splendiddata

Splendid Data white paper

Automated migration of Oracle® databases to PostgreSQL

Cortex highlights

This white paper is a working document that is subject to review and changes.
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Introduction

About Cortex

Cortex is the most sophisticated product available in the market to perform automated migration of your Oracle databases to native PostgreSQL. Our experts that built and continuously improving Cortex have in-depth technical knowhow of both Oracle databases and PostgreSQL as well as parser and compiler techniques.

Translation of the Oracle database Data Objects and Code Objects (PL/SQL to PL/pgSQL) is done semantically in relation to their context (including dependencies throughout the PL/SQL code). All other products in the market are mainly based on “find and replace” without any dependency checks throughout the PL/SQL code, which makes the overall automatic translation of these products unreliable and inefficient, and basically inappropriate to setup a larger scale migration of Oracle databases to PostgreSQL program/project.

Because we believe in database freedom, we always migrate Oracle databases to native PostgreSQL to avoid any vendor lock-in and to deliver maximum freedom of deployment on- premise and/or in the Cloud. Our Cortex product doesn’t leave a footprint behind, so there will be no vendor lock-in after using Cortex for a migration your Oracle database to PostgreSQL.

Some of our references that are convinced of what we promise and deliver

Migrating Oracle to native PostgreSQL

Cortex is developed with the aim of automating the migration from Oracle databases to PostgreSQL and providing as much flexibility as possible using settings to achieve the desired and accurate results.

In order to achieve the most accurate results, Cortex performs the translation of the Oracle database Data Objects and Code Objects (PL/SQL to PL/pgSQL) semantically in relation to their context (including dependencies throughout the code).

What does Cortex migrate to native PostgreSQL?

Tables and Columns (incl. defaults)
Constraints (incl. unique, primary key, foreign key, not null and check constraints)
Indexes (incl. function based)
Triggers (incl. before each row, after each row, compound etc.)
Partitions and subpartitions
Views and materialized views
Types (composite types, collection types and subtypes)
Synonyms (will be taken into account where applicable)
Sequences
PL/SQL (packages/package bodies, functions, procedures, global variables, global constants, etc.)
References to dblinked tables
Spatial and Geographic objects (Oracle Locator and Spatial to PostGIS)
XML
Merge statements
External SQL's
"connect by" queries
Old Oracle-style outer joins "(+)"

Cortex is available via container technology (e.g. OCIv2). Depending on the target version of PostgreSQL, starting at version 14 up to the latest release, a Cortex Image is available. From a Cortex Image a Cortex Runtime Container is created.

Cortex has graphical user interface to steer, influence and manage each Oracle to PostgreSQL migration.

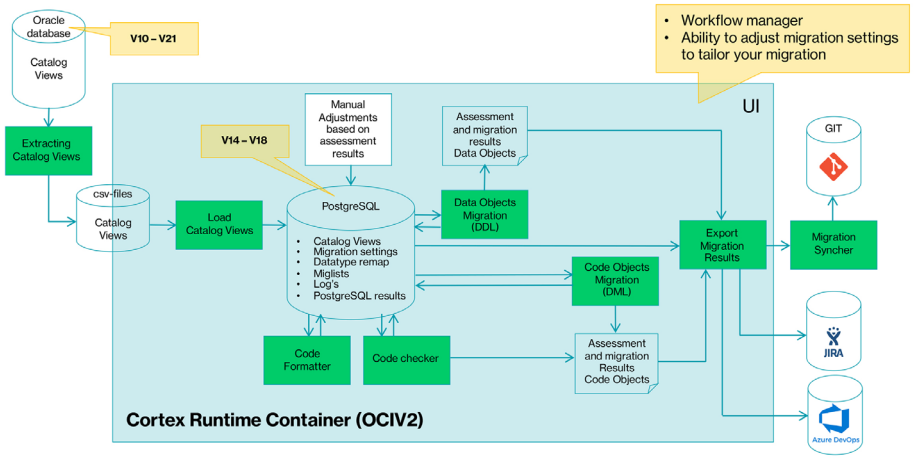
Benefits of using Cortex for Migrations of Oracle databases to PostgreSQL

- **Proven software** Our partners, clients and us are using Cortex to perform migrations of Oracle databases to native PostgreSQL.
- **Factory-based approach** A standardized and repeatable process.
- **Highly automated** In average 80% of the Oracle Code Objects (PL/SQL) will be automatically migrated to native PostgreSQL (PL/pgSQL) and in most cases all of the Oracle database Data Objects are fully automatic migrated to native PostgreSQL by Cortex.
- **Audit trail** Based on extensive logging and tracing, issue management and version management, it is always possible to keep track on what Cortex has done, which settings have been used, which changes have been made, what the source data (meta data) was and which manual adjustments need to be made.
- **Flexibility** Cortex has a lot of settings that can be set to “influence” the migration of both Oracle database Data Objects and Code Objects to the desired PostgreSQL implementation (for example: what to do with partitions/subpartitions, datatypes and datatype remapping, how to deal with synonyms, collection types etc.).
- **Supporting releases** Cortex gives you the ability to migrate Oracle databases v10 and higher to PostgreSQL v14, v15, v16, v17 and v18.
- **Saving time and money** Cortex highly automates the migration of an Oracle database to PostgreSQL and this makes it very effective and efficient. Automated migration of code is always performed uniformly and much less error prone. Ultimately, a much higher productivity is obtained, allowing more databases to be migrated in a much shorter time and at a much lower cost.
- **Lower costs** The target database PostgreSQL is open source, which means that there are no licence and maintenance costs. This implies considerable cost savings will occur now and in the future. Cost savings can accumulate to 80%-90% of what you are used to with Oracle.
- **No vendor lock-in** Cortex avoids any vendor lock-in and any technology push. All objects are migrated to native PostgreSQL and manual adjustments can be made using standard IDE tooling of choice, as part of the standard PostgreSQL DTAP environment. Cortex leaves no footprint behind.

Cortex Migration

How does it work?

Per Oracle database, which is going to be migrated to PostgreSQL, a Cortex Runtime Container is created (spinned). A container contains all the software components (incl. a PostgreSQL database) needed to perform a migration.



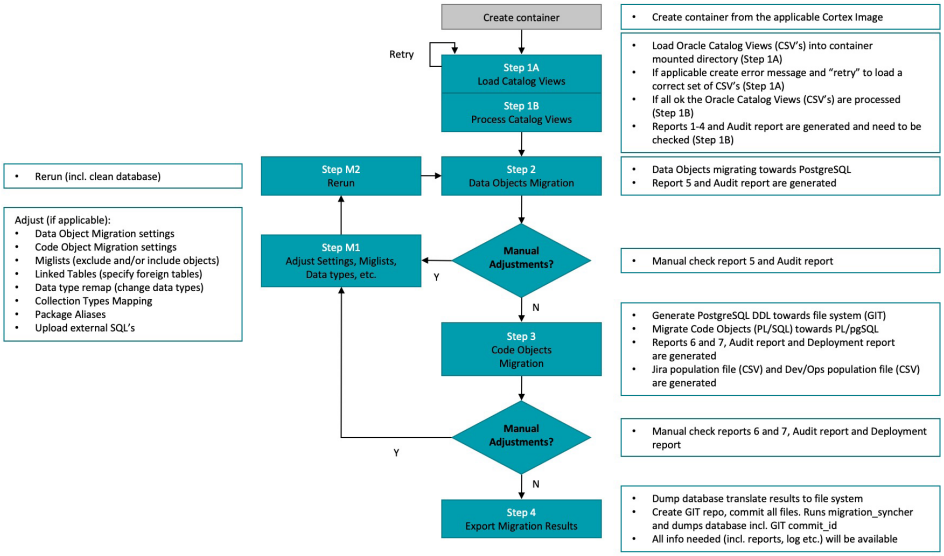
Cortex overview

The PostgreSQL database plays an important role in the container. This database is used to store the Catalog Views of the Oracle database to be migrated, all controls like migration settings, datatype changes (remaps), excluded objects and log data, as well results of the database migrated to PostgreSQL.

Software Components	Description
Extractor	Extracting the Oracle Catalog Views (DDL and DML) from the applicable Oracle database and creates csv-files
Loader	Loading the extracted Oracle Catalog Views (csv-files) into a PostgreSQL database
Migration Toolkit Interface	Steering the assessment and migration process of the DDL and DML related to the Oracle Catalog Views to PostgreSQL
Graphical User Interface	Managing Cortex Images and Containers, and steering the assessment and migration process incl. manual interventions (like: settings, miglists, datatype remap, etc.)
Data Objects Migrator	Assessment and migration of the DDL related Oracle Catalog Views to PostgreSQL
Code Objects Migrator	Assessment and migration of the DML related Oracle Catalog Views to PostgreSQL
Code Formatter	Based on an analysis of the syntax, it indents lines appropriately and squashes extraneous blank spaces and lines in order to produce more readable PL/pgSQL code. Open Source Software with Copyright owned by Splendid Data (https://github.com/splendiddata/pgcode_formatter).
Code Checker	Analyses PL/pgSQL code to flag programming errors, bugs, stylistic errors, and suspicious constructs. Open Source Software with Copyright owned by Pavel Stehule (https://github.com/okbob/plpgsql_check).
PostgreSQL	Target database used during the assessment and migration. Open Source software, MIT/PostgreSQL licensed
PostgreSQL extensions	All kinds of Open Source PostgreSQL extension to support the assessment and migration of the DDL and DML related to the Oracle Catalog Views to native PostgreSQL
Migration Syncher	Synchronizing PL/pgSQL code to GIT. Open Source Software with Copyright owned by Splendid Data (https://github.com/splendiddata/migration_syncher).

Cortex software components

The migration of an Oracle database consists of several steps that can be initiated via graphical interface or the command line interface.



Cortex workflow

Based on the various assessment/migration reports produced during the different steps, insight is gained into the extent to which the migration is automated. This information is valuable because it can be used to make adjustments (e.g. adjust a datatype because Cortex has found a foreign key mismatch, exclude certain objects before the migration, etc.) and/or to change settings used during the migration.

Once changes have been made, a rerun can be initiated. The migration results produced so far are deleted and based on the original Oracle database Catalog Views, the adjustments and the changed settings Cortex will rerun the previous step(s). This process can be repeated until the desired results are achieved. These results can be transferred to your own development environment to complete the migration to perform the manual adjustments. For issue management Cortex produces csv-files for Jira and Azure DevOps.

Cortex literally keeps track of everything (audit trail). It is always clear which settings have been used, what has been adjusted (like datatype remap), which object have been excluded, what went right, what went wrong and why did something went wrong.

Because Cortex takes dependencies between objects into account to an extreme degree, it is important to have a correct migration of the Oracle database Data Objects to PostgreSQL. Based on the reports provided it can be checked if specific adjustments are needed. The "better" the implementation of the Oracle database Data Objects to PostgreSQL is, the "better" the results of the migration of Oracle database Data Objects to PostgreSQL will be.

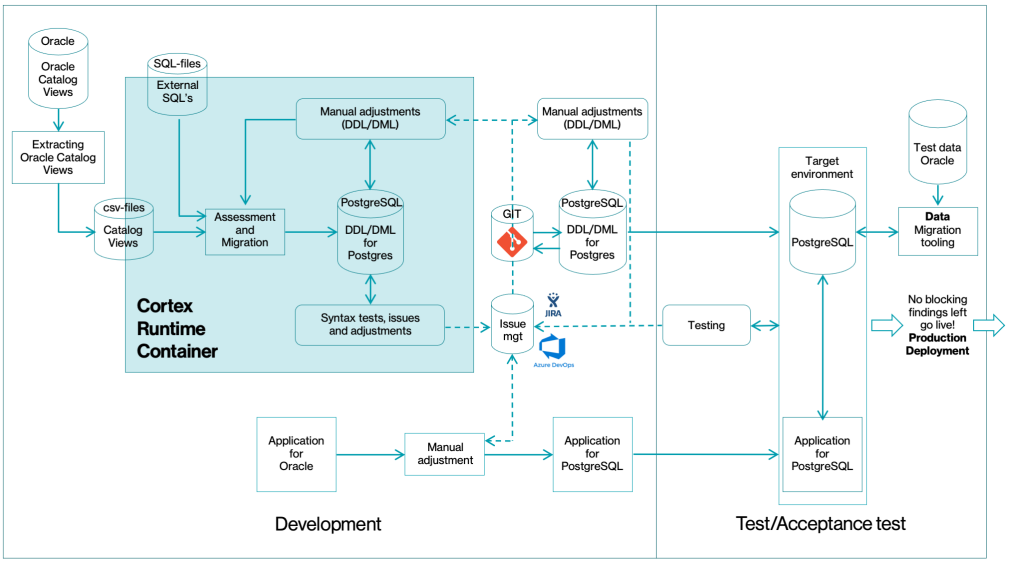
Continuous improvement and maintenance (Kaizen)

Given the many implementation occurrences of the Oracle database Data Objects and Code Objects, Cortex is continuously improved and maintained, and new Cortex releases will be provided frequently. This is done based on the usage of Cortex and finished migration programs/projects worldwide. Therefore, it is desirable that during the usage of Cortex there are contact moments on regular basis between the clients and partners (both users of the Cortex product) and Splendid Data to provide feedback to improve and maintain Cortex.

This continuous improvement process is based on Kaizen and iterates on the steps:

1. Find unexpected outcomes or problems
2. Create solutions
3. Test solutions
4. Analyse results
5. Standardise
6. Repeat previous steps

Project flow by using Cortex



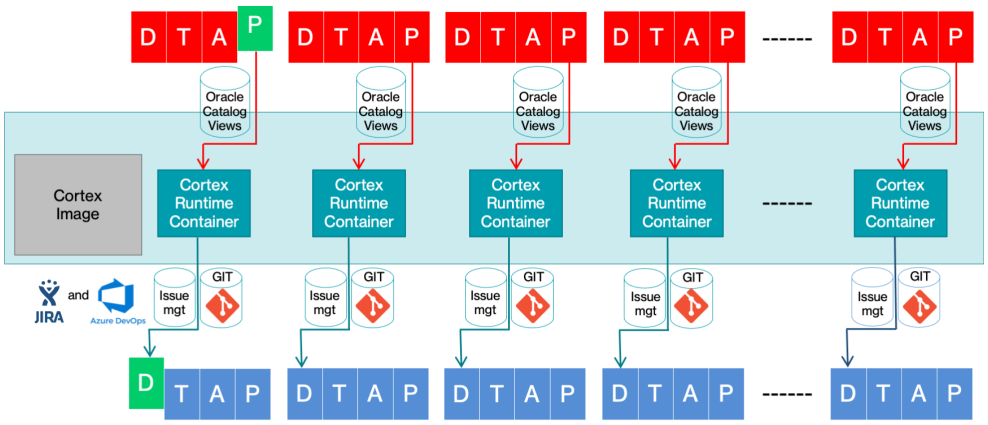
Standard project flow

Each migration of an Oracle database to PostgreSQL is a project on its own. After a migration performed with Cortex the results are available in GIT (version management) and the manual adjustments to be performed are available in Jira or Azure DevOps (issue management).

Besides the database, in almost any case, also the application using the database needs to be adjusted (outside the scope of Cortex). As soon as both database and application are finalized from a development point of view, the next steps like testing, acceptance/ performance test etc. need to be performed. At the stage where no blocking findings (issues) are left, the final step “production deployment” can start.

Using Cortex in a factory-based approach

For organisations that need to migrate a large number of Oracle databases to PostgreSQL a factory-based approach supported by the usage of Cortex is the only setup to do this in a controlled and unified way.



Cortex factory approach

From a Cortex Image the Cortex Containers are created (spinned). Each container has its own life-cycle. It always starts with uploading the meta data of the applicable Oracle database (production) to be migrated to PostgreSQL. As soon the meta data is available in the container the migration process can start. Always check the reports Cortex produces and use these reports to make adjustments and to change settings to end-up with the best migration results. After finalizing the migration you can transfer your results (incl. all reports) to your own development environment. After everything is transferred, the Cortex container can be stopped and removed.

Cortex promotes a highly standardized approach and it's possible to create an overall factory approach in different regions staffed with your own people and/or staffed with people of your preferred partner(s). Cortex allows running migrations in parallel to feed the different project teams. Cortex avoids any vendor lock-in and any technology push. All objects are migrated to native PostgreSQL and manual adjustments can be made using the IDE tooling of choice.

Additional services

Support

Splendid Data provides support during the use of Cortex Image(s) and the Cortex Runtime Container(s) and/or Software Components delivered by Splendid Data separately, in case of questions regarding the functioning.

Training workshops

Splendid Data provides specific training workshops regarding the use of Cortex in combination with specific hands-on knowledge, by providing insight into the differences between an Oracle database and PostgreSQL, in order to successfully perform the migration from an Oracle database to PostgreSQL.

Consulting services

If necessary or desired, the migration experts of Splendid Data can be hired for consulting to contribute to the successful migration of your Oracle databases to PostgreSQL.

Data migration

Test and acceptance test
Splendid Data can provide scripting to migrate test data from the Oracle database to the PostgreSQL migrated database based on the PostgreSQL extension Oracle_fdw (Foreign Data Wrapper).

Production deployment
Splendid Data can advise you on which tooling is best to use given the data volume, available downtime, deployment (on-premise, cloud managed etc.) and potential special circumstances to consider.

Contact

Ready to benefit from PostgreSQL by using Cortex?

Please feel free to contact us if you have any questions left or to setup a meeting for a demo of Cortex.

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About Splendid Data

Splendid Data was founded in 2013 and since then our focus has been purely on PostgreSQL and to pass on its benefits to our clients and partners.

Our specialist team that has many years of in-depth knowledge of Oracle databases and PostgreSQL, enabling us to build **PostgresPURE** – our 100% open source subscription-based software that makes the most of PostgreSQL. At the same time, we developed **Cortex**, our unique solution for the automated migration of Oracle databases (DDL and DML) to native PostgreSQL. And to give organisations a full overview of their Oracle database environments and its suitability for migration, we created **Migration Scoping**, a clever piece of software that takes out all the guess work of a potential migration to PostgreSQL.

We're proud to assist companies of all shapes and sizes to find their way to digital liberty, agility and the power of PostgreSQL. Get in touch today to start your journey to a world without Oracle databases.

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