

# Managing Multi-DBMS on Single UI, A Web-Based Spatial DB Manager

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## 1. Introduction

In developing business systems based on spatial data, sometimes, system developers experience troubles with DB administrators. The DB administrators take it odd that query results from spatial DB are not text-formatted, and they hardly understand spatial indices. And, the developers carry on the developments without general understanding about management of DBMS. Such misunderstandings about each fields mainly cause troubles between them. Spatial data is also a kind of well refined data and this means that it can be also saved in, managed in, and queried from DBMS like others. In practice, most of DBMS support spatial data and you can query it through SQL with complex conditions. So, if a DB-handling tool which DB administrators are familiar with can support effectively spatial queries and developers can use the same tool so that they can understand overall DB mechanism and make necessary spatial queries in developments easily, it will help both

groups collaborate with each other efficiently. And, major DBMS like Oracle, SQL Server, and etc, don't provide any tool to insert spatial data into the DB, so it even needs many steps of process to insert well-known formats of spatial data like ESRI Shape into the DB. In addition, you have to use suitable tools for each DBMS. These situations lay a tons of burden on both administrators and developers whenever multiple DBMS are necessary in a system or they should test on various DBMS. Tadpole SDM (Spatial DB Manager) is a tool, devised for both administrators and developers to manipulate DB efficiently. With Tadpole SDM, they can easily identify visually databases, tables, and columns in various DBMS like PostGIS, Oracle, SQL Server and etc, spatial distributions of data on maps, and query results of complex spatial queries. And, they can dump files of ESRI Shape into the DB and export spatial data in tables into files of SQL command set or ESRI Shape.

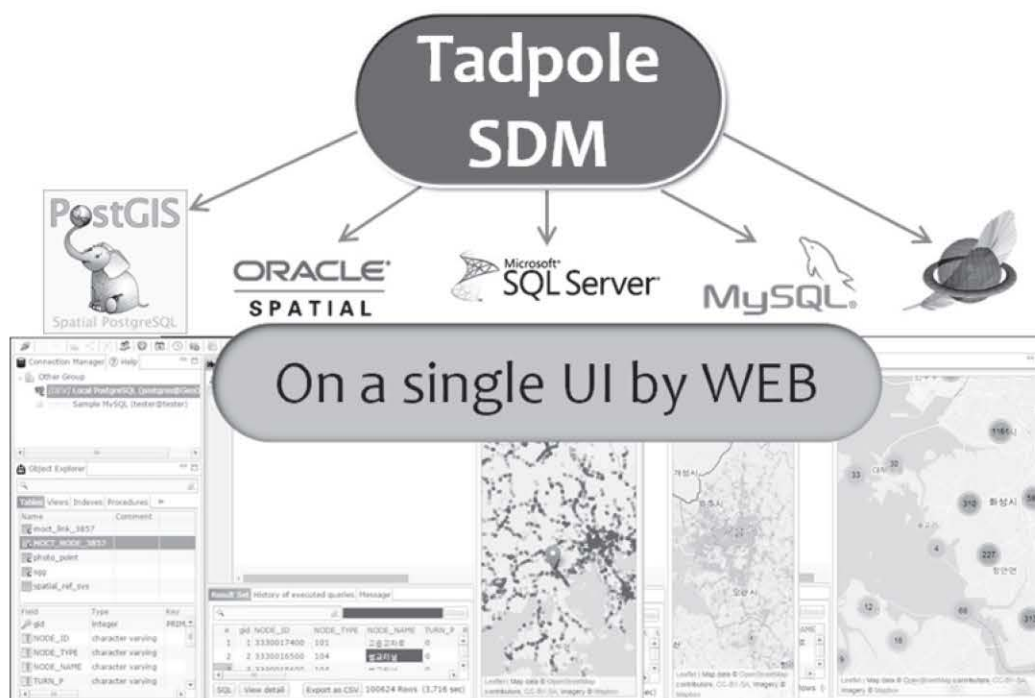


Figure 1: Tadpole SDM service concept

## 2. Current Features of Tadpole SDM

Tadpole SDM supports vector data management of following DBMS. Tadpole SDM marks clearly objects concerned with spatial data on DB Resource Tree UI.

- In the Connection Manager, "G" is added on a DB icon for spatial-data-supported DB.



- In the Object Explorer, "G" is added on an object icon for objects whose tables and columns have spatial data.



Tadpole SDM shows results of spatial queries on maps.

- Whenever any column of spatial data is in SQL made by users, a map window is activated and the query results are shown on it after they are arrived from the DB.
- It supports a mode of point cluster to identify spatial distributions of query results roughly.

- It supports a mode of heat map to identify spatial densities of query results.
- It supports a normal GIS mode to visualize results of spatial queries like other general GIS tools. This mode makes you be able to identify visually queried or trimmed spatial data like as through pgRouting without any GIS tool.

Tadpole SDM links tabular query results to those visualized on maps.

- When you select a row on the table of query results, the matched object on the map is highlighted to inform both are same.
- When an object is highlighted on a map, a balloon UI with attributes informations of it is turned on.

Tadpole SDM provides a tool to import and export of big-sized spatial data. (This function is being developed now.)

- ESRI Shape files can be imported into various DBMS like PostGIS, Oracle, and SQL Server through a unified UI.
- Contents in tables or queried results can be exported to files of ESRI Shape or SQL scripts so that they can be used in another tools or DBMS.

Table 1: DBMS support state

DBMS Name	Support version	Comment
PostgreSQL	v9.3 with PostGIS 2.x	
MS SQL Server	Tested on v2008	
Oracle	Tasted on v12c Enterprise	SDO_CS Package must exist

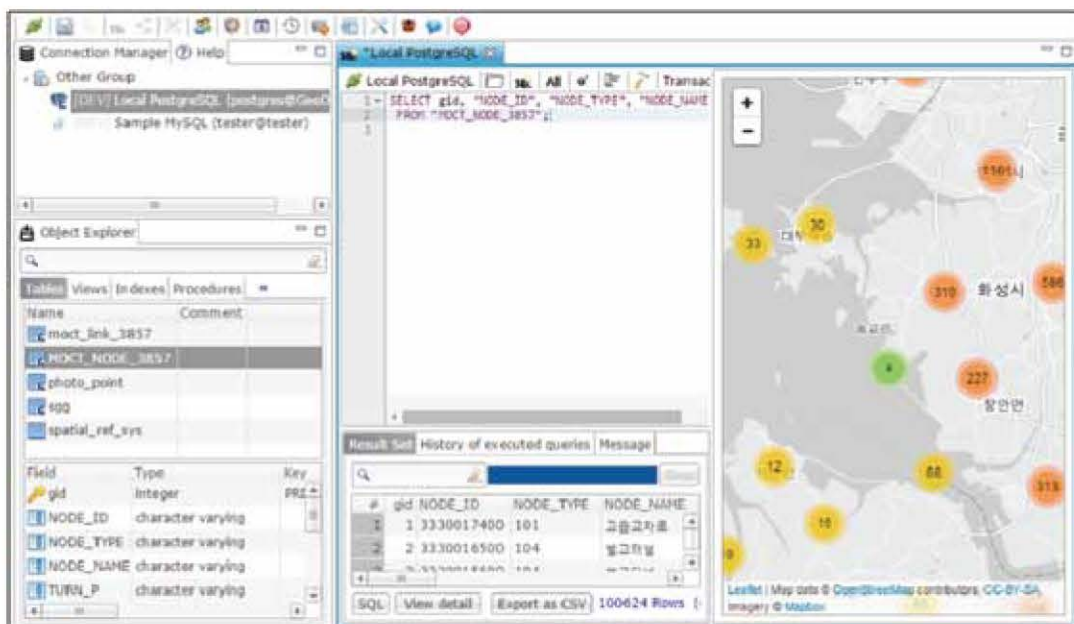


Figure 2: Point cluster mode

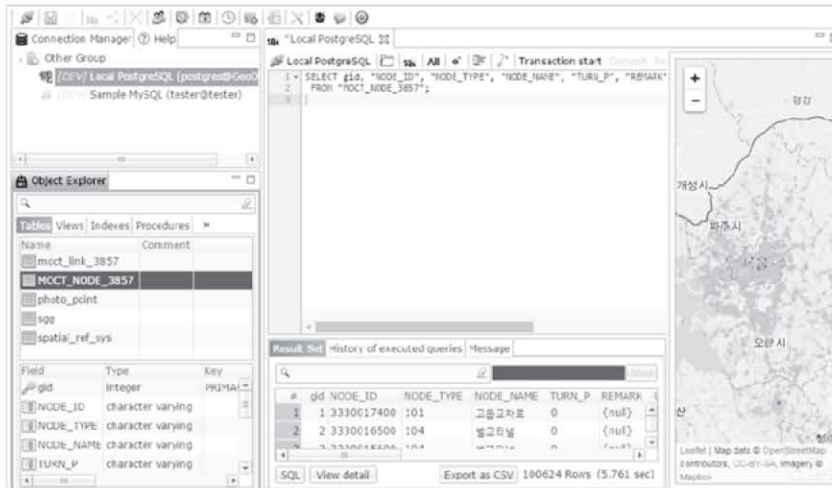


Figure 3: Heat map mode

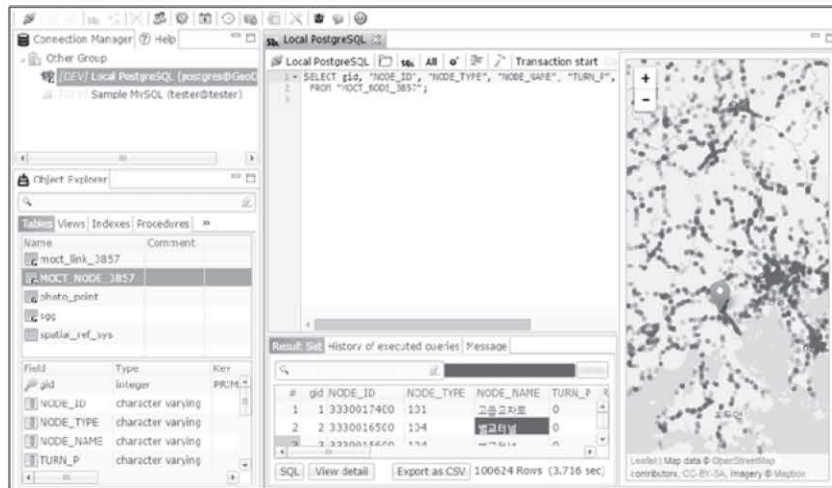


Figure 4: Normal mode

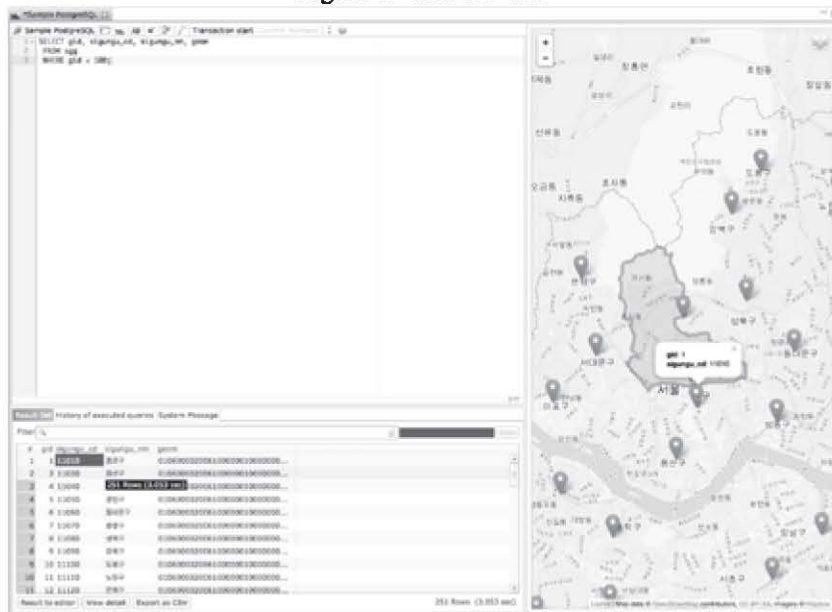


Figure 5: Linking of table row and feature



### 3. How was Tadpole SDM Developed?

Tadpole SDM is based on Tadpole DB Hub, an open source project, and developed with extending LeafletJS, also an open source project, to a map viewer. Tadpole DB Hub is a management tool running on web browsers for various DB. It provides functions for DB registration, queries for schema, edition and execution of PL/SQL, session management, execution of SQL queries, and so on like other general DB management tools. Besides, it provides a unified web-based UI for manipulations of various DBMS, that is, with a tool, you can handle heterogeneous DBMS as RDB like PostgreSQL, MySQL, MariaDB, Oracle, SQL Server, CUBRID, SQLite and etc, document-oriented DB like MongoDB, and SQL-on-Hadoop like Apache TAJO, Apache Hive and so on. Also you can handle cloud database on Amazon RDS (Relational Database System). There is another important meaning in the fact that Tadpole DB Hub is a web-based tool, beyond that it can run in web browsers. The core of it runs in server side, manages roles and authorities of each users, monitors queries to check if they lower performance of the server,

and if so, and sends warning to the administrator. Also it provides functions of audit and ERD on web environments. These server-oriented features enable efficient DB managements on cloud services like AWS (Amazon Web Service) increasing rapidly recently. It's expected that Tadpole SDM being developed on Tadpole DB Hub will be extended to handle spatial data services efficiently on cloud environments. The map viewer of Tadpole SDM uses canvas drawing extended from LeafletJS for fast map drawing. LeafletJS is a lightweight and well made map view control, and easy to be extended. L.GeoJSON. Canvas was extended from L.CanvasOverlay, L.GeoJSON. Heatmap was extended from HeatmapOverlay, and L.GeoJSON.Cluster was extended from Leaflet.markercluster. These three classes have the same interfaces as L.GeoJSON class. Extension points of Tadpole DB Hub were used to make queried results handed over to the map viewer. Tadpole DB Hub is built up on Eclipse RCP base, and set to be extended with Eclipse extension point.

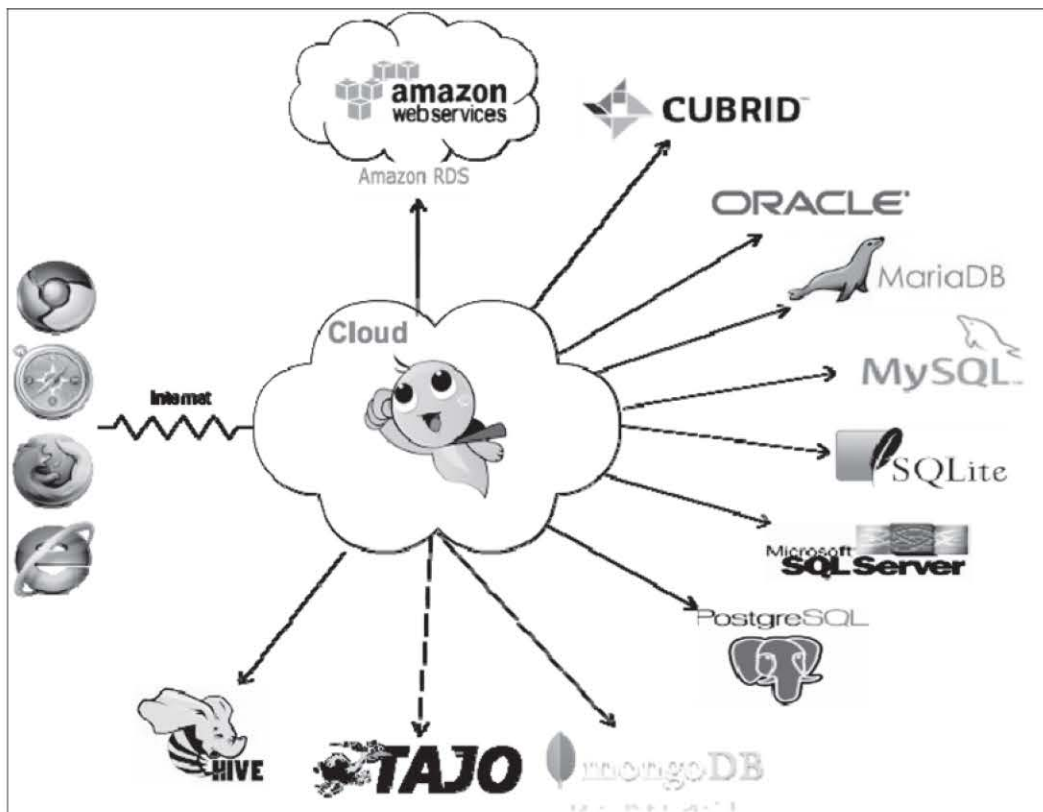


Figure 6: Tadpole DB Hub Service Concept

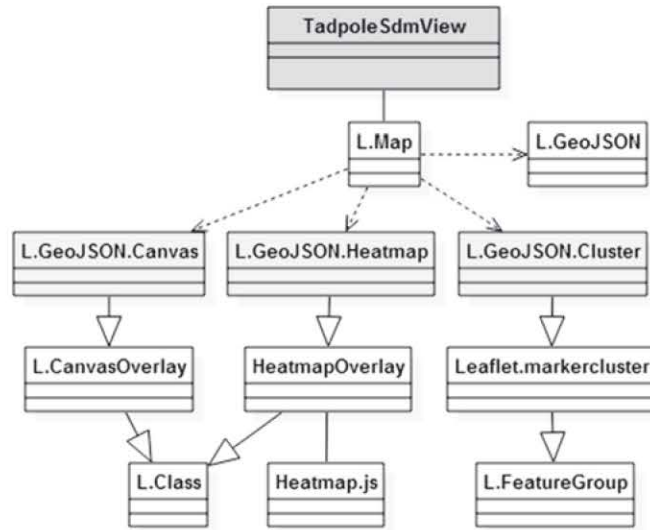


Figure 7: Tadpole SDM Map View Class Diagram

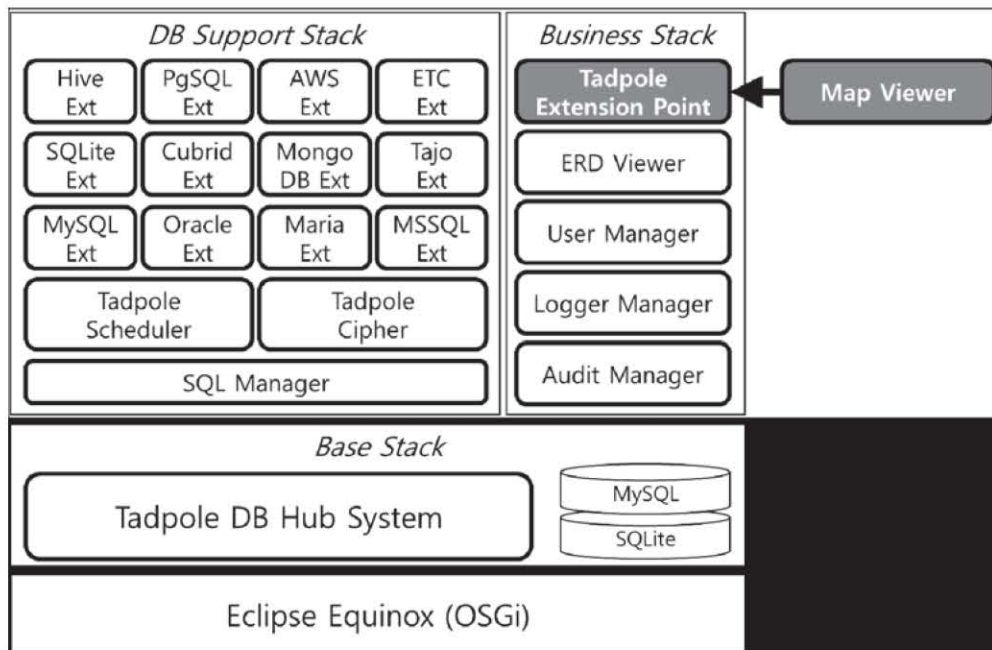


Figure 8: Tadpole SDM Architect

The function to query DB objects of spatial data and display them visually in Tadpole SDM is carried on through following processes.



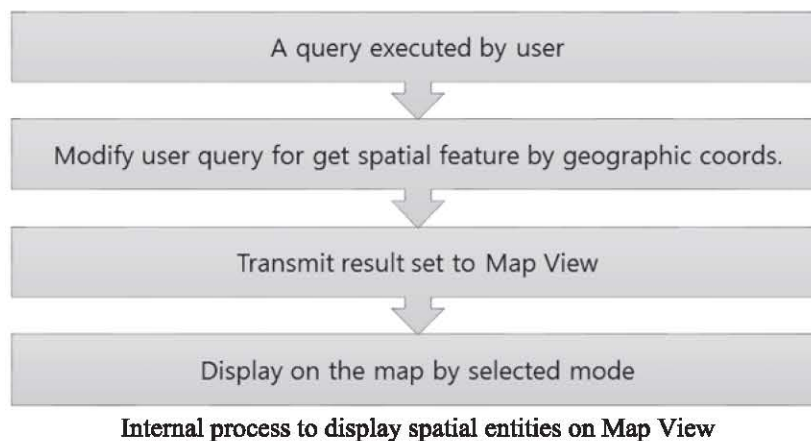
Internal process to display spatial DB object indicator

Take PostGIS, for example, some metadata are stored in the geometry columns view and Tadpole SDM retrieves information by executing the following query

```
SELECT
  f_table_catalog -- database catalog
  ,f_table_schema -- spatial table schema
  ,f_table_name -- spatial table name
  ,f_geometry_column -- spatial data column
  ,coord_dimension -- coord dimension
  ,srid -- ID of CRS
  ,type -- spatial data type(POINT, LINESTRING,... )
FROM
  geometry_columns;
```

The whole process from execution of a user query to expression of results on a map is following. To display spatial entities of various coordinate systems in DB, the query statements made by users are modified to unify coordinate systems of geometries in results into EPSG:4326 and formats of them into GeoJSON. For example, If the name of a table queried by a user is 'world\_cities' and that of a column which is a type of geometries, the query

statement made by the user over the whole entities in the table is modified into following automatically. The coordinate system of geometries in the results is changed by the function 'st\_transform' and the result format is changed into GeoJSON by the function 'st\_AsGeoJson'. The queried entities in GeoJSON are handed over to the map viewer based on LeafletJS and displayed on a map.



**Original user query:**

```
SELECT gid, city, latitude, country, rank, population, longitude, geom
FROM world_cities;;
```

**Automatically translated query by Tadpole SDM:**

```
SELECT *, st_AsGeoJson(st_transform(TADPOLESUB.geom, 4326)) as TADPOLE_HIDE_geom
FROM
  (SELECT gid, city, latitude, country, rank, population, longitude, geom
   FROM world_cities)
  as TADPOLESUB ;
```

#### 4. What is expected on Tadpole SDM?

Tadpole SDM supports only PostGIS, Oracle, and SQL Server as for now. It will be extended to deal with more or less than 8 DBMS including Spatialite and MySQL and query and display on a map raster

data in DB. In addition, as Tadpole DB Hub is proceeding to a SaaS (Software as a Service) which can manage cloud environments, Tadpole SDM will keep pace with it to do so.