Your remote PostgreSQL DBA Team

data egret

An ultimate guide to upgrading your PostgreSQL installation

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Why this talk?

Upgrading your PostgreSQL is not a rocket science!

- ...but there are **lots** of small details
- An unsuccessful upgrade can ruin your data
- Or at least cause an unacceptable downtime
- Upgrade requires good knowledge of your system and substantial preparation time

Because of that

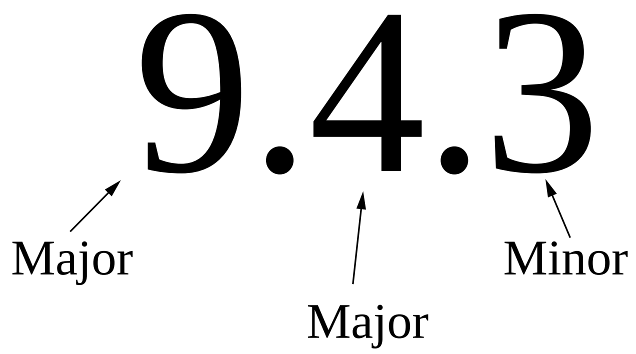
- DBAs do not like upgrades
- They are attached to outdated versions
- They manage to screw up an upgrade when they finally decide to perform one

Why do you need to upgrade?

- Bugfixes, security fixes
- Many performance improvements and new features over the last years
- Upgrading on time makes it easier
- Running 7.* (or even 9.*) in 2023 would make consultants too happy

PostgreSQL version numbering

<= 9.6.*



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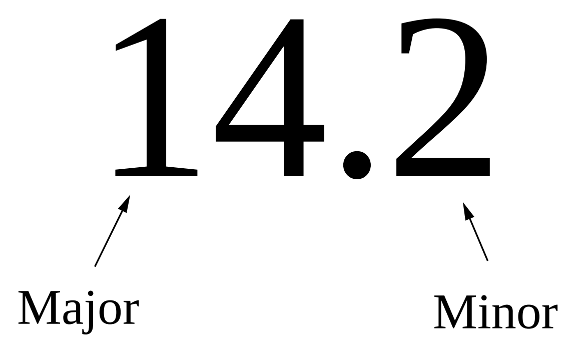


Types of upgrades

- Minor
    - New versions' binaries can run on old version datafiles
- Major
    - New versions' binaries can run on old version datafiles, but require new system tables and internal data format may change
- Major with special requirements

Before any upgrade

- Read carefully version specific release notes
- Play with chosen upgrade method in test environment
- Align with your application development team
- **Make a backup and check it by test recovery**

Minor upgrades are easy

- You simply install new binaries and start new database server on the old data directory
- There are no new features between minor versions
- Still - keep an eye on updating all PostgreSQL-related packages you use

Major upgrade prerequisites

- Install new versions for all PostgreSQL-related packages
- Read carefully all release notes
- Know your PostgreSQL installation
- Choose the method and carefully read the documentation for this method
- Align with your application development team
- **Do a backup and check it by doing a test recovery**

Check which PostgreSQL-related packages you use

```
your_server:~$ sudo dpkg -l *postgres*
||/ Name                                                   Version
+++-==================================================-=============================
ii  postgresql-9.3                                         9.3.15-1.pgdg14.04+1
ii  postgresql-client-9.3                                  9.3.15-1.pgdg14.04+1
ii  postgresql-client-common                               182.pgdg14.04+1
ii  postgresql-common                                      182.pgdg14.04+1
ii  postgresql-contrib-9.3                                 9.3.15-1.pgdg14.04+1
ii  postgresql-plperl-9.3                                  9.3.15-1.pgdg14.04+1
ii  postgresql-server-dev-9.3                              9.3.15-1.pgdg14.04+1

your_server:~$ sudo dpkg -l *pg*
||/ Name                                                   Version
+++-==================================================-=============================
ii  libdbd-pg-perl                                         2.19.3-2
ii  pgbouncer                                              1.5.4-4
ii  pgdg-keyring                                           2014.1
```

Major upgrade methods

- Good old dump/restore
- pg_upgrade
- Replication-based methods

Major upgrade using pg_dump

- Difficult to make without downtime if you have a large, heavy loaded database
- Requires additional disk space
- Works with any PostgreSQL version since 7.0
- *pg_dump -Fc* - custom format, *-Z* - compression

Major upgrade using pg_dump

- *pg_dump -Fd --jobs* can be a good option in terms of speed and downtime
- But if using *-j* you can't do things like that: *pg_dumpall -p 5432| psql -d postgres -p 5433*
- If your installation can be upgraded easily by dump/restore, you are lucky!

Major upgrade using pg_dump - procedure

- Install new binaries
- Initialize new cluster. Don't forget about locale
- Change config files appropriately
- It can be a good idea to use newer version of pg_dump, but be careful if running on pre-9.2 server
- Restore the dump, try to figure out if everything looks good
- Switch your application to the new cluster

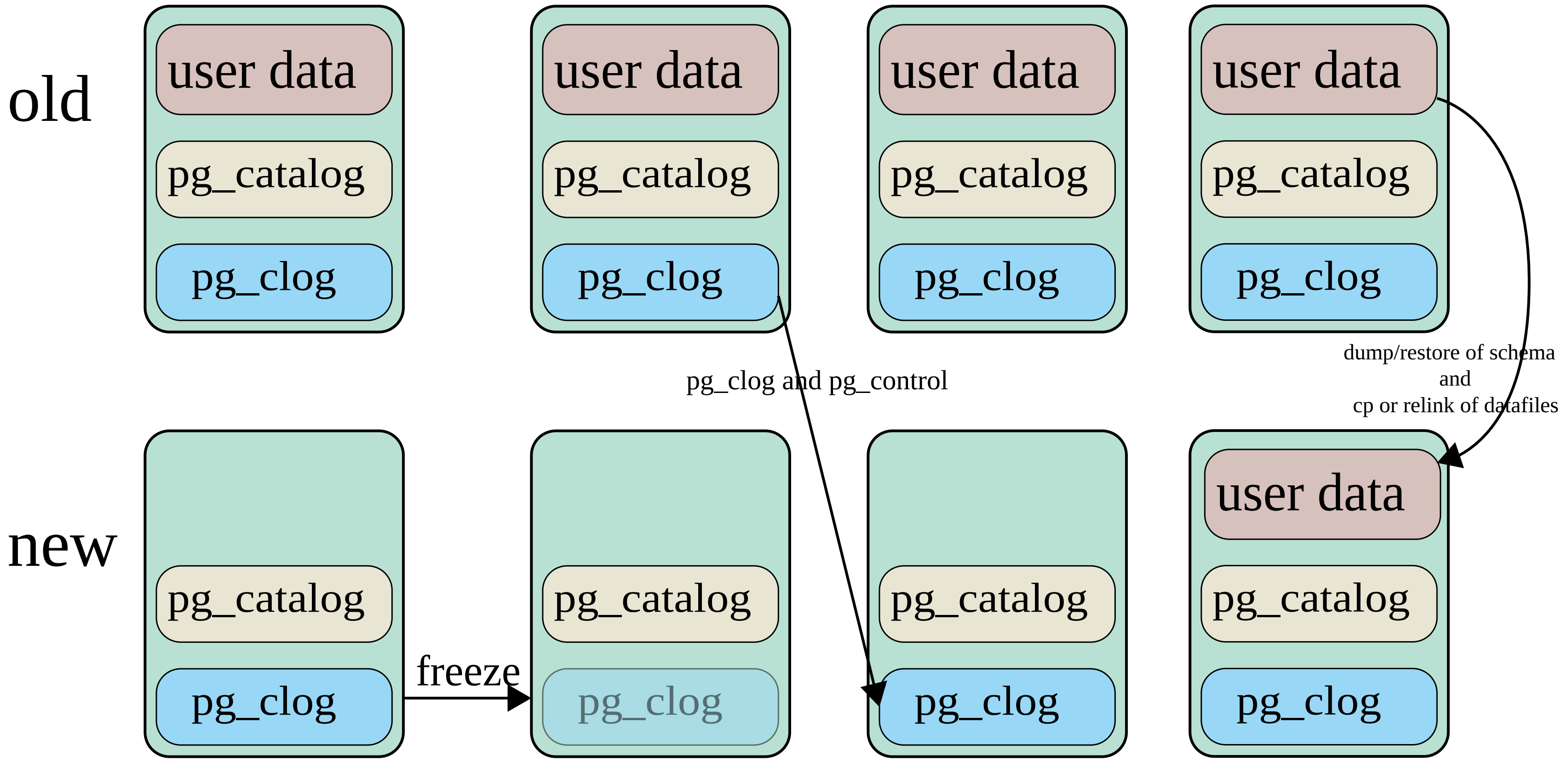
Install new binaries

- Know your packet manager!
- Debian/Ubuntu tweaks:
  - in */etc/postgresql/14/main/start.conf* change *auto* to *manual*
  - remember about *--download-only*

pg_upgrade - outline

- How it works?
- Procedure
  - Simple case - standalone server
  - How to minimize downtime?
  - Upgrading hot-standby cluster
- Details

pg_upgrade - How it works?



pg_upgrade - preparations

- check for replication slots (we most likely need to recreate them after upgrade)
- Read release notes
  - pg_upgrade documentation
  - incompatibilities section
  - check list of your extensions and their compatibility
- Discuss procedure with your Dev Team
- **make an extra backup**
- `pg_dumpall -s`

pg_upgrade - procedure

- Create empty database for new version of PostgreSQL
- Stop database with old PostgreSQL version
- Start upgrade procedure with pg_upgrade command
- Start database that runs on new PostgreSQL version

pg_upgrade - procedure

- Start collecting statistics (pg_upgrade does not transfer optimizer statistics)
- When statistic collection started, you can open database for your application
- Depending on your database, you can achieve 1-10 min downtime target

pg_upgrade - minimizing downtime

- Use pgbouncer
    - *PAUSE/RESUME*
    - Issue *CHECKPOINT;* on old server before you start, to make shutdown process faster
- Use *-k (--link)* to use hard links instead of copy (**but carefully!**)

pg_upgrade - hot-standby replica

- Upgrade primary as a standalone server
- Keep replica intact to failover if something goes wrong
- Reinstantiate your replica
- Procedure
    - Pause pgbouncer on standby or stop it
    - Clone a replica from upgraded primary using pg_basebackup
    - Start replica with new binaries
    - Resume pgbouncer connections or start pgbouncer.

pg_upgrade - Details

- **pg_upgrade does not transfer optimizer statistics**
- instead, it generates a script *./analyze_new_cluster.sh*
    - It basically runs *vacuumdb --all --analyze-in-stages*
    - In some cases it is better to run *vacuumdb --all --analyze-only*
    - Since 9.5 you can vacuumdb run in parallel (*-j 20*)
    - We usually use *vacuumdb --all --analyze-in-stages* and open database for application after medium optimizer statistics (10 targets) are generated

pg_upgrade - Details

- **Documentation suggests to use rsync to reinstantiate standby**
- *rsync --archive --delete --hard-links --size-only old_pgdata new_pgdata remote_dir*
- rsync allows you to save a lot of network traffic in that case
- ...and provides **lots** of opportunities to shoot yourself in the foot
- **pg_basebackup** is generally safer
  - *pg_basebackup -v -P -R -c fast -h IP -U replica -D /var/lib/postgresql/14/main --wal-method=stream*

pg_upgrade - Details

- **Debian/Ubuntu follow their own way**
- Wrappers, like *pg_ctlcluster* are designed to manipulate PostgreSQL cluster in a Debian way
- *pg_upgradecluster -v 9.5 9.3 main1 -m upgrade -k* supposed to be a make-me-happy button for a DBA
- It even takes care of converting postgresql.conf parameters for you
- **But I strongly recommend to do this manually**

pg_upgrade - Details

- **Extensions can surprise you**
- pg_upgrade keeps old versions of extensions
- We advise to cycle through all extensions and perform *alter extension EXTENSION_NAME update;*
- Some extensions need special care: for example PostGIS should be updated before an upgrade

pg_upgrade - work in progress

- Recently there was a bit discoussion of pg_upgrade at Developer Unconference 2023 in Ottawa
  - no statistic in the new cluster is the biggest problem
  - a nice idea is to sample old cluster and transfer that statistics
  - implementation of that could be not easy

pg_upgrade - notes on pgBackRest

- check version compatibility
- right after pg_upgrade
  - change path in pgbackrest.conf
  - `pgbackrest --stanza=$STANZA stanza-upgrade --no-online`

Using replication to upgrade PostgreSQL

- Streaming replication doesn't work between versions
- But some replication methods can do that
  - Logical replication
  - Slony-I (Yes, even in 2023!)
  - Londiste (maybe not in 2023...)
- Procedure
  - Setup new database cluster
  - Setup replication from old one to a new one
  - Perform failover

Conclusion

Method	downtime	extra disk space	complexity	riskiness
dump/restore	high	double	low	low
pg_upgrade (copy)	high	double	high	low
pg_upgrade (link)	low	low	high	very high
Logical replication	low	double	high	low
Slony-I	low	double	medium	low
Londiste	low	double	medium	low

Don't forget manual vacuum

Reading list

- http://momjian.us/main/writings/pgsql/pg_upgrade.pdf
- https://blog.2ndquadrant.com/untangling-the-postgresql-upgrade/
- http://blog.endpoint.com/2016/12/postgres-statistics-and-pain-of-analyze.html
- https://www.depesz.com/2016/11/08/major-version-upgrading-with-minimal-downtime/

Questions?

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