

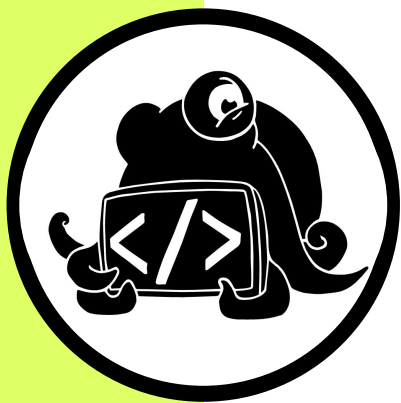
How we migrated 7'000 client PostgreSQL databases

Silicon Chalet, 16.10.2024

LUCY LINDER

Software Engineer

Head of Infrastructure at **DIVIO**



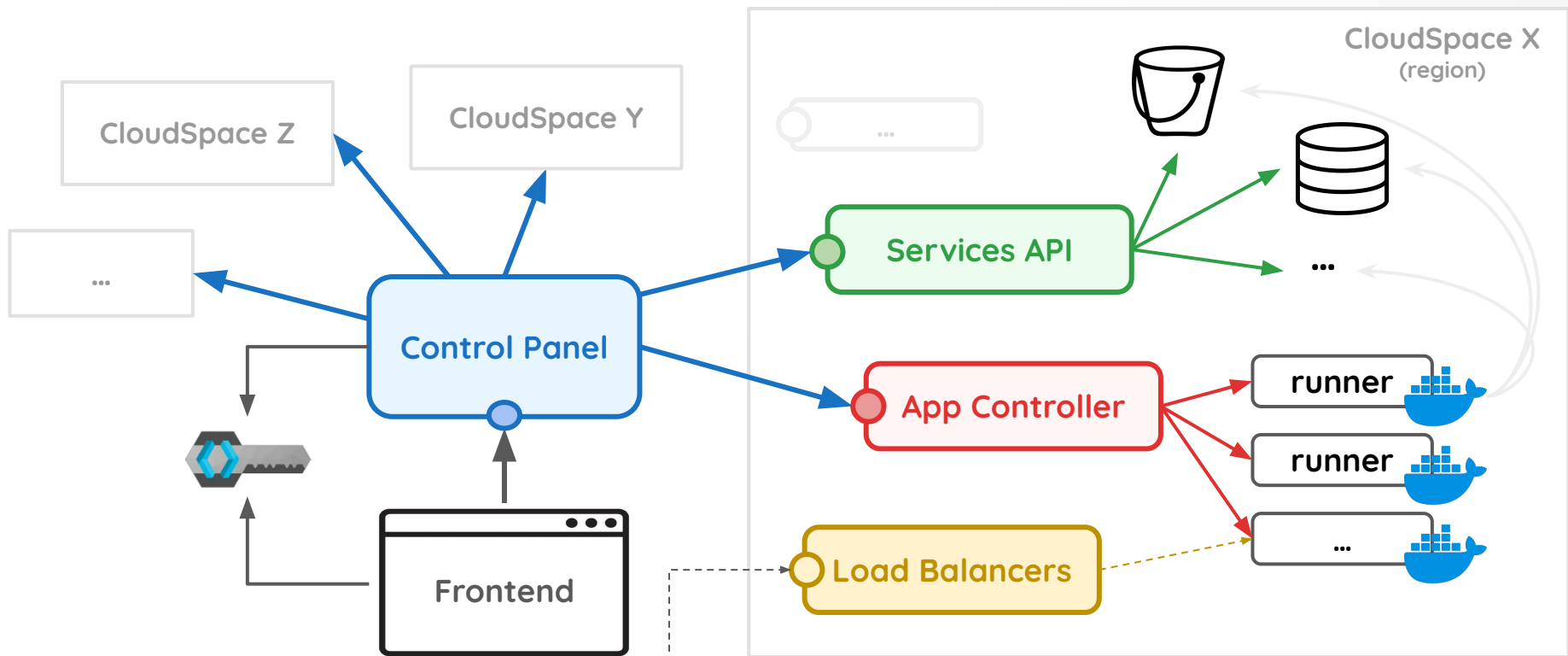
@DERLIN

<https://derlin.ch>

DIVIO?

PAAS

"PEACE OF MIND"



5 + X
regions

7'000+
applications

10'000+
environments

8 engineers

7'326
postgres 13

25'000+
services



Back to Postgres

PostgreSQL 13

24.09.2020

PostgreSQL 15

12.10.2022

FROM: Amazon Web Services, Inc.

ON: June 11, 2024

[Action required] Update Your Amazon RDS and Amazon Aurora SSL/TLS Certificates by August 22, 2024

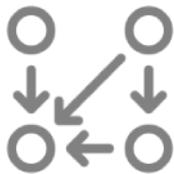
...



"good"
design



I. codebase



II. dependencies



III. config



IV. backing services



V. build|release|run



VI. processes

The Twelve-Factor App

<https://12factor.net>



VII. port binding



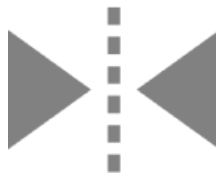
VIII. concurrency



IX. disposability



X. logs



XI. dev/prod parity



XII. admin processes

III. config

Store config in the environment

A Divio App is ...

1. Dockerized code
2. Running in **stateless** containers
3. Connected to **backing services**
4. Configured via **Environment variables**
5. And **disposable** (scalable!)



VI. processes

Execute the app as one or more stateless processes



IV. backing services

Treat backing services as attached resources



VIII. Concurrency

Scale out via the process model



IX. disposability

Maximize robustness with fast startup and graceful shutdown

Deploy



V. build|release|run

Strictly separate stages

1

(BUILD)

`docker build -t bld0 ...`

FROM ...



- Dockerfile
- index.html
- ...
- src



2

RELEASE

`docker build -t rel0 ...`FROM **bld0**

```
ENV X_DATABASE_DSN=postgres://user:pass@host/dbname
ENV F00=bar
ENV ...
```

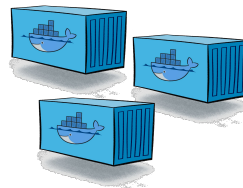


3

RUN

`docker run rel0`

sanity checks



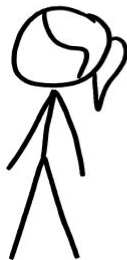
stop old release

Basic Migration Process

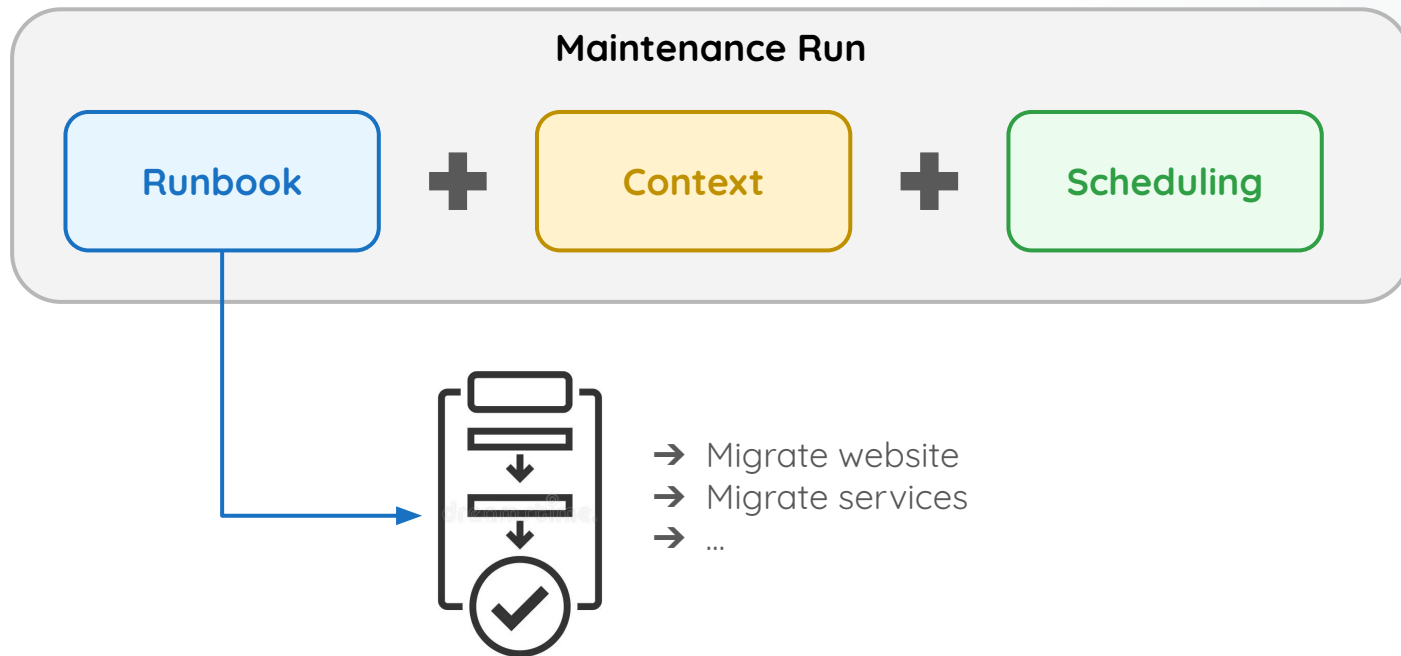
- ✓ . Create **NEW**
- ✓ . **Stop** writes
- ✓ . Backup **OLD** (pg_dump)
- ✓ . Restore to **NEW** (pg_restore)
- ✓ . Update app
- ✓ . **Resume** writes
- ✓ . Delete **OLD**

ALMOST
THERE!

JUST 800 MORE
MILES TO GO!



What's a maintenance?



XII. admin processes

Run admin/management tasks as one-off processes

base class

```
class Runbook:
    preconditions = None
    operations = None

    def estimated_execution_time(self, run):
        # return a maintenance duration

    def apply(self, run):
        # apply maintenance on each context
```

limit to pg13 apps

```
class PostgresRunbook(runbook.Runbook):
    preconditions = [
        conditions.HasServiceInstance(
            service_identifier="postgresql-database-13",
            provisioned=True,
        )
    ]
    operations = [
        ...
    ]
```

provision

```
operations.CollectServiceInstances(  
    service_identifier="postgresql-database-13",  
    provisioned=True,  
)  
  
operations.ReprovisionCollectedServiceInstances(  
    service_identifier_overrides={  
        "postgresql-database-13": "postgresql-database-15"  
    },  
    copy_runtime_options=True,  
)
```

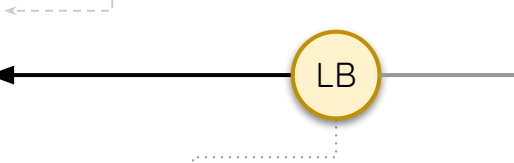
pause the app

```
operations.WithMaintenancePage(  
    pause=True,  
    maintenance_app_pk=settings.MAINTENANCE_APP_ID,  
    operations=[  
        ...  
    ],  
) # will unpause after the operations
```



Temporarily undergoing maintenance

We should be back online shortly



switch database

```
operations.BackupCollectedServices(  
  notes=(  
    "Backup taken prior to the migration of the database"  
    " from Postgres 13 to Postgres 15."  
  ),  
,  
operations.RestoreBackupToReprovisionedServices(),  
operations.EnableReprovisionedServices(),
```

Available in the
backups tab :)

redploy

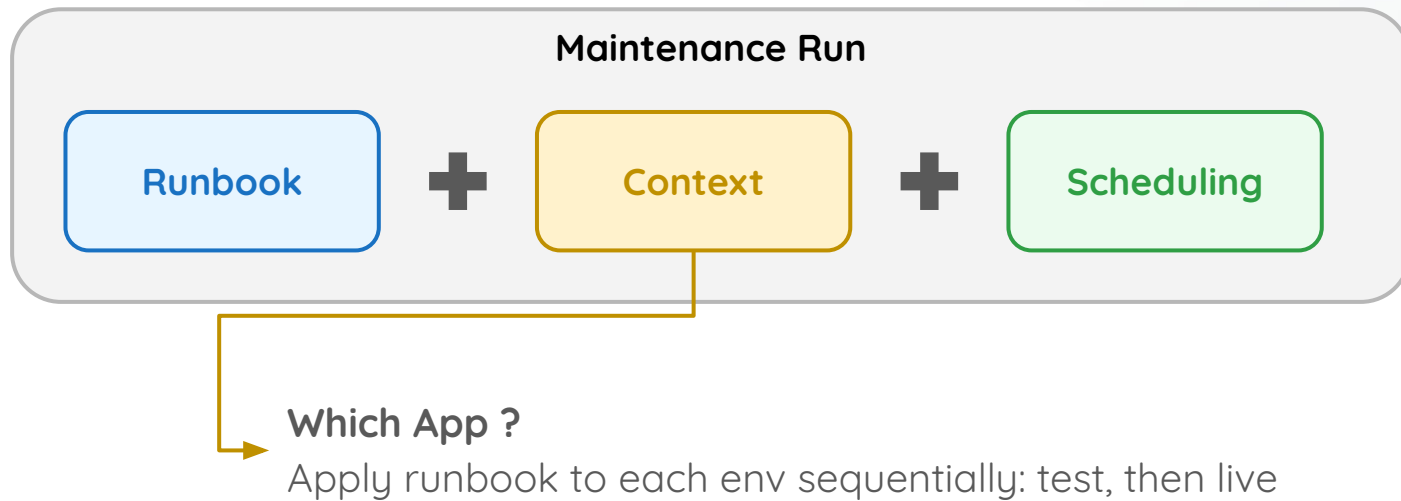
```
operations.ConditionalOperation(  
  when=[conditions.Deployed()],  
  then=[  
    operations.Deploy(  
      adopt=True,  
      run_release_commands=False,  
      allow_failure=False,  
    ),  
  ],  
,
```

no re-build,
re-release only

cleanup

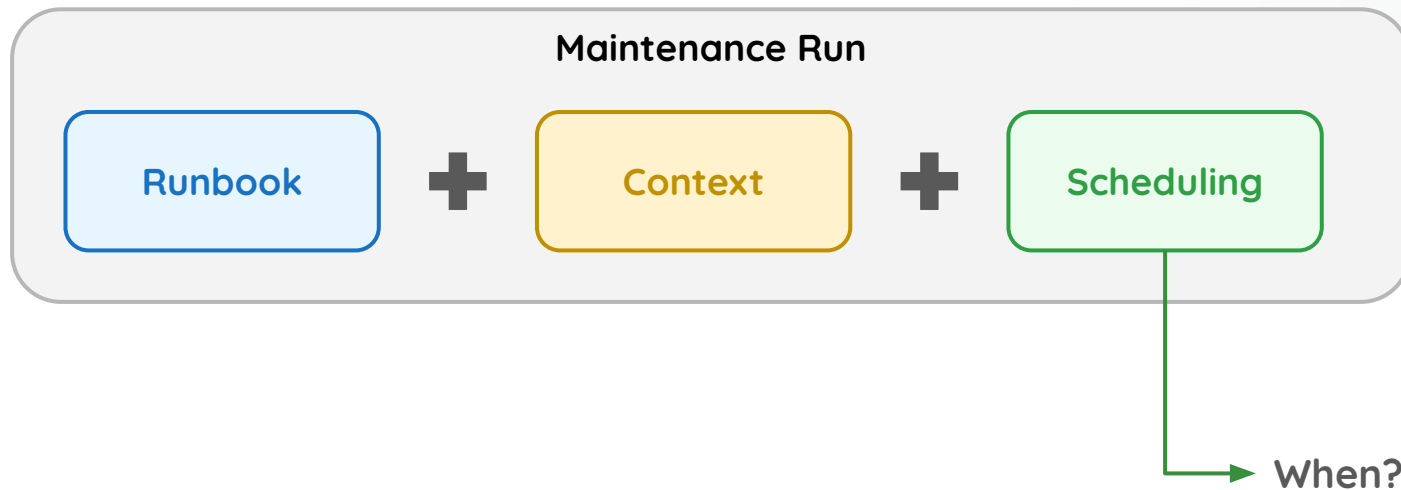
```
operations.DeprovisionCollectedServiceInstances(),
```

WithMaintenancePage



XII. admin processes

Run admin/management tasks as one-off processes



XII. admin processes

Run admin/management tasks as one-off processes

maintenance window

2 weeks notice

estimated duration

limited resources

scheduler



Maintenance window: Thursday, 01:00 - 05:00 UTC

Upcoming Window: August 29, 2024 01:00 - 05:00 UTC

Change time

Upcoming

Migration of PostgreSQL 13 to PostgreSQL 15

Scheduled

September 19, 2024 01:00 - 05:00 UTC



In case of failure...

Deployment

Activity

Deploy

Last deployment **failed** at 20.08.2024 01:03.

See [Services](#) in our documentation.

Live

Object Storage

RabbitMQ Virtual Host

PostgreSQL 13 Database

test

PostgreSQL 15 Database

Object Storage

RabbitMQ Virtual Host

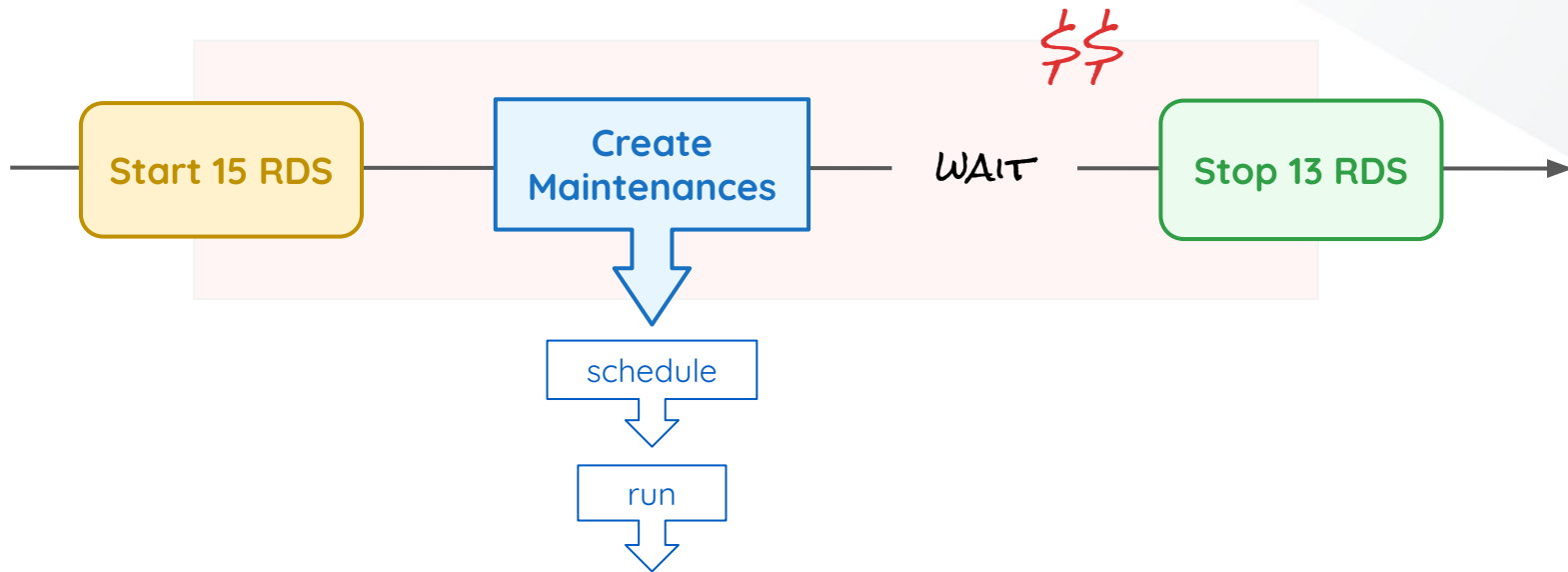
PostgreSQL 13 Database

PRODUCTION

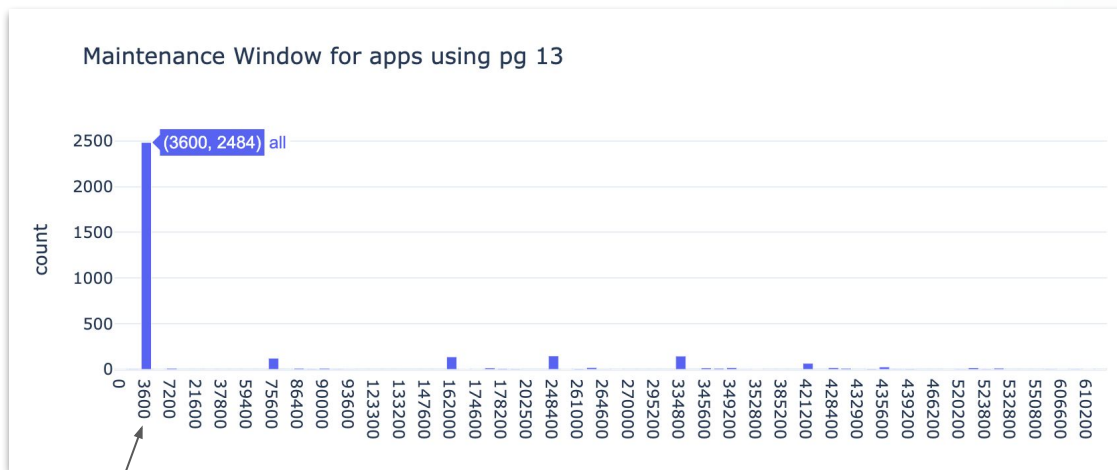
Object Storage	DEFAULT	European Union	ATTACHED
RabbitMQ Virtual Host	DEFAULT	European Union	ATTACHED
PostgreSQL 13 Database	DEFAULT	European Union	ATTACHED
PostgreSQL 15 Database	DEFAULT	European Union	PENDING ATTACHMENT
Object Storage	DEFAULT	European Union	ATTACHED
RabbitMQ Virtual Host	DEFAULT	European Union	ATTACHED
PostgreSQL 13 Database	DEFAULT_0LD_N9S1K1	European Union	PENDING DETACHMENT

What about the cost?

On each region (in parallel)

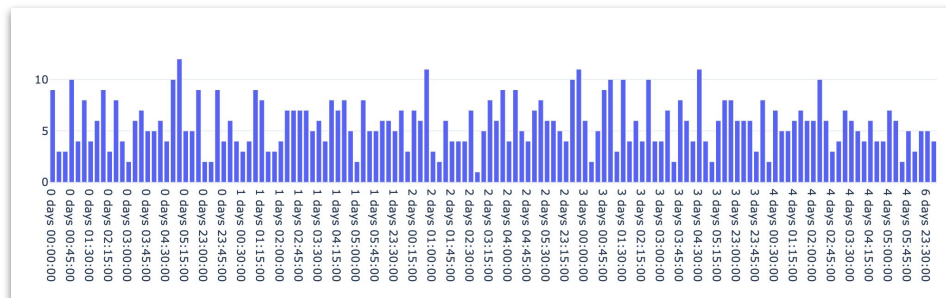


Now, the real world



Monday, 3 am

shuffle
(almost randomly)



Backup times

```
mean      00:00:19
```

```
std      00:02:22
```

min 00:00:00

75% 00:00:04

max 00:51:25

Let's do a first test ...

```
01:57:18.37 WEB File "/usr/local/lib/python3.6/site-packages/django/db/backends/postgresql/base.py", line 178, in get_new_connection
01:57:18.37 WEB connection = Database.connect(**conn_params)
01:57:18.37 WEB File "/usr/local/lib/python3.6/site-packages/psycopg2/__init__.py", line 122, in connect
01:57:18.37 WEB conn = _connect(dsn, connection_factory=connection_factory, **kwargs)
01:57:18.37 WEB django.db.utils.OperationalError: SCRAM authentication requires libpq version 10 or above
01:57:18.37 WEB
01:57:18.37 WEB unable to load app 0 (mountpoint='') (callable not found or import error)
01:57:18.37 WEB *** no app loaded. GAME OVER ***
01:57:18.37 WEB SIGINT/SIGQUIT received...killing workers...
01:57:18.38 WEB gateway "uWSGI http 1" has been buried (pid: 17)
01:57:18.38 DEPLOYMENT connection error.
```

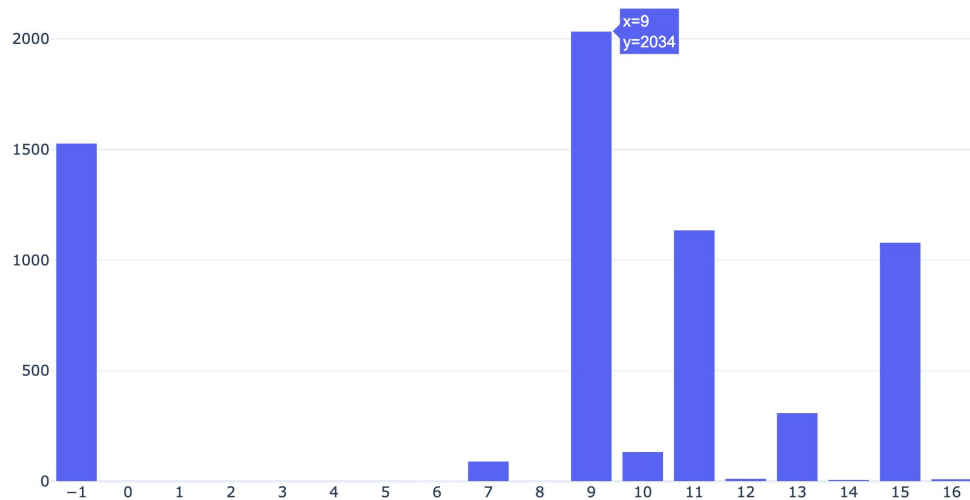
libpq

libpq is the C application programmer's interface to PostgreSQL.

PostgreSQL 14 Release Notes

- Change the default of the password_encryption server parameter to **scram-sha-256** (Peter Eisentraut)

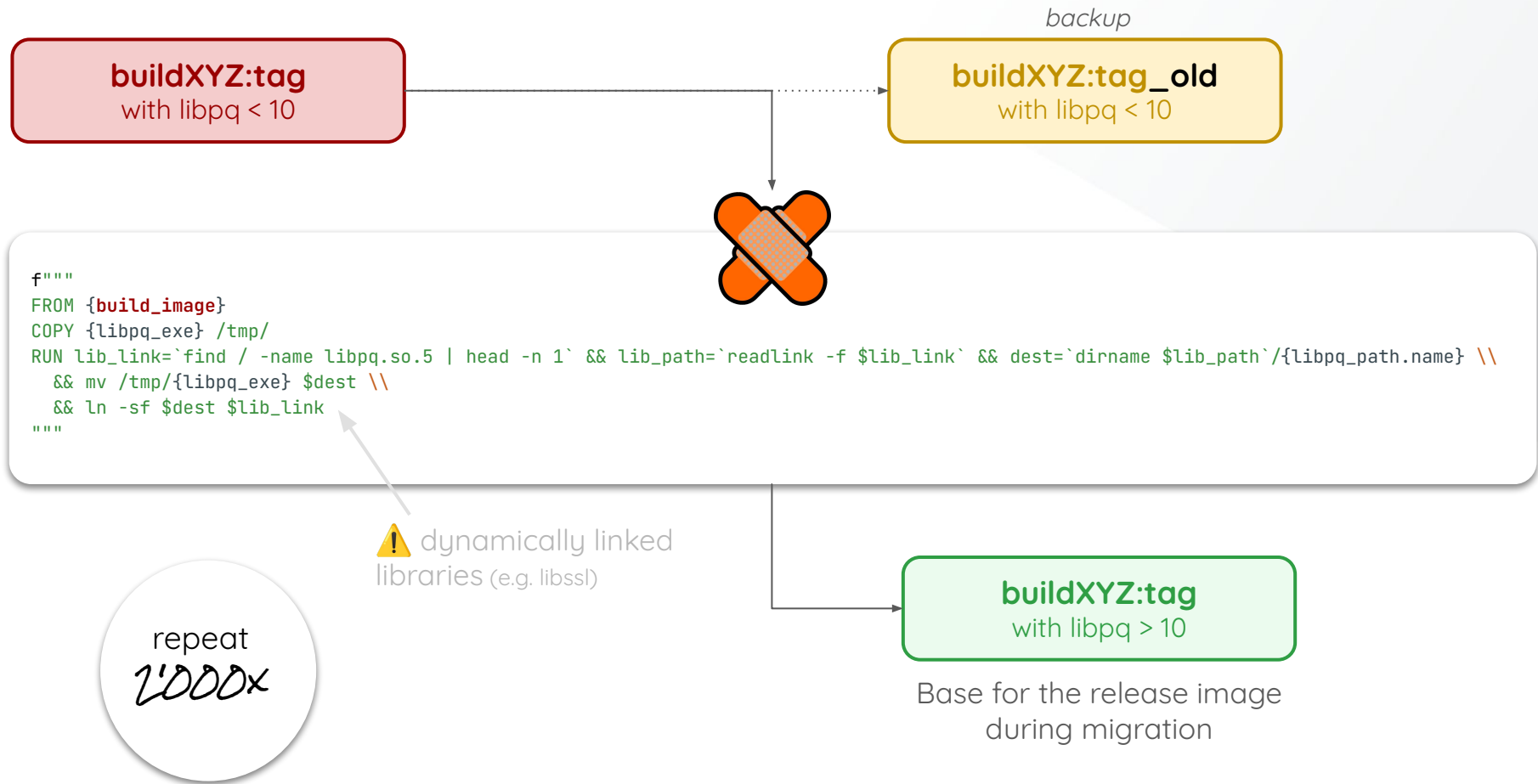
libpq versions (6382)



All build images are:

1. x86_64 linux
2. stored in our registry
3. only rebuilt on code change





In 2 cases:

```
pg_restore [...]
```

ERROR: index row size 3048 exceeds btree version 4 maximum 2704 for index **i**

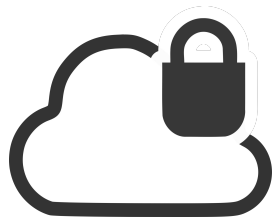
DETAIL: Index row references tuple (841,9) in relation **t**.

HINT: Values larger than 1/3 of a buffer page cannot be indexed. Consider a function index of an MD5 hash of the value, or use full text indexing.

Command was: `CREATE INDEX i ON public.t USING btree (bar);`

ON RDS ONLY!
¯_(ツ)_/¯

And more ...



To sum up

Between July and August, with 1.5 engineers:

5'000+
migrations

7'000+ databases

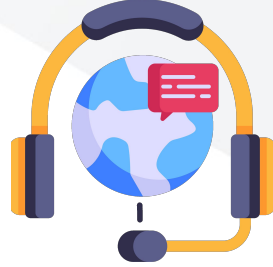
102
failures

99% libpq related
2 index related



99.98%
success rate









QUESTIONS

FOUND IN GOOGLE AUTOCOMPLETE

WHY DO WHALES JUMP
WHY ARE WITCHES GREEN
WHY ARE THERE MIRRORS ABOVE BEDS
WHY DO I SAY UH
WHY IS SEA SALT BETTER
WHY ARE THERE TREES IN THE MIDDLE OF FIELDS
WHY IS THERE NOT A POKEMON MMO
WHY IS THERE LAUGHING IN TV SHOWS
WHY ARE THERE DOORS ON THE FREEWAY
WHY ARE THERE SO MANY SUICIDE CASES RUNNING
WHY AREN'T THERE ANY COUNTRIES IN ANTARCTICA
WHY ARE THERE SCARY SOUNDS IN MINECRAFT
WHY IS THERE KICKING IN MY STOMACH
WHY ARE THERE TWO SCARIES AFTER HTTP
WHY ARE THERE CELEBRITIES
WHY DO SNAKES EXIST
WHY DO OYSTERS HAVE PEARLS
WHY ARE DUCKS CALLED DUCKS
WHY DO THEY CALL IT THE CLAP
WHY ARE KYLE AND CARTMAN FRIENDS
WHY IS THERE AN ARROW ON PANG'S HEAD
WHY ARE TEXT MESSAGES BLUE
WHY ARE THERE MUSTACHES ON CLOTHES
WHY ARE THERE MUSTACHES ON CARS
WHY ARE THERE MUSTACHES EVERYWHERE
WHY ARE THERE SO MANY BIRDS IN OHIO
WHY IS THERE SO MUCH RAIN IN OHIO
WHY IS OHIO WEATHER SO WEIRD
WHY ARE THERE MALE AND FEMALE BIKES
WHY ARE THERE BRIDGES
WHY DO SPIDERS COME INSIDE
WHY ARE THERE HUGE SPIDERS IN MY HOUSE
WHY ARE THERE LOTS OF SPIDERS IN MY HOUSE
WHY ARE THERE SPIDERS IN MY ROOM
WHY ARE THERE SO MANY SPIDERS IN MY ROOM
WHY DO SPIDER BITES ITCH
WHY IS DYING SO SCARY
WHY ARE THERE SQUIRRELS
WHY IS PROGRAMMING SO HARD
WHY IS THERE A D OMM RESISTOR
WHY DO PERSONS HAVE WHITE SCARS
WHY DO RAINBOWS SOUND GOOD
WHY DO TREES DIE
WHY IS THERE NO SOUND ON OWN
WHY AREN'T POKEMON REAL
WHY AREN'T BULLETS SHARP
WHY DO DREAMS SEEM SO REAL
WHY DO TESTICLES MOVE
WHY ARE THERE PSYCHICS
WHY ARE HITS SO EXPENSIVE
WHY IS THERE CRYING IN MY SHOWER
WHY DO YOUR BOOBS HURT
WHY ARE THERE SLAVES IN THE BIBLE
WHY DO TWINS HAVE DIFFERENT FINGERPRINTS
WHY ARE AMERICANS AFRAID OF DRAGONS
WHY IS HTTPS CROSSED OUT IN RED
WHY IS THERE A LINE THROUGH HTTPS
WHY IS THERE A RED LINE THROUGH FACEBOOK
WHY IS HTTPS IMPORTANT
WHY AREN'T MY ARMS GROWING
WHY ARE THERE LADIES
WHY DO I FEEL DIZZY
WHY ARE THERE SO MANY CROWS IN ROCHESTER
WHY IS PSYCHIC WEAK TO BUG
WHY DO CHILDREN GET CANCER
WHY IS POSEIDON ANGRY WITH ODYSSEUS
WHY IS THERE ICE IN SPACE
WHY ARE THERE ANTS IN MY LAPTOP
WHY IS THERE AN OWL IN MY BACKYARD
WHY IS THERE AN OWL OUTSIDE MY WINDOW
WHY IS THERE AN OWL ON THE DOLLAR BILL
WHY DO OWLS ATTACK PEOPLE
WHY ARE AK 47s SO EXPENSIVE
WHY ARE THERE HELICOPTERS CIRCLING MY HOUSE
WHY ARE MY BOOBS ITCHY
WHY ARE THERE GODS
WHY ARE THERE TWO SPOOKS
WHY ARE THERE DUCKS IN MY POOL
WHY IS JESUS WHITE
WHY IS THERE LIQUID IN MY EAR
WHY DO Q TIPS FEEL GOOD
WHY DO GOOD PEOPLE DIE
WHY IS MT VESUVIUS THERE
WHY DO THEY SAY T MINUS
WHY ARE THERE OBELISKS
WHY ARE WRESTLERS ALWAYS WET
WHY ARE OCEANS BECOMING MORE ACIDIC
WHY IS ARWEN DYING
WHY AREN'T MY QUAIL LAYING EGGS
WHY AREN'T MY QUAIL EGGS HATCHING
WHY AREN'T THERE ANY FOREIGN MILITARY BASES IN AMERICA
WHY ARE ULTRASOUNDS IMPORTANT
WHY ARE ULTRASOUNDS PREPARED ORDINANCE
WHY IS STEALING WRONG
WHY AREN'T THERE GUNS IN HARRY POTTER
WHY AREN'T THERE GUNS IN ENGLAND
WHY ARE DOGS AFRAID OF FIREWORKS
WHY IS THERE NO KING IN ENGLAND
WHY ARE THERE GHOSTS
WHY ARE THERE FEMALE MR MINES
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