Open Source Alternatives for Enterprise Databases[1]

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Abstract

In this paper are presented the proprietary database engines that are used in enterprise environment and are analyzed the open source alternatives that can be used by business critical applications. There are presented three open source database engines that are compared with the proprietary database engines using some key criteria and specifications.

Keywords: *Database, Microsoft SQL Server, Oracle DB,MySQL, PostgreSQL, MariaDB.*

ACM/AMS Classification: 68P15

1. *Introduction*

In the enterprise environment we need to rely on powerful and robust database engines to guarantee the consistency, security and performance ([9], [10], [11]) of the business critical applications that are running in very tough conditions, usually under high load pressure due to a high number of transactions. In real scenarios, only a few of the database engines were considered as high-quality to be used by the large companies from all the countries. According to the [1], in the top 3 popularity we have two well-known proprietary databases: Oracle DB and Microsoft SQL Server. Additionally to these, other Open Sources alternatives emerged and most important of these will be presented in this article.

Many companies were starting to add open source into parts of their software infrastructure considering that open source approach provides additional business ([12],[13],[14],[15],[16]) value, while keeping the costs under a precise control.

[1]Citation: Gura C., Iacob N.M., *Open Source Alternatives for Enterprise Databases*, "An. Univ. Spiru Haret, Ser. Mat.-Inform.", 12(2), pp. 11-17, 2016.

Generally speaking, Enterprise DB engines have to offer some key features such as:

- Data scheme;
- Relational DBMS;
- XML support;
- SQL support;
- APIs and other access methods;
- Server-side scripts;
- Triggers;
- Partitioning;
- Replication;
- Transaction concepts;
- Durability (data persistency).

2. ***Open source database engines***

Looking to the above mentioned database technical aspects there are three Open Source database engines alternatives that can be considered:

- **MySQL** (http://www.mysql.com) – Widely used open source RDBMS, having 2nd position in the rank from [1]. The license provided is either Open Source, but is also available an Oracle Commercial License if necessary. According with [3], examples of customers that are relying on MySQL databases are: NASA, US Navy, Netflix or Booking.com;

- **PostgreSQL** (https://www.postgresql.org/) – It is one of the most powerful database being placed on the 4th position, in general rank from [1], from more than 250 databases analyzed. PostgreSQL is having a BDS Open Source license, commercial support might be offered through 3rd party companies when necessary. According to [4], examples of customers that are using PostgreSQL databases are: U.S. State Department, U.S. Agency for International Development, IMDB.com, Apple or Cisco;

- **MariaDB** (https://mariadb.com/) – Is considered as "The Fastest Growing Open Source Database", as per their authors says. In the rank from [1] is placed on the 20th position with a continuous growing. MariaDB is a community-developed branch of the MySQL relational database management system intended to remain free under the GNU GPL, after Oracle acquired Sun Microsystems in 2010 [5]. As per [6] the following companies are relying on MariaDB: Google (for a part of development projects), Mozilla or Wikimedia Foundation (which run Wikipedia).

3. ***Technical features***

In order to understand and compare the technical features of the above mentioned enterprise graded relational databases, we developed the following sections:

3.1. **Operating system support**

Database Name	Windows OS	Linux OS	Unix OS
Microsoft SQL Server	Yes	Yes [8]	No
Oracle DB	Yes	Yes	Yes
MySQL	Yes	Yes	Yes
PostgreSQL	Yes	Yes	Yes
MariaDB	Yes	Yes	Yes

As we can see, all databases are able to run on the above mentioned operating systems, with only one exception, Microsoft SQL Server that is unable to run on Unix.

3.2. **Database data types**

Database Name	Integer	Floating Point	Decimal	String	Binary	Date/Time
Oracle DB	NUMBER	BINARY_FLOAT, BINARY_DOUBLE	NUMBER	CHAR, VARCHAR2, CLOB, NCLOB, NVARCHAR2, NCHAR, LONG (deprecated)	BLOB, RAW, BFILE, LONG RAW (deprecated)	DATE, TIMESTAMP (with or without TIMEZONE), INTERVAL
MySQL	TINYINT (8-bit), SMALLINT (16-bit), MEDIUMINT (24-bit), INT (32-bit), BIGINT (64-bit)	FLOAT (32-bit), DOUBLE (aka REAL) (64-bit)	DECIMAL	CHAR, BINARY, VARCHAR, VARBINARY, TEXT, TINYTEXT, MEDIUMTEXT, LONGTEXT	TINYBLOB, BLOB, MEDIUMBLOB, LONGBLOB	DATETIME, DATE, TIMESTAMP, YEAR
PostgreSQL	SMALLINT (16-bit), INTEGER (32-bit), BIGINT (64-bit)	REAL (32-bit), DOUBLE PRECISION (64-bit)	DECIMAL, NUMERIC	CHAR, VARCHAR, TEXT	BYTEA	DATE, TIME (with or without TIMEZONE), TIMESTAMP (with or without TIMEZONE), INTERVAL
MariaDB	TINYINT (8-bit), SMALLINT (16-bit), MEDIUMINT (24-bit), INT (32-bit), BIGINT (64-bit)	FLOAT (32-bit), DOUBLE (REAL) (64-bit)	DECIMAL	CHAR, BINARY, VARCHAR, VARBINARY, TEXT, TINYTEXT, MEDIUMTEXT, LONGTEXT	TINYBLOB, BLOB, MEDIUMBLOB, LONGBLOB	DATETIME, DATE, TIMESTAMP, YEAR

We observe that there are no major data types differences we are having between the observed databases, whether we are speaking about proprietary or Open Source databases.

3.3. **Database native features**

Database Name	ACID	Referential Integrity	Transactions	Locking	Unicode Support
Microsoft SQL Server	Yes	Yes	Yes	Yes (Row-level locking)	Yes
Oracle DB	Yes	Yes	Yes	Yes (Row-level locking)	Yes
MySQL	Yes	Yes	Yes	Yes (Row-level locking)	Yes
PostgreSQL	Yes	Yes	Yes	Yes (Row-level locking)	Yes
MariaDB	Yes	Yes	Yes	Yes (Row-level locking)	Yes

All five Enterprise Databases analyzed considered are sharing the same native features, without exception.

3.4. **Database data size limits**

Database Name	Maximum DB Size	Maximum Table Size	Maximum Row Size	Maximum columns/row	Maximum Clob/Blob Size
Microsoft SQL Server	524,272TB	524,272TB	8,060 bytes	1,024/30,000 (with sparse columns)	2GB
Oracle DB	Unlimited (4GB* block size per tablespace)	4GB * block size	8KB	1000	128 TB
MySQL	Unlimited	256TB (MyISAM), 64TB (Innodb)	64KB	4096	4GB
PostgreSQL	Unlimited	32TB	1.6TB	2501600 depending on type	1GB (inline)/ 4TB (pg_largeobject)
MariaDB	Unlimited	256TB (MyISAM), 64TB (Innodb)	64KB	4096	4GB

Even if almost unlimited DB Size are specific for all the five databases analyzed, few differences we are having on maximum limits. Before deciding to choose one specific database for our production system it is advisable do a double check on these details to avoid any challenges during implementation, especially in regards to the maximum number of columns per row.

3.5. **Database Indexes – other than basic B-/B+ tree**

For the database indexes support analyzed, the PostgreSQL Open Source database is placed in a superior position.

Database Name	R+/R- tree	Hash	Expression	Bitmap	Fulltext
Microsoft SQL Server	Spatial Indexes	Yes	Yes	Bitmap filter index for Star Join Query	Yes
Oracle DB	Yes	Cluster Tables	Yes	Yes	Yes
MySQL	MyISAM tables only	MEMORY, Cluster (NDB), InnoDB, tables only	No	No	MyISAM tables and, since v5.6.4 on InnoDB
PostgreSQL	Yes	Yes	Yes	Yes	Yes
MariaDB	Aria and MyISAM tables only	MEMORY, InnoDB tables only	PERSISTENT virtual columns only	No	Yes

3.6. **Database *SQL* core capabilities**

Database Name	Union	Intersect	Inner Joins	Outer Joins	Clobs and Blobs
Microsoft SQL Server	Yes	Yes	Yes	Yes	Yes
Oracle DB	Yes	Yes	Yes	Yes	Yes
MySQL	Yes	No	Yes	Yes	Yes
PostgreSQL	Yes	Yes	Yes	Yes	Yes
MariaDB	Yes	No	Yes	Yes	Yes

Similarly to the Database Native Features mentioned before, all five Enterprise Databases analyzed in this article are sharing the same values, with only two small exceptions for MySQL and MariaDB on *Intersect* capability (for a better clarity, the INTERSECT operator process the results of two queries and returns only rows that appear in both results – it removes duplicate rows from the final result).

3.7. **Database partitioning support**

Database Name	Range	Hash	List
Microsoft SQL Server	Yes	No	No
Oracle DB	Yes	Yes	Yes
MySQL	Yes	Yes	Yes
PostgreSQL	Yes	Yes	Yes
MariaDB	Yes	Yes	Yes

A partition is seen as a separation of a logical database or its constituent elements into distinct independent slices. Three modes of partitioning are frequently used:

- **Range** – choose a partition by determining if the partitioning key is inside a certain range. For example, in a telecom database, we could have a partition for all where the *phoneNumber* is taking a value between *40720000000* and *40729999999*;
- **Hash** – use a hash function to some attribute that produces the partition code;

- **List** – when we assign a list of values for a partition. If the partitioning key has one of these values, the partition is selected. For example, all rows where the column *carColor* is taking *Red*, *Green*, *White* values.

3.8. **Database objects support**

Database Name	Cursor	Trigger	Function	Procedure
Microsoft SQL Server	Yes	Yes	Yes	Yes
Oracle DB	Yes	Yes	Yes	Yes
MySQL	Yes	Yes	Yes	Yes
PostgreSQL	Yes	Yes	Yes	Yes
MariaDB	Yes	Yes	Yes	Yes

In the previous table, **function** and **procedure** columns refer to internal routines written in SQL or database procedural language such as *Transact-SQL* for example.

4. ***Conclusion***

After analyzing in details all five databases (two Proprietary and three Open Source) we can conclude that all of them are quite similar and are sharing almost the same features or limitations that are making them good enough to be used in enterprise environments to support different type of businesses.

Nowadays, Open Source software tends to be more stable, robust and secure, and usually has a better up-front cost. Most of the time however, using open source software, without 3rd party vendor support, means relying on your own resources for maintenance and support. Proprietary software in contrast, usually comes bundled with strong support options, depending on the commercial offer agreed with the vendor.

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