Xs` Stream the WAL files during the backup `-P` Show progress (interactive view of backup process)

> ⚠️ If you haven't configured `.pgpass` or `trust` in `pg_hba.conf` , this command may prompt for a password.

🔹 Option 2: Uncompressed Backup (Tar Format Only)

This is ideal for:

- Local development.
- When speed matters more than space.
- Testing backup/restore pipelines.

🧱 Step 1: Create the Destination Directory

```
sudo mkdir -p /var/lib/pgsql/pg_backup_uncompressed
sudo chown postgres:postgres /var/lib/pgsql/pg_backup_uncompressed
```

```
[root@ip-172-31-92-215 ~]# sudo mkdir -p /var/lib/pgsql/pg_backup_uncompressed
[root@ip-172-31-92-215 ~]#
[root@ip-172-31-92-215 ~]# sudo chown postgres:postgres /var/lib/pgsql/pg_backu
[root@ip-172-31-92-215 ~]#
```

🚀 Step 2: Run the Uncompressed Backup

```
pg_basebackup \
  -h localhost \
  -p 5432 \
  -U postgres \
  -D /var/lib/pgsql/pg_backup_uncompressed \
  -Ft \
  -Xs \
  -P
```

```
[root@ip-172-31-92-215 ~]# pg_basebackup \
  -h localhost \
  -p 5432 \
  -U postgres \
  -D /var/lib/pgsql/pg_backup_uncompressed \
  -Ft \
  -Xs \
  -P
Password:
38523/38523 kB (100%), 1/1 tablespace
[root@ip-172-31-92-215 ~]#
```

This command will create `.tar` files but will **not compress them** with gzip. This results in:

- Faster backup times.
- Larger file sizes.
- Easier extraction when restoring.

✅ Step 4: Verify Backup Completion

Whether you created a compressed or uncompressed backup, it's important to verify that all expected files were written.

📁 For Uncompressed Backup:

```
ls -lrt /var/lib/pgsql/pg_backup_uncompressed
```

You should see files like:

```
[root@ip-172-31-92-215 ~]# ls -lrt /var/lib/pgsql/pg_backup_uncompressed
total 55104
-rw-------. 1 root root 39448064 Jun 30 19:52 base.tar
-rw-------. 1 root root   194152 Jun 30 19:52 backup_manifest
-rw-------. 1 root root 16778752 Jun 30 19:52 pg_wal.tar
[root@ip-172-31-92-215 ~]#
```

These are:

- `base.tar` : Contains your cluster data (tables, indexes, catalogs).
- `pg_wal.tar` : Contains the necessary WAL files to restore the database to a consistent state.

📦 For Compressed Backup:

If you used the `-z` flag, your output may look like:

```
[root@ip-172-31-92-215 ~]# ls -ltr /var/lib/pgsql/pg_backup
total 5924
-rw-------. 1 postgres postgres  194152 Jun 30 19:51 backup_manifest
-rw-------. 1 postgres postgres 5848048 Jun 30 19:51 base.tar.gz
-rw-------. 1 postgres postgres   17685 Jun 30 19:51 pg_wal.tar.gz
[root@ip-172-31-92-215 ~]#
```

You can extract them later using:

```
tar -xzf base.tar.gz
```

or:

```
gzip -d base.tar.gz
tar -xf base.tar
```

🛡 Tips for Ensuring a Healthy Backup

- 🔁 Schedule this backup process regularly via `cron`.
- 🧪 Periodically test restoring your backups to avoid surprises during a real incident.
- 📦 If backing up to remote storage, validate file integrity using checksums.
- 📉 Monitor WAL size during the backup to avoid filling disk space (especially for large clusters).

💥 Step 5: Simulate a Failure (Disaster Recovery Test)

Once you've completed a successful backup using `pg_basebackup`, it's essential to test the **recovery process**.

> Backups are **only useful if they can be restored** — so this step validates your strategy.

We'll simulate a failure by shutting down PostgreSQL and **deleting the entire data directory**, as if the server had been corrupted or suffered disk loss.

🔻 Stop PostgreSQL 17 Service

To simulate failure, start by stopping the active PostgreSQL instance. This avoids file corruption during deletion.

```
sudo systemctl stop postgresql-17
```

```
[root@ip-172-31-92-215 ~]#
[root@ip-172-31-92-215 ~]# sudo systemctl stop postgresql-17
[root@ip-172-31-92-215 ~]#
```

> You can verify the status using:

```
sudo systemctl status postgresql-17
```

```
[root@ip-172-31-92-215 ~]# sudo systemctl status postgresql-17
○ postgresql-17.service - PostgreSQL 17 database server
     Loaded: loaded (/usr/lib/systemd/system/postgresql-17.service; enabled; pr
     Active: inactive (dead) since Mon 2025-06-30 19:56:27 UTC; 2min 34s ago
   Duration: 8min 37.580s
 Invocation: ea4788d10d604eb382f91449d80e545d
       Docs: https://www.postgresql.org/docs/17/static/
    Process: 20056 ExecStartPre=/usr/pgsql-17/bin/postgresql-17-check-db-dir ${
    Process: 20062 ExecStart=/usr/pgsql-17/bin/postgres -D ${PGDATA} (code=exit
   Main PID: 20062 (code=exited, status=0/SUCCESS)
   Mem peak: 83M
        CPU: 370ms

Jun 30 19:47:46 ip-172-31-92-215.ec2.internal systemd[1]: Starting postgresql-1
Jun 30 19:47:46 ip-172-31-92-215.ec2.internal postgres[20062]: 2025-06-30 19:47
Jun 30 19:47:46 ip-172-31-92-215.ec2.internal postgres[20062]: 2025-06-30 19:47
Jun 30 19:47:46 ip-172-31-92-215.ec2.internal systemd[1]: Started postgresql-17
Jun 30 19:56:24 ip-172-31-92-215.ec2.internal systemd[1]: Stopping postgresql-1
Jun 30 19:56:27 ip-172-31-92-215.ec2.internal systemd[1]: postgresql-17.service
Jun 30 19:56:27 ip-172-31-92-215.ec2.internal systemd[1]: Stopped postgresql-17
Jun 30 19:56:27 ip-172-31-92-215.ec2.internal systemd[1]: postgresql-17.service
[root@ip-172-31-92-215 ~]#
```

> *The service should now be inactive (`dead` state).*

🧨 Delete the Existing Data Directory

Now, delete PostgreSQL's `data_directory` . This mimics a catastrophic event like disk failure or accidental deletion.

> ⚠️ **Caution:** Only do this in a **test or staging environment** — not production!

```
sudo rm -rf /var/lib/pgsql/17/data
```

```
[root@ip-172-31-92-215 ~]#
[root@ip-172-31-92-215 ~]# sudo rm -rf /var/lib/pgsql/17/data
[root@ip-172-31-92-215 ~]#
```

> 💡 PostgreSQL stores all critical data in this directory: system catalogs, databases, config files, WAL segments, etc.

At this point, PostgreSQL has **no idea how to start** — it's as if the cluster never existed. Next, let's restore it.

🔄 Step 6: Restore the Backup (Base Files + WAL Files)

With the original cluster erased, we now **rebuild the PostgreSQL 17 environment** using the files generated by `pg_basebackup` .

You'll restore:

- `base.tar.gz` : Full physical snapshot of your database
- `pg_wal.tar.gz` : Write-Ahead Logs required to bring the cluster to a consistent state

📁 Step 6.1: Restore the Base Backup

Let's restore the snapshot that holds all database data.

📌 Step 1: Go to the Backup Location

Navigate to the location where you saved your backup:

```
cd /var/lib/pgsql/pg_backup
```

```
[root@ip-172-31-92-215 ~]# cd /var/lib/pgsql/pg_backup
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]#
```

> Your backup directory should contain `base.tar.gz` and `pg_wal.tar.gz`.

📌 Step 2: Recreate the Data Directory

Now we recreate the PostgreSQL 17 data directory from scratch:

```
sudo mkdir -p /var/lib/pgsql/17/data
sudo chown postgres:postgres /var/lib/pgsql/17/data
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo mkdir -p /var/lib/pgsql/17/data
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo chown postgres:postgres /var/lib/pgsql/
[root@ip-172-31-92-215 pg_backup]#
```

This prepares the environment for extraction.

📌 Step 3: Extract the Base Backup

If your backup is compressed (`base.tar.gz`), first unzip it:

```
gunzip base.tar.gz
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# gunzip base.tar.gz
[root@ip-172-31-92-215 pg_backup]#
```

Now extract its contents into the new data directory:

```
tar -xvf base.tar -C /var/lib/pgsql/17/data
```

```
[root@ip-172-31-92-215 pg_backup]# tar -xvf base.tar -C /var/lib/pgsql/17/data
backup_label
tablespace_map
pg_wal/
./pg_wal/archive_status/
./pg_wal/summaries/
global/
global/1262
global/2964
global/1213
global/1260
global/1261
global/1214
global/2396
global/6000
global/3592
global/6243
global/6100
global/4177
global/4178
global/2966
global/2967
global/4185
global/4186
global/4175
global/4176
global/2846
global/2847
global/4181
global/4182
global/4060
global/4061
global/6244
global/6245
global/4183
global/4184
global/2671
global/2672
global/2965
```

This command restores the **entire PostgreSQL system**, including:

- `base/` → database files
- `global/` → system-wide metadata
- `pg_xact/`, `pg_multixact/`, `pg_stat/` → transaction status
- Config files like `postgresql.auto.conf`, `standby.signal`, etc.

At this point, your database structure is rebuilt.

🔁 Step 6.2: Restore WAL Segment Files

WAL files are essential to make the database consistent — they allow recovery up to the moment the backup finished.

📌 Step 1: Decompress the WAL Archive

```
gunzip pg_wal.tar.gz
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# gunzip pg_wal.tar.gz
[root@ip-172-31-92-215 pg_backup]#
```

This creates `pg_wal.tar`.

📌 Step 2: Create the `pg_wal` Directory

If it doesn't already exist, create the WAL segment directory inside the restored cluster:

```
mkdir -p /var/lib/pgsql/17/data/pg_wal
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# mkdir -p /var/lib/pgsql/17/data/pg_wal
[root@ip-172-31-92-215 pg_backup]#
```

> You may need to remove a partially extracted `pg_wal/` folder before restoring, to avoid conflicts.

📌 Step 3: Extract the WAL Files

```
tar -xvf pg_wal.tar -C /var/lib/pgsql/17/data/pg_wal
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# tar -xvf pg_wal.tar -C /var/lib/pgsql/17/dat
000000010000000000000002
```

```
archive_status/000000010000000000000002.done
[root@ip-172-31-92-215 pg_backup]#
```

This places all archived WAL files into the correct location, enabling PostgreSQL to **replay transactions and finalize recovery** when started.

🔍 Step 6.3: Verify the Restored Structure

Before proceeding, quickly check the directory structure:

```
ls -lh /var/lib/pgsql/17/data
ls -lh /var/lib/pgsql/17/data/pg_wal
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# ls -lh /var/lib/pgsql/17/data
total 64K
-rw-------. 1 postgres postgres    3 Jun 30 19:36 PG_VERSION
-rw-------. 1 postgres postgres  225 Jun 30 19:51 backup_label
drwx------. 6 postgres postgres   46 Jun 30 19:51 base
-rw-------. 1 postgres postgres   30 Jun 30 19:47 current_logfiles
drwx------. 2 postgres postgres 4.0K Jun 30 20:03 global
drwx------. 2 postgres postgres   32 Jun 30 19:36 log
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_commit_ts
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_dynshmem
-rw-------. 1 postgres postgres 5.4K Jun 30 19:36 pg_hba.conf
-rw-------. 1 postgres postgres 2.6K Jun 30 19:36 pg_ident.conf
drwx------. 4 postgres postgres   68 Jun 30 19:51 pg_logical
drwx------. 4 postgres postgres   36 Jun 30 19:36 pg_multixact
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_notify
drwx------. 2 postgres postgres    6 Jun 30 19:51 pg_replslot
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_serial
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_snapshots
drwx------. 2 postgres postgres    6 Jun 30 19:47 pg_stat
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_stat_tmp
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_subtrans
```

```
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_tblspc
drwx------. 2 postgres postgres    6 Jun 30 19:36 pg_twophase
drwx------. 4 postgres postgres   77 Jun 30 20:06 pg_wal
drwx------. 2 postgres postgres   18 Jun 30 19:36 pg_xact
-rw-------. 1 postgres postgres   88 Jun 30 19:36 postgresql.auto.conf
-rw-------. 1 postgres postgres  31K Jun 30 19:47 postgresql.conf
-rw-------. 1 postgres postgres    0 Jun 30 19:51 tablespace_map
[root@ip-172-31-92-215 pg_backup]#
```

```
[root@ip-172-31-92-215 pg_backup]# ls -lh /var/lib/pgsql/17/data/pg_wal
total 16M
-rw-------. 1 postgres postgres 16M Jun 30 19:51 000000010000000000000002
drwx------. 2 postgres postgres  43 Jun 30 20:06 archive_status
drwx------. 2 postgres postgres   6 Jun 30 19:47 summaries
[root@ip-172-31-92-215 pg_backup]#
```

You should see PostgreSQL folders like:

- `base/`, `pg_wal/`, `pg_xact/`, `global/`, `pg_stat/`
- Files like `PG_VERSION`, `postgresql.auto.conf`, `pg_control`

This confirms that your cluster has been physically restored.

🔧 Step 7: Update PostgreSQL 17 Restore Configuration

After restoring the base data and WAL (Write-Ahead Log) files, we must ensure that PostgreSQL knows **how to locate and restore the archived WAL files** during startup. This is done via the `restore_command` setting in the `postgresql.conf` file.

🔍 What is `restore_command`?

The `restore_command` tells PostgreSQL how to **retrieve archived WAL segments** when starting up after a crash or when performing recovery. It is essential for:

- Crash recovery
- Replication
- Point-in-Time Recovery (PITR)

During recovery, PostgreSQL will:

1. Detect it needs to replay WAL.
2. Request each missing WAL segment by name.
3. Use `restore_command` to fetch the segment.

If the file is not found, recovery will **pause or fail**, which is why this step is critical.

🛠️ Editing the Configuration File

Open the `postgresql.conf` file in your restored cluster's data directory:

```
sudo vi /var/lib/pgsql/17/data/postgresql.conf
```

Scroll down to the **archiving and recovery** section and set the following:

```
restore_command = 'cp /var/lib/pgsql/17/backups/pg_wal/%f /var/lib/pgsql/17/dat
```

Explanation of this line:

- `%f` : The filename of the requested WAL segment (e.g., `000000010000000010000005A`)
- `%p` : The absolute path where PostgreSQL expects the WAL segment

- `cp` : The command that physically copies the file from the archive to the required location

> ✅ This command ensures PostgreSQL can retrieve and apply archived WALs during recovery.

🔐 Ensure Permissions Are Correct

Make sure the `postgres` user has ownership and permissions over the `pg_wal` directory and the restored files:

```
sudo chown -R postgres:postgres /var/lib/pgsql/17/data
sudo chown -R postgres:postgres /var/lib/pgsql/17/backups
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo chown -R postgres:postgres /var/lib/pgs
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo chown -R postgres:postgres /var/lib/pgs
[root@ip-172-31-92-215 pg_backup]#
```

🚀 Step 8: Restart PostgreSQL 17 and Verify Restoration

With everything in place — restored files and `restore_command` configured — it's time to bring the PostgreSQL service back online and confirm that everything works.

🔄 Restart PostgreSQL 17

Start the PostgreSQL service:

```
sudo systemctl start postgresql-17
```

If you are getting an error like the one below, then you need to troubleshoot it as follows

I have just reproduced the error for your reference

```
[root@ip-172-31-92-215 pg_backup]# sudo systemctl start postgresql-17
Job for postgresql-17.service failed because the control process exited with er
See "systemctl status postgresql-17.service" and "journalctl -xeu postgresql-17
[root@ip-172-31-92-215 pg_backup]#
```

You need to run the following command to check the error details

```
journalctl -xeu postgresql-17.service
```

You will see error details like the following:

> *data directory "/var/lib/pgsql/17/data" has invalid permissions*
>
> *ETAIL: Permissions should be u=rwx (0700) or u=rwx,g=rx (0750).*

Run the following `journalctl` command:

```
[root@ip-172-31-92-215 pg_backup]# journalctl -xeu postgresql-17.service
▒
▒ A stop job for unit postgresql-17.service has finished.
▒
▒ The job identifier is 83856 and the job result is done.
Jun 30 19:56:27 ip-172-31-92-215.ec2.internal systemd[1]: postgresql-17.service
▒ Subject: Resources consumed by unit runtime
▒ Defined-By: systemd
▒ Support: https://access.redhat.com/support
▒
▒ The unit postgresql-17.service completed and consumed the indicated resource
Jun 30 20:09:34 ip-172-31-92-215.ec2.internal systemd[1]: Starting postgresql-1
▒ Subject: A start job for unit postgresql-17.service has begun execution
▒ Defined-By: systemd
▒ Support: https://access.redhat.com/support
▒
▒ A start job for unit postgresql-17.service has begun execution.
▒
▒ The job identifier is 84142.
Jun 30 20:09:34 ip-172-31-92-215.ec2.internal postgres[20483]: 2025-06-30 20:09
Jun 30 20:09:34 ip-172-31-92-215.ec2.internal postgres[20483]: 2025-06-30 20:09
Jun 30 20:09:34 ip-172-31-92-215.ec2.internal systemd[1]: postgresql-17.service
▒ Subject: Unit process exited
▒ Defined-By: systemd
▒ Support: https://access.redhat.com/support
▒
▒ An ExecStart= process belonging to unit postgresql-17.service has exited.
▒
▒ The process' exit code is 'exited' and its exit status is 1.
Jun 30 20:09:34 ip-172-31-92-215.ec2.internal systemd[1]: postgresql-17.service
▒ Subject: Unit failed
▒ Defined-By: systemd
▒ Support: https://access.redhat.com/support
▒
▒ The unit postgresql-17.service has entered the 'failed' state with result 'e
Jun 30 20:09:34 ip-172-31-92-215.ec2.internal systemd[1]: Failed to start postg
▒ Subject: A start job for unit postgresql-17.service has failed
▒ Defined-By: systemd
▒ Support: https://access.redhat.com/support
▒
▒ A start job for unit postgresql-17.service has finished with a failure.
▒
▒ The job identifier is 84142 and the job result is failed.
[root@ip-172-31-92-215 pg_backup]#
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo chmod 750 /var/lib/pgsql/17/data
[root@ip-172-31-92-215 pg_backup]#
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo systemctl start postgresql-17
[root@ip-172-31-92-215 pg_backup]#
```

Check the status immediately:

```
sudo systemctl status postgresql-17
```

```
[root@ip-172-31-92-215 pg_backup]#
[root@ip-172-31-92-215 pg_backup]# sudo systemctl status postgresql-17
● postgresql-17.service - PostgreSQL 17 database server
     Loaded: loaded (/usr/lib/systemd/system/postgresql-17.service; enabled; pr
     Active: active (running) since Mon 2025-06-30 20:16:34 UTC; 27s ago
 Invocation: c4cd0309e4c84fe8933f472fbb3a3510
       Docs: https://www.postgresql.org/docs/17/static/
    Process: 20523 ExecStartPre=/usr/pgsql-17/bin/postgresql-17-check-db-dir ${
   Main PID: 20529 (postgres)
      Tasks: 8 (limit: 5687)
     Memory: 34.2M (peak: 34.4M)
        CPU: 65ms
     CGroup: /system.slice/postgresql-17.service
             ├─20529 /usr/pgsql-17/bin/postgres -D /var/lib/pgsql/17/data/
             ├─20531 "postgres: logger "
             ├─20532 "postgres: checkpointer "
```

```
              ├─20533 "postgres: background writer "
              ├─20535 "postgres: walwriter "
              ├─20536 "postgres: autovacuum launcher "
              ├─20537 "postgres: archiver "
              └─20538 "postgres: logical replication launcher "

Jun 30 20:16:34 ip-172-31-92-215.ec2.internal systemd[1]: Starting postgresql-1
Jun 30 20:16:34 ip-172-31-92-215.ec2.internal postgres[20529]: 2025-06-30 20:16
Jun 30 20:16:34 ip-172-31-92-215.ec2.internal postgres[20529]: 2025-06-30 20:16
Jun 30 20:16:34 ip-172-31-92-215.ec2.internal systemd[1]: Started postgresql-17
[root@ip-172-31-92-215 pg_backup]#
```

Expected output:

- Status should be `active (running)`
- No critical errors or failure messages

> 💡 If anything goes wrong (e.g., WAL not found, permissions denied), check logs with:

```
sudo journalctl -u postgresql-17 -n 50
```

🧠 What Happens Behind the Scenes?

Once PostgreSQL starts:

1. It detects that a recovery is needed (based on the presence of `backup_label` or `standby.signal`).
2. It begins **replaying the WAL logs** from the `pg_wal` directory.
3. If additional segments are needed, it uses `restore_command` to fetch them.
4. After reaching consistency, it transitions to the normal operational state and accepts connections.

🔑 Connect to PostgreSQL and Validate the Restore

Switch to the `postgres` system user:

```
sudo su - postgres
```

```
[root@ip-172-31-92-215 pg_backup]# sudo su - postgres
Last login: Mon Jun 30 19:51:00 UTC 2025 on pts/2
[postgres@ip-172-31-92-215 ~]$
[postgres@ip-172-31-92-215 ~]$
```

Then connect to PostgreSQL:

```
psql
```

```
[postgres@ip-172-31-92-215 ~]$
[postgres@ip-172-31-92-215 ~]$ psql
psql (17.5)
Type "help" for help.

postgres=#
```

Inside the PostgreSQL shell, check the list of databases:

```
\l+
```

You should see:

```
postgres=#
postgres=# \l+

   Name    |  Owner   | Encoding | Locale Provider | Collate |  Ctype  | Locale
-----------+----------+----------+-----------------+---------+---------+-------
 dvdrental | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
 postgres  | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
 template0 | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
           |          |          |                 |         |         |
 template1 | postgres | UTF8     | libc            | C.UTF-8 | C.UTF-8 |
           |          |          |                 |         |         |
(4 rows)

postgres=#
```

✅ These are the exact databases that existed at the time of your backup.

You can explore tables and data:

```
\c dvdrental
\dt
SELECT COUNT(*) FROM some_table;
```

```
postgres=#
postgres=# \c dvdrental
You are now connected to database "dvdrental" as user "postgres".
dvdrental=#
dvdrental=# \dt
             List of relations
```

```
 Schema |      Name       | Type  |  Owner
--------+-----------------+-------+----------
 public | actor           | table | postgres
 public | address         | table | postgres
 public | category        | table | postgres
 public | city            | table | postgres
 public | country         | table | postgres
 public | customer        | table | postgres
 public | film            | table | postgres
 public | film_actor      | table | postgres
 public | film_category   | table | postgres
 public | inventory       | table | postgres
 public | language        | table | postgres
 public | payment         | table | postgres
 public | rental          | table | postgres
 public | staff           | table | postgres
 public | store           | table | postgres
(15 rows)

dvdrental=#
dvdrental=# SELECT COUNT(*) FROM actor;
 count
-------
   200
(1 row)

dvdrental=#
```

This confirms that **your data, structure, and transactions were fully restored.**

✅ Summary of Steps Completed

Step	Description
1–4	Took a full backup using `pg_basebackup`
5	Simulated a disaster by deleting the data directory
6	Restored base and WAL backup files
7	Configured `restore_command` in `postgresql.conf`
8	Restarted PostgreSQL and verified the recovery

🎉 **Congratulations!** You've just walked through a **realistic PostgreSQL 17 disaster recovery scenario** using native tools and no third-party plugins.

This setup prepares you for:

- Hardware crashes
- Accidental data deletion
- Cloud VM failures
- Compliance audits (via PITR)

Would you like to continue with:

- ⏱️ Automating this backup/restore process via cron or shell scripts?
- ☁️ Sending WAL backups to AWS S3 or GCS for offsite recovery?
- ⏪ Performing Point-in-Time Recovery (PITR) to a specific timestamp?

⚠️ Important Considerations When Using pg_basebackup in PostgreSQL 17

Creating a backup is easy. Creating a **useful** and **reliable** backup that you can confidently restore in a crisis is what truly matters. Let's take a closer look at some critical considerations to make your PostgreSQL backup strategy production-grade.

🗜 Compression Saves Disk Space — But May Increase CPU Load

When taking a backup using `pg_basebackup`, you can enable compression by adding the `-z` flag (e.g., `pg_basebackup -z ...`). This compresses the backup archive using

gzip, reducing file size significantly.

Benefits:

- **Reduces disk space usage**, especially for large databases
- **Minimizes transfer size** if you're uploading the backup to cloud storage
- Speeds up backups over the network

Tradeoffs:

- **Compression consumes CPU**. On busy or resource-constrained PostgreSQL servers, it may temporarily impact database performance during the backup window.
- Compression may **slow down backup speed** slightly depending on the server's I/O and CPU.

> 🧠 **Best Practice**: Use compression on staging environments or schedule compressed backups during off-peak hours. Alternatively, perform the backup from a replica server to avoid impacting the primary database.

📜 WAL Logs Are Not Optional — They Are Critical

One of the biggest mistakes novice DBAs make is backing up only the base data directory without including WAL (Write-Ahead Log) segments.

In PostgreSQL, WAL files are essential because:

- They contain **all changes** made to the database.
- PostgreSQL uses them to **replay committed transactions** that occurred after the base backup was taken.
- WALs are required for **Point-in-Time Recovery (PITR)** and **replication**.

If you lose the WAL logs, you may still have the base backup — but you'll lose any data created, updated, or deleted after that snapshot.

What to Do:

- Set `archive_mode = on` in `postgresql.conf`

- Configure a reliable `archive_command`, such as:

```
archive_command = 'cp %p /var/lib/pgsql/17/backups/pg_wal/%f'
```

- Store WAL files in durable storage (NFS, S3, GCS, etc.)
- Periodically clean up old WALs with tools like `pg_archivecleanup` to avoid disk overflows

> 🔐 Without WAL backups, **you cannot achieve PITR**, and you risk **partial or corrupted restores.**

🔁 Test Your Backups Regularly

Taking a backup is only half the job — you need to know with certainty that your backups actually work.

Risks of Not Testing:

- Backups that **look complete but are corrupted**
- Archived WAL files **missing or not properly copied**
- `restore_command` not working, breaking recovery
- Inconsistent configurations that silently fail

How to Test:

- Set up a separate PostgreSQL 17 test server or container
- Simulate real disaster scenarios (delete the data directory)
- Restore the base backup and replay WALs
- Validate the data integrity (e.g., row counts, indexes, schema)

> 🧪 A backup you haven't tested is just a **false sense of security.**

🚀 Final Summary: PostgreSQL 17 Backup & Restore Workflow

Let's summarize everything we've covered — from the tools used to the critical best practices:

📌 Task	🛠️ Tool / Step	📝 Notes
Backup Full Cluster	`pg_basebackup`	Use `-z` for compression, `-Xs` for streaming WAL
Restore Base + WAL	`tar + gunzip + cp`	Manual directory recreation required
Replay WAL for Recovery	`restore_command`	Crucial for transactional consistency
Enable PITR	Archive WAL files	Required for restoring to a specific time
Verify Restoration	`psql`, `\l`, `\dt`, data checks	Always confirm post-recovery state

✅ You're Now Ready for Real-World PostgreSQL Recovery Scenarios

By following this workflow, you've:

- Used PostgreSQL-native tools (no third-party dependencies)
- Taken a **hot backup** without downtime
- Recovered from a **simulated disaster** on the same host
- Ensured support for **WAL-based recovery and PITR**

Whether you're running PostgreSQL 17 on-prem, on EC2, or inside a Kubernetes cluster, this strategy scales.

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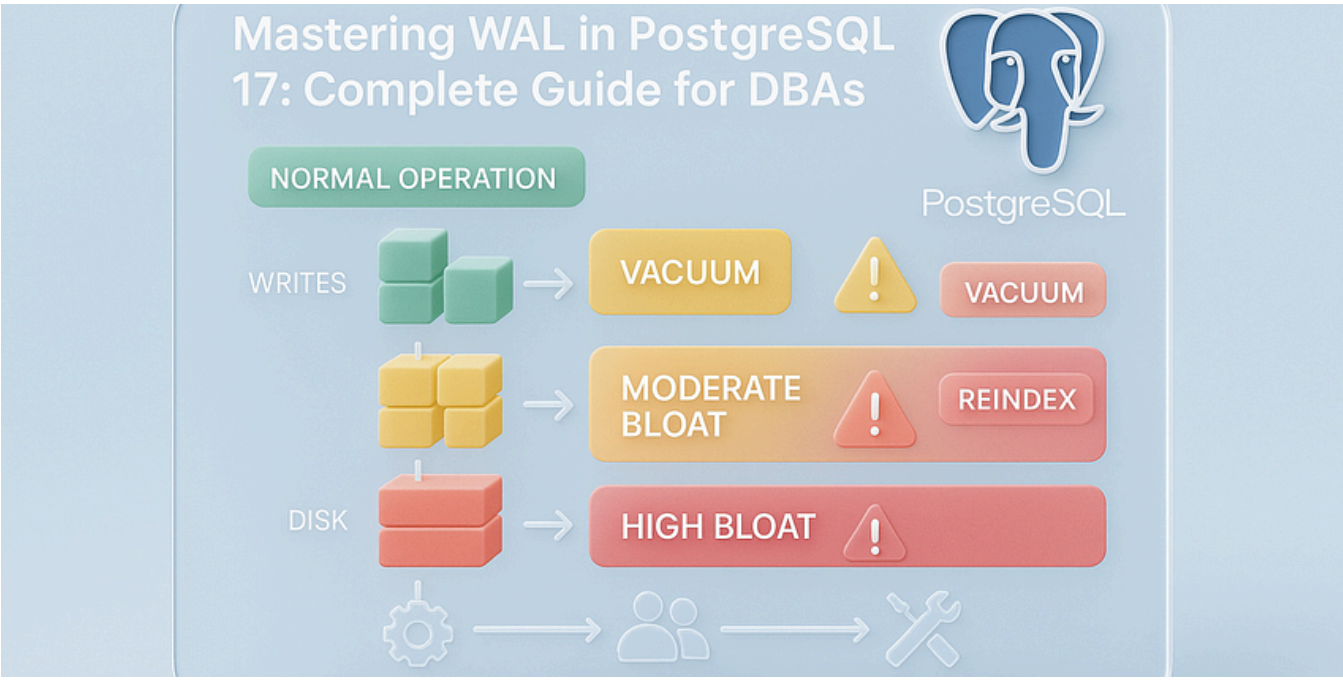

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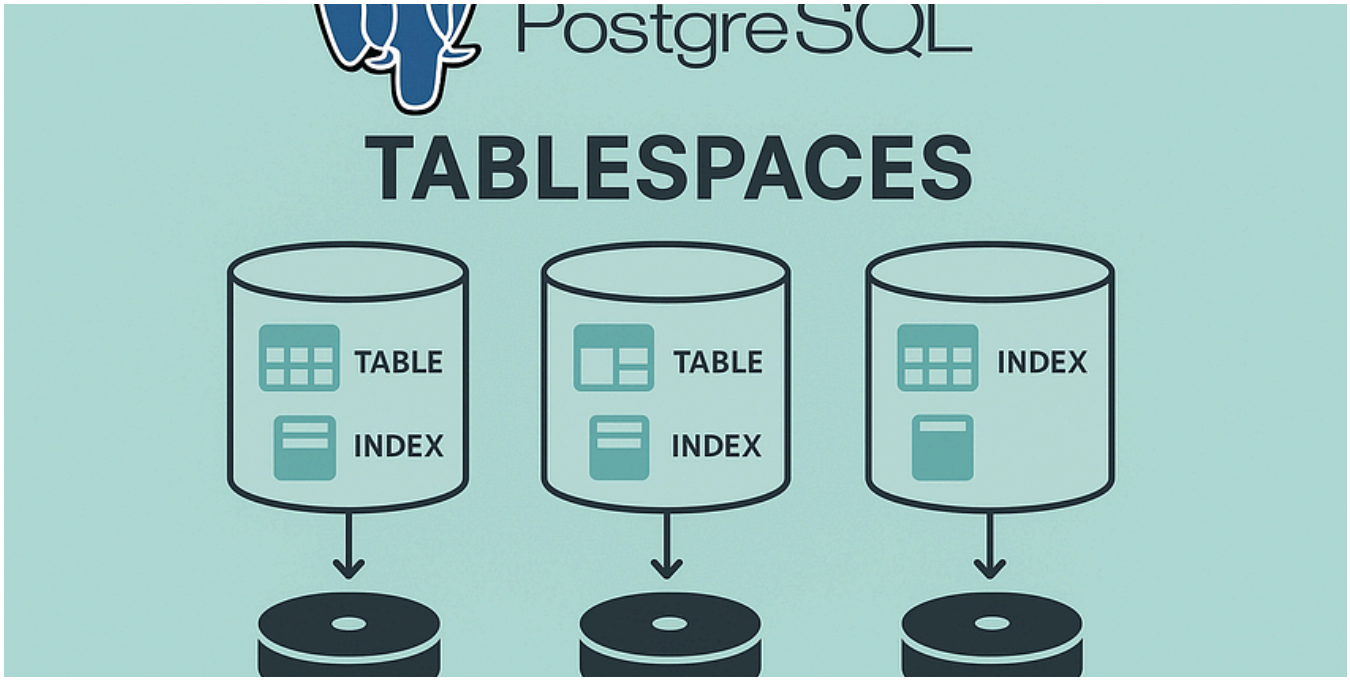

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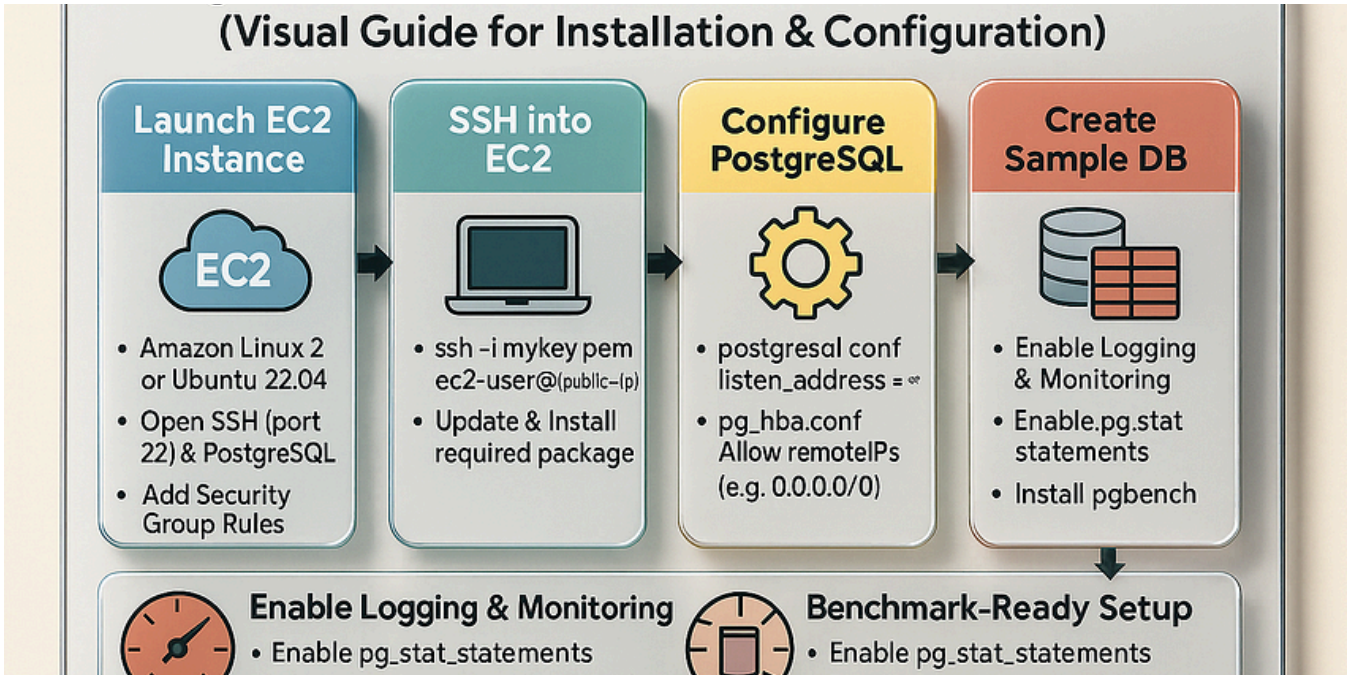

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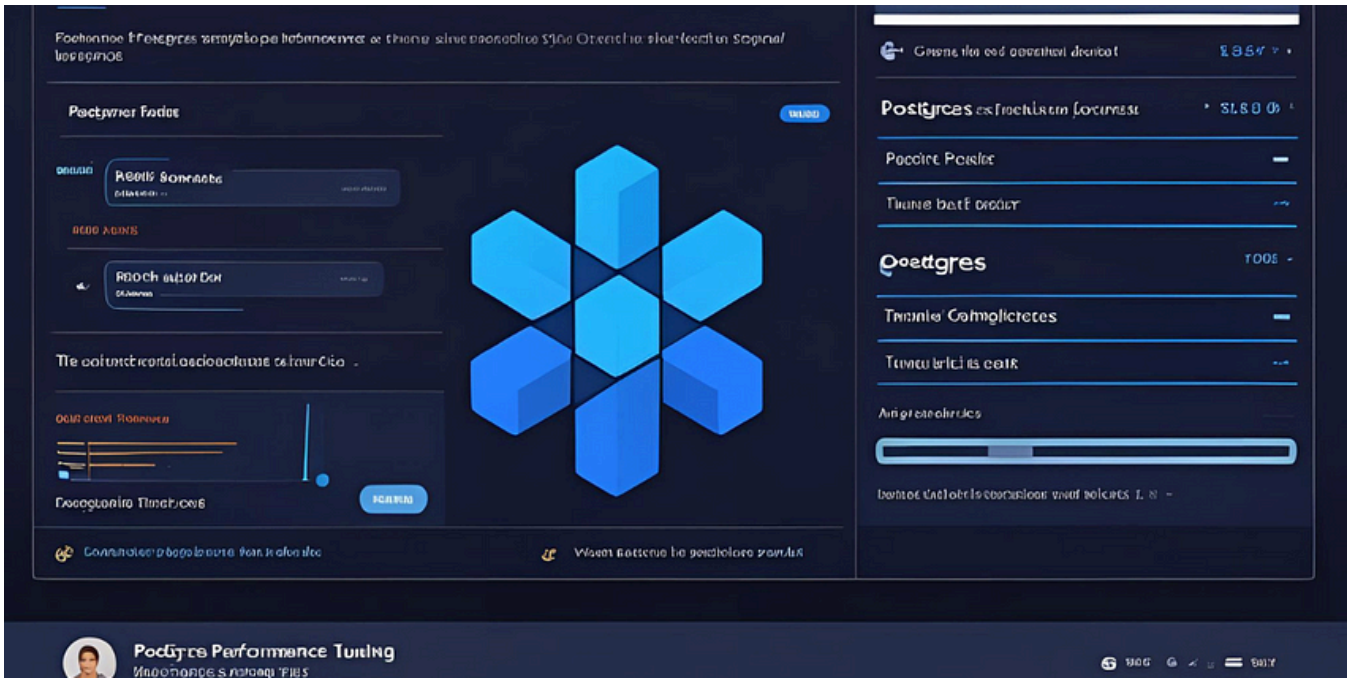

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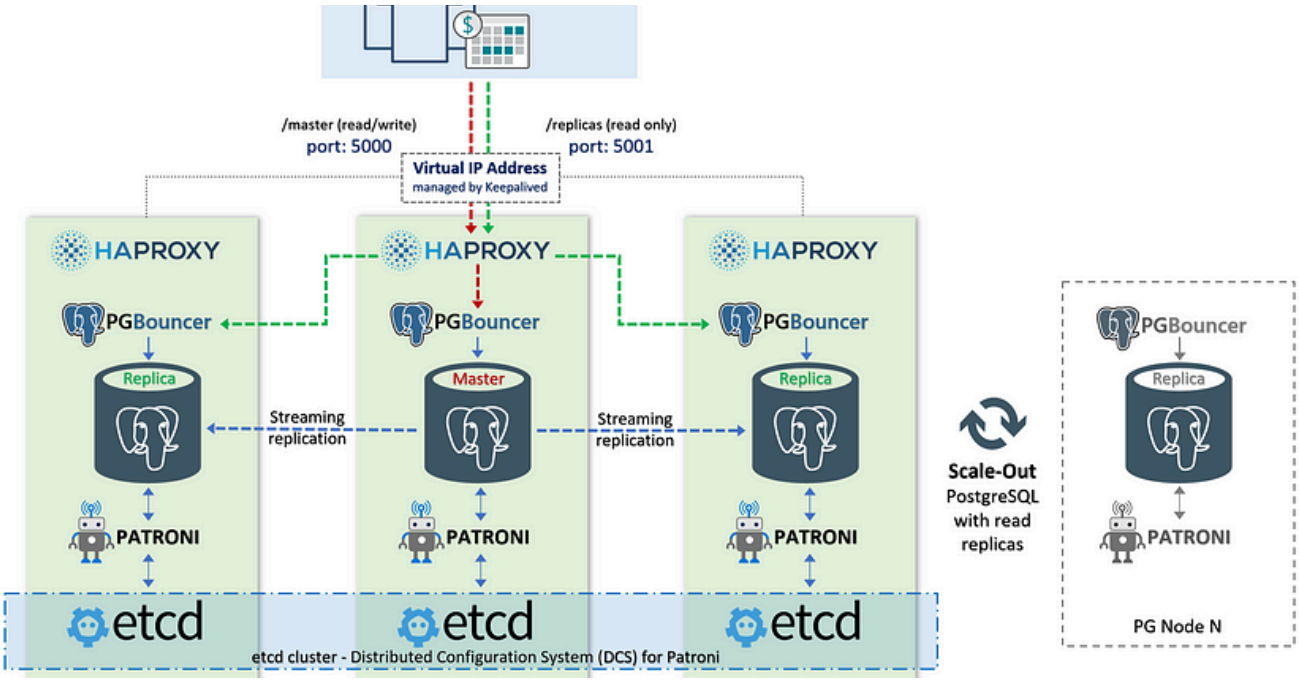

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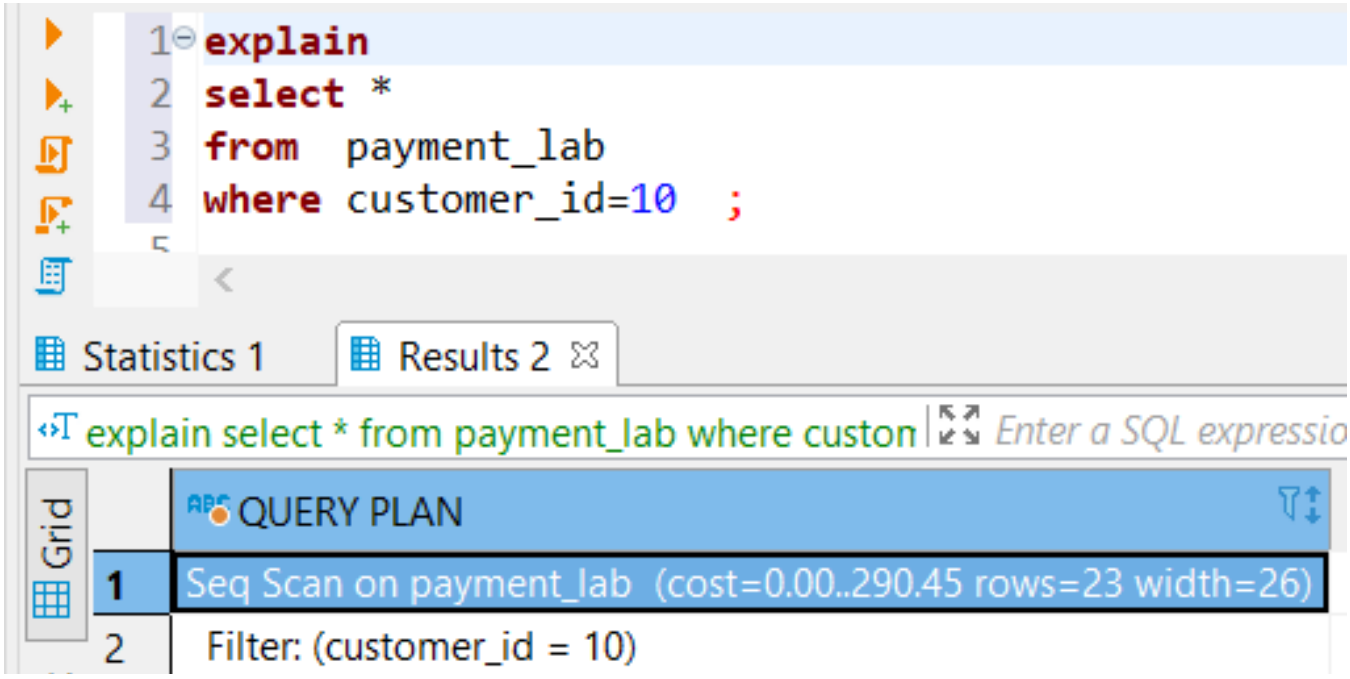

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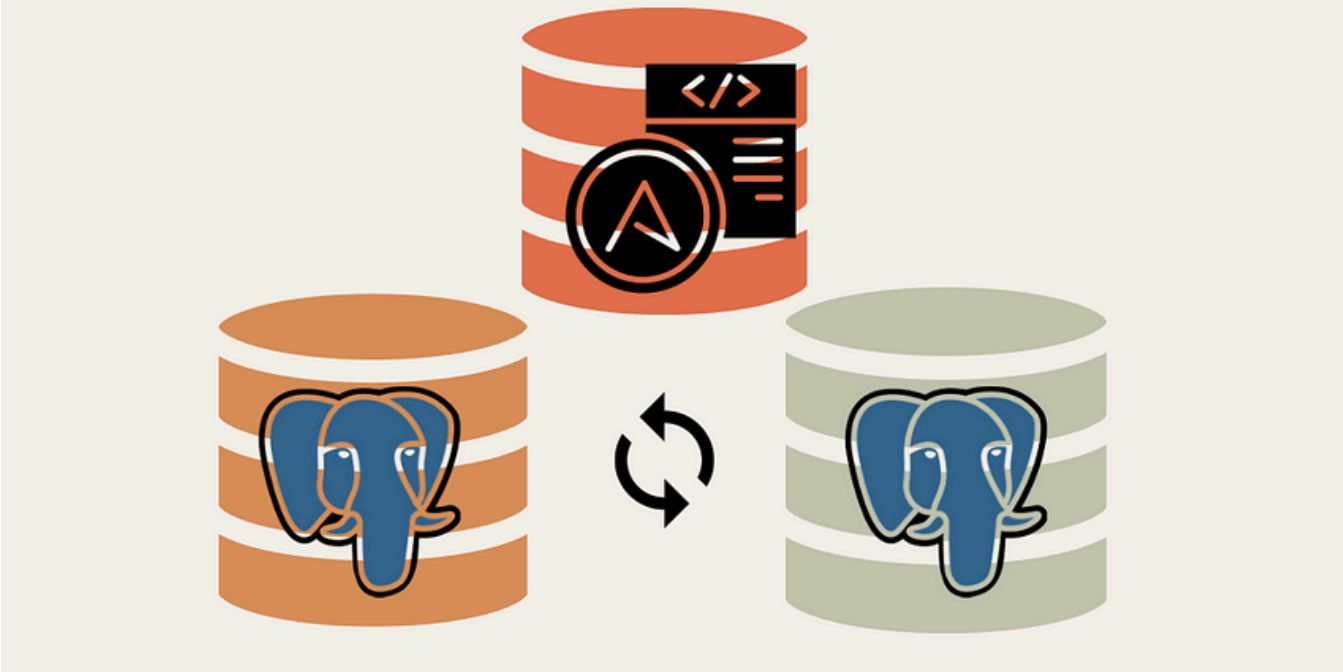

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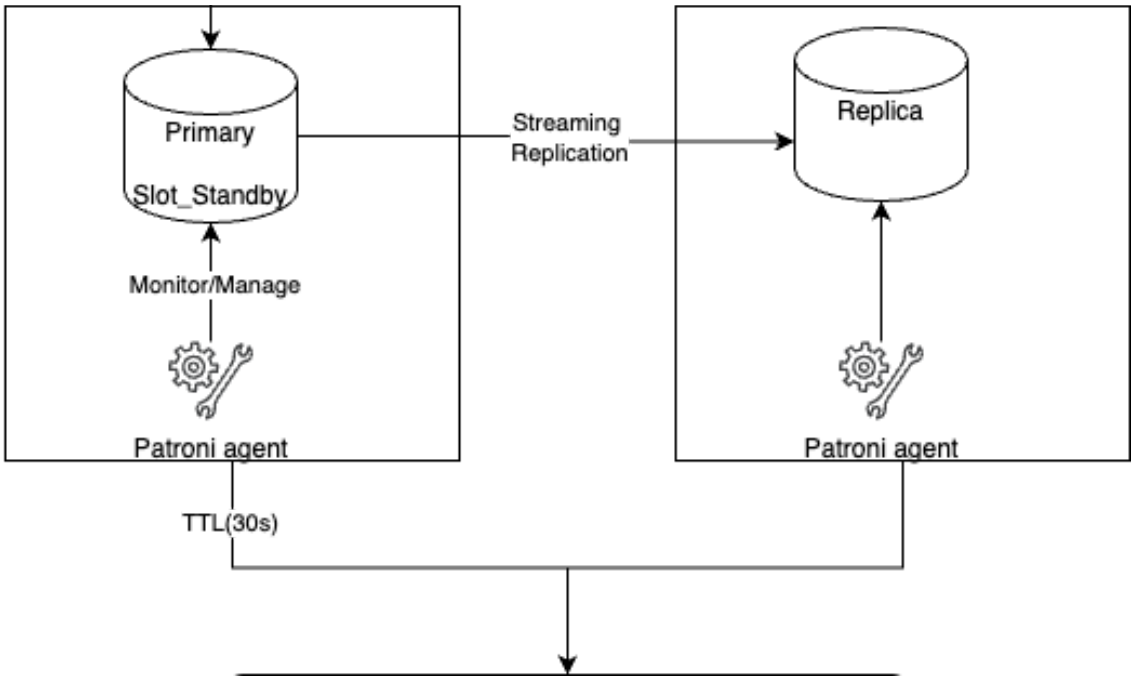

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