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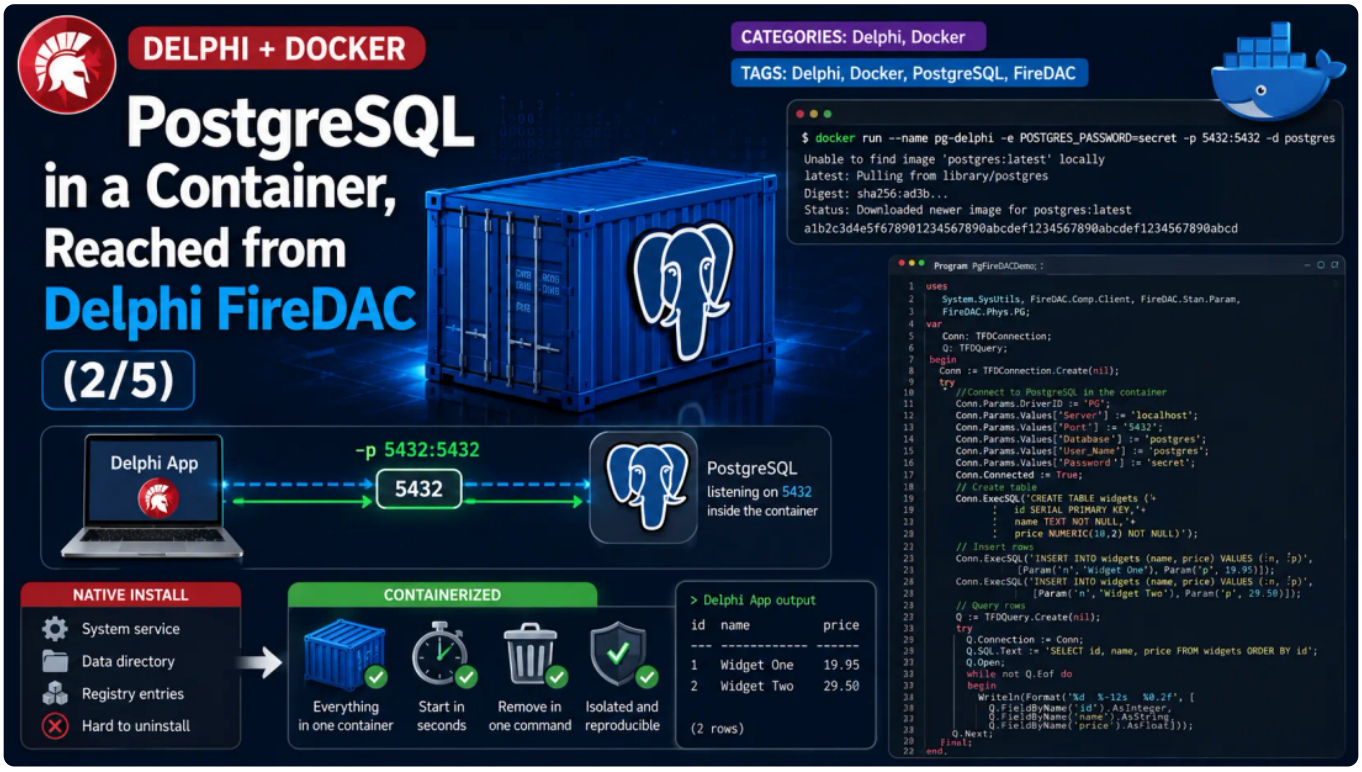
PostgreSQL in a Container, Reached from Delphi FireDAC (2/5)

By Dr. Holger Flick



Part 1 got Docker Desktop installed, ran `hello-world`, and pinned down three words — **image**, **container**, **registry** — so they'd stop being intimidating. That was the warm-up. You can run containers now. Time to run something you'd actually want on your machine.

Here's the promise for this post: a fully working **PostgreSQL** database server — the same relational database that backs a large slice of the software industry — started with **one command**, no native installer, no "next-next-finish" wizard, no service quietly wedged into your Windows startup. And by the end, a real Delphi console program using **FireDAC** that creates a table, inserts rows, and reads them back out of that container.

The kicker is what happens when you're done experimenting: `docker rm` the container and your machine is **spotless**. No leftover PostgreSQL service, no stray data directory, no registry entries. The database existed, did its job, and vanished without a trace — exactly the tidiness Part 1 promised containers would give you.

This is the second stop in a five-part journey, so here's the whole map.

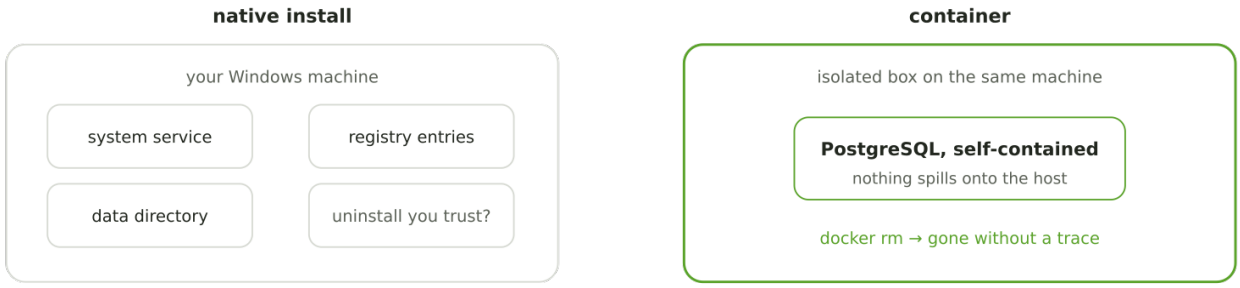
> **This series: Docker for Delphi Developers**

> 1. Install Docker Desktop and run your first container — the tool, and the three words that matter 2. **PostgreSQL in a container, reached from Delphi FireDAC — this post** — run a real database, talk to it from Pascal 3. Images, tags, layers, and registries — where that `postgres` image actually came from 4. Docker Compose: a database and a backend together — describing a whole stack in one file 5. The full picture: web ’ backend ’ database, isolated— how the pieces wire up in real deployments

Why a database is the perfect first real container

A database is the ideal thing to containerize first, and the reason is emotional as much as technical. Installing PostgreSQL natively has always been a small commitment — a system service, a data directory, a superuser password you'll forget, an uninstall you don't fully trust. That friction is exactly why "just try Postgres for an afternoon" so rarely happens.

A container erases the commitment. The database runs in an isolated box that shares nothing with your host except the one port you hand it, and throwing it away is a single command. Try a schema, break it, delete the container, start fresh — the cost of experimenting drops to almost zero.



A native install lives on your machine; a container is a disposable box

Read the two boxes side by side: on the left, a native install scatters itself across your system; on the right, everything the database needs lives inside one container that you can delete cleanly. That contrast is the whole reason we start here.

Step 1 — Run PostgreSQL with one command

Everything begins with a single `docker run`. We'll use the official `postgres` image on Docker Hub — the image maintained by the PostgreSQL Docker community, the canonical way to run PostgreSQL (the open-source relational database) in a container. Here is the command, and then we'll interpret every flag.

```
docker run --name pg-delphi -e POSTGRES_PASSWORD=secret -p 5432:5432 -d postgres
```

Each piece earns its place, so let's name what each one does:

- `docker run` — create and start a container from an image, exactly as in Part 1.
- `--name pg-delphi` — give the container a friendly name so you can refer to it later (`docker stop pg-delphi`) instead of a random hash Docker would otherwise assign.
-

`-e POSTGRES_PASSWORD=secret` — set an *environment variable* inside the container. Per the official image documentation, `POSTGRES_PASSWORD` is the one variable the image *requires*: it's the password for the default superuser. (Two optional siblings exist: `POSTGRES_USER` changes the superuser name from its default of `postgres`, and `POSTGRES_DB` sets the initial database name, which otherwise defaults to the user's name. We'll lean on the defaults and keep the moving parts few.)

- `-p 5432:5432` — publish a port: map port **5432 on your host** to port **5432 inside the container**. `5432` is PostgreSQL's standard port. This flag is the entire bridge between your Delphi app and the database, and it gets its own diagram in Step 3.
- `-d` — run *detached*, in the background, so your terminal comes straight back to you instead of tailing the server's log.
- `postgres` — the image to run. Since it isn't on your machine yet, Docker pulls it from the registry (Part 1's third word) on first use.

That port number is not new to you if you followed the networking series — it's the same "programs listen on a numbered port" idea from ports and localhost, now pointed at a container. Run the command, and in a few seconds you have a PostgreSQL server accepting connections on `localhost:5432`. No installer ran. Nothing touched your Windows services.

Step 2 — Confirm it's alive

Before writing a line of Delphi, let's prove the server is up. The everyday command for "what's running right now" is `docker ps`, which lists your live containers.

```
docker ps
```

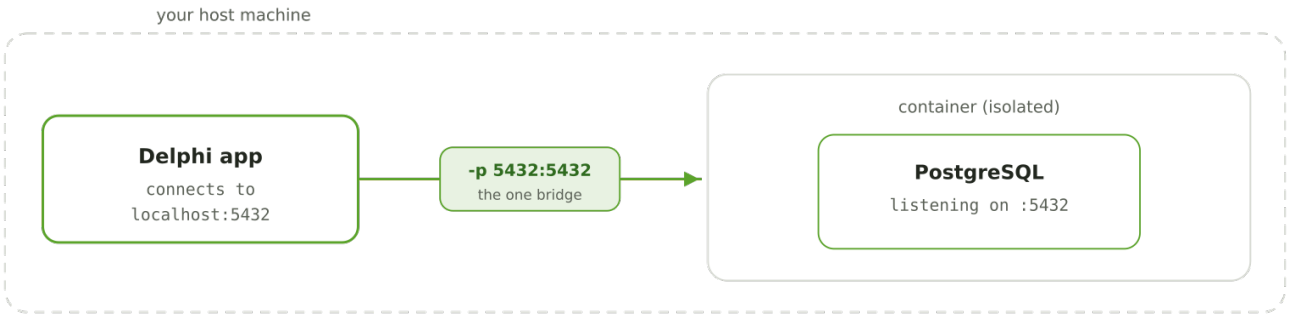
You'll see a row for `pg-delphi` with an image of `postgres`, a status like `Up 12 seconds`, and a ports column showing `0.0.0.0:5432->5432/tcp` — Docker confirming the mapping you asked for. If you want to *peek inside* the running database, you can open a shell into the container and talk to PostgreSQL with its own command-line client, `psql`:

```
docker exec -it pg-delphi psql -U postgres
```

That command deserves a one-line gloss: `docker exec` runs a command *inside an already-running container* (as opposed to `docker run`, which starts a new one). The `-it` flags make it interactive with a terminal attached, and `psql -U postgres` launches PostgreSQL's built-in client as the `postgres` superuser. You'll land at a `postgres=#` prompt — that's the database itself, answering from inside the box. Type `\q` to leave. This step is entirely optional; it's here so you can *see* that the server is real before Delphi ever connects.

Step 3 — The mental model: one port, bridged into the box

The single most important concept in this whole post is that `-p 5432:5432` flag, so let's make it a picture. A container is isolated — by default nothing outside can reach a program inside it. Publishing a port drills exactly one predictable hole through that isolation.



Port mapping: localhost:5432 on the host is bridged to 5432 inside the container

Read it left to right: your Delphi app connects to `localhost:5432` as if a database were installed right there on your machine. It has no idea a container exists. The `-p 5432:5432` mapping quietly forwards that traffic across the container's boundary to PostgreSQL listening on `5432` *inside* the box. The number on the left of the colon is the host port you dial; the number on the right is the port inside the container. Here they match, which keeps things simple — but they needn't: `-p 6000:5432` would let you reach the same database at `localhost:6000` instead, handy when host port 5432 is already taken.

That's the whole abstraction. To every tool on your host — Delphi, `psql`, a GUI, anything — the containerized database looks exactly like a local one on `localhost:5432`.

Now the Delphi part: FireDAC talks to the container

This is where a seasoned Delphi developer smiles, because from Pascal's side there is nothing exotic here at all. The database is *just a PostgreSQL server on* `localhost:5432`. You connect to it with FireDAC — Delphi's built-in, high-performance database access layer — exactly as you would to any PostgreSQL server, containerized or not.

FireDAC identifies each database engine by a short **DriverID**, and PostgreSQL's is `PG`. Per Embarcadero's Connect to PostgreSQL (FireDAC)) guide, a PostgreSQL connection is described by a handful of parameters — `DriverID`, `Server`, `Port`, `Database`, `User_Name`, and `Password` — and the driver lives in the unit `FireDAC.Phys.PG`. Here is a complete, focused console program that connects, creates a table, inserts two rows, and selects them back.

```
program PgDemo;

{$APPTYPE CONSOLE}

uses
  System.SysUtils,
  FireDAC.Comp.Client,   // TFDConnection, TFDQuery
  FireDAC.Phys.PG,       // the PostgreSQL driver (DriverID = PG)
  FireDAC.Phys.PGDef,    // its design/registration definitions
  FireDAC.Stan.Def,      // driver/connection definition manager
  FireDAC.Stan.Async,    // async execution support
  FireDAC.DApt;          // the data adapter that fills TFDQuery

var
  Conn: TFDConnection;
  Qry: TFDQuery;
begin
  try
    Conn := TFDConnection.Create(nil);
```

```
    try
      // Describe the connection to our containerized PostgreSQL.
      Conn.Params.DriverID  := 'PG';
      Conn.Params.Values['Server']    := 'localhost';
      Conn.Params.Values['Port']      := '5432';
      Conn.Params.Values['Database']  := 'postgres';   // the default DB
      Conn.Params.Values['User_Name'] := 'postgres';   // default superuser
      Conn.Params.Values['Password']  := 'secret';     // matches POSTGRES_PASSWORD
      Conn.Connected := True;
      Writeln('Connected to PostgreSQL in the container.');

      // CREATE + INSERT are statements that return no rows: ExecSQL.
      Conn.ExecSQL(
        'CREATE TABLE IF NOT EXISTS widgets (' +
        '  id     SERIAL PRIMARY KEY,' +
        '  name   TEXT NOT NULL,' +
        '  price  NUMERIC(10,2) NOT NULL)');

      Conn.ExecSQL(
        'INSERT INTO widgets (name, price) VALUES (:n, :p)',
        ['Rocket Skates', 20.00]);
      Conn.ExecSQL(
        'INSERT INTO widgets (name, price) VALUES (:n, :p)',
        ['Portable Hole', 99.00]);
      Writeln('Inserted 2 rows.');

      // SELECT returns rows, so use a TFDQuery and loop the result set.
      Qry := TFDQuery.Create(nil);
      try
        Qry.Connection := Conn;
        Qry.Open('SELECT id, name, price FROM widgets ORDER BY id');
        while not Qry.Eof do
        begin
          Writeln(Format('#%d  %-16s  $%.2f',
            [Qry.FieldByName('id').AsInteger,
             Qry.FieldByName('name').AsString,
             Qry.FieldByName('price').AsFloat]));
          Qry.Next;
        end;
      finally
        Qry.Free;
      end;
    finally
      Conn.Free;
    end;
  except
    on E: Exception do
      Writeln('ERROR: ', E.ClassName, ': ', E.Message);
  end;
  Readln;
end.
```

A couple of things are worth calling out. Notice the split between `TFDConnection.ExecSQL` and `TFDQuery`: `ExecSQL` is for statements that *change* data but return no result set — `CREATE TABLE`, `INSERT`, `UPDATE`, `DELETE` — while `TFDQuery.Open` runs a `SELECT` and hands you a navigable result set you walk with the classic `while not Eof do … Next` loop every Delphi developer already has in muscle memory. The `:n` and `:p` are FireDAC *parameters* — placeholders bound to the values you pass, so PostgreSQL sees properly-typed, safely-escaped data rather than string-concatenated SQL. Run it, and the console prints your two widgets, read straight back out of the container:

```
Connected to PostgreSQL in the container.
Inserted 2 rows.
#1  Rocket Skates     $20.00
#2  Portable Hole     $99.00
```

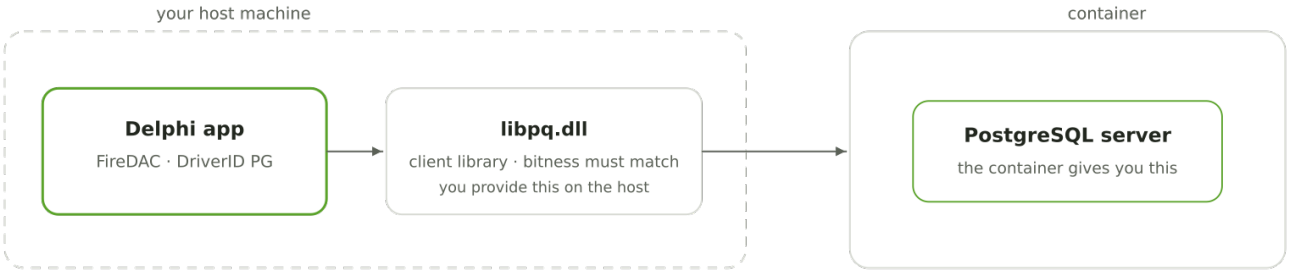
That output is the full round trip: a modern Delphi program, using nothing but the built-in RTL and FireDAC, creating and querying a real PostgreSQL server that you conjured into existence with one `docker run`.

The honest gotcha: FireDAC needs the client library

There is one real snag between you and that output, and it's better to hear it now than to fight a cryptic error later. FireDAC's native PostgreSQL driver doesn't speak the PostgreSQL wire protocol on its own — it delegates to **libpq**, PostgreSQL's official C client library, shipped as `libpq.dll` on Windows. The container gave you the *server*; it did **not** put the *client library* on your host, and your Delphi app runs on your host.

> **FireDAC needs the PostgreSQL client library (libpq)**
> Per Embarcadero's Connect to PostgreSQL (FireDAC)) documentation, the native PG driver requires `libpq.dll` — plus the DLLs it depends on — to be reachable by your application at runtime (on the `PATH`, or sitting next to your `.exe`). The container is the **server**; libpq is the **client**, and it lives with *your app*, not in the box. Two rules keep this painless: the DLL's **bitness must match your app** — a 64-bit Delphi build needs the 64-bit `libpq.dll`, a 32-bit build the 32-bit one — and, ideally, the client version should be close to the server version.

Where do you get it? libpq ships inside the standard PostgreSQL Windows download (from EDB) — you can run the installer and select only the *command-line tools* to get `libpq.dll` and its companions without installing the server itself, then copy that set of DLLs next to your `.exe` or onto your `PATH`. This is a one-time setup on each machine that runs the app, and once the DLLs are in place, FireDAC connects without another thought. It's a small tax, and it's entirely reproducible — no guessing.



Server in the container, client library on the host — both are needed

Read the three boxes as a chain: your Delphi app calls into `libpq.dll` on the host, and `libpq` is what actually talks across the port to the PostgreSQL server in the container. Miss the middle box and FireDAC has no way to reach the server — that's the gotcha in one picture.

The same database welcomes any client

Because this is a standard PostgreSQL server, nothing about it is Delphi-specific — and that's a strength worth naming honestly. The container speaks the ordinary PostgreSQL protocol, so *any* client on the planet connects to the exact same `localhost:5432` with the exact same credentials.

> **Reach the same container from anything**

> You already met one client: `psql`, PostgreSQL's own command line, via `docker exec` in Step 2. Prefer a GUI? DBeaver and pgAdmin are excellent free tools that connect to `localhost:5432` and let you browse tables visually. Writing a backend in another stack? A Node.js service with the `pg` package or a Python app with `psycopg` talks to this identical container. The database doesn't care who's calling — which is exactly why containerizing it is so freeing. Your Delphi app is one welcome client among many, not a locked-in one.

That interoperability is the quiet payoff of using a standard, open-source database in a container: your Delphi frontend and, say, a web backend can share one database without either knowing or caring what the other is written in.

One catch to remember: this data is temporary

There's a deliberate simplification in everything above, and it's important you know about it before you rely on this container for anything you'd miss. Right now, the `widgets` table and its rows live *inside* the container.

> **Stop the container, and the data is gone**
> Delete this container with `docker rm` and PostgreSQL's data goes with it — which is *perfect* for throwaway experiments (that's the spotless-machine promise) but obviously not what you want for data you intend to keep. The fix is a **volume**: a piece of storage that lives on your host and outlives any single container, so you can destroy and recreate the database container while the data stays put. We don't need it yet, and teaching it here would blur the mental model — so Part 4 introduces volumes properly when we assemble a real stack with Docker Compose.

For this post, temporary is a feature: experiment freely, and when you're done, `docker stop pg-delphi && docker rm pg-delphi` leaves your machine exactly as it was before you started.

Takeaways

You just ran a production-grade database with one command, talked to it from Delphi with the tools you already know, and learned the one abstraction — the published port — that makes a containerized service feel local.

> A PostgreSQL server is now one `docker run` away, and reaching it from Delphi is ordinary FireDAC against `localhost:5432` — provided libpq rides along on the host. When you're done, `docker rm` and your machine is spotless.

Three things are worth carrying forward. First, `-p host:container` is *the* bridge — internalize that single flag and containers stop being mysterious. Second, from Delphi's side there's nothing new to learn: DriverID `PG`, standard FireDAC, one honest dependency (libpq, matched to your app's bitness). Third, the database is standard and open, so it welcomes Delphi, `psql`, DBeaver, or a Node backend with equal indifference.

One question is left hanging on purpose: where did that `postgres` image actually *come from*, and what is it made of? That's the subject of Part 3 — **images, tags, layers, and repositories** — the anatomy of the thing you pulled without a second thought. See you there.

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