



ENTERPRISE OPEN SOURCE DATABASES

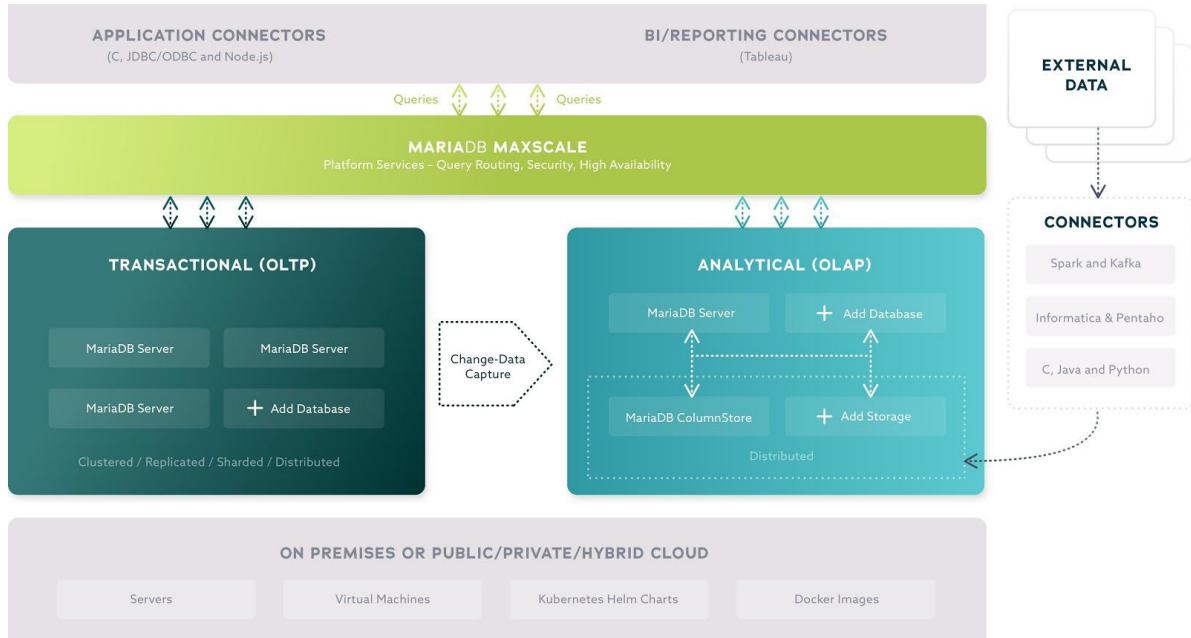
MariaDB vs. Oracle MySQL vs. EnterpriseDB

MARIADB PLATFORM



Transactions and Analytics, UNITED

MariaDB Platform is an enterprise open source database for transactional, analytical or hybrid transactional/analytical processing at scale. By preserving historical data and optimizing it for real-time analytics, all while continuing to process transactions, MariaDB Platform provides businesses with the means to create competitive advantages and monetize data – everything from providing data-driven customers with actionable insight to empowering them with self-service analytics.



MariaDB Server

MariaDB Server is the foundation of the MariaDB Platform. It is the only open source database with the same enterprise features found in proprietary databases, including Oracle Database compatibility (e.g., PL/SQL), temporal tables, sharding, point-in-time rollback and transparent data encryption.

MariaDB ColumnStore

MariaDB ColumnStore extends MariaDB Server with distributed, columnar storage and massively parallel processing for ad hoc, interactive analytics on hundreds of billions of rows via standard SQL – with no need to create and maintain indexes, and with 10% of the disk space using high compression.

MariaDB MaxScale

MariaDB MaxScale provides MariaDB Platform with a set of services for modern applications, including transparent query routing and change-data-capture for hybrid transactional/analytical workloads, high availability (e.g., automatic failover) and advanced security (e.g., data masking).

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INTRODUCTION



The role of open source software in modern infrastructure is expanding – the operating system, the middleware, and now, the database. In fact, many organizations are implementing open source mandates and/or strategic initiatives to evaluate open source software and limit the use of proprietary software. It reduces costs, supports the shift from capital expenses to operating expenses and enables enterprises to benefit from community collaboration and innovation.

The leading enterprise open source databases are MariaDB Platform (MariaDB), Oracle MySQL Enterprise (MySQL) and EnterpriseDB Postgres Platform (EnterpriseDB). However, when it comes to standardizing on an enterprise open source database, it is important to understand the differences both between the vendors and between the databases. The vendors have different business models while the databases have different architectures and features.

This white paper compares MariaDB, MySQL and EnterpriseDB. It begins with a comparison of business models and licensing strategies and then focuses on the following database features:

- Disaster recovery
- High availability
- Security
- Firewall
- Performance and scalability
- Development
- Oracle compatibility

Comparisons are based on MariaDB Platform X3, Oracle MySQL Enterprise 8 and EnterpriseDB Postgres Platform 11.

VENDOR COMPARISON

MySQL and EnterpriseDB follow an open core business model. MySQL Enterprise Edition extends MySQL with proprietary features (e.g., MySQL Enterprise Audit) and EnterpriseDB Postgres Platform extends PostgreSQL with proprietary features (e.g., hash partitioning). However, MariaDB Platform does not extend MariaDB Server with proprietary features.

MariaDB, MySQL and EnterpriseDB subscriptions include both open source and proprietary tools. However, for proprietary tools, MariaDB uses a Business Source License (BSL) that automatically converts to the General Public License (GPL) on a specific date. MariaDB MaxScale 2.1, for example, automatically converted from BSL to GPL on July 1, 2019.

In addition, whereas MySQL development is closed, MariaDB development is open and transparent, ensuring the community and customers have access to everything from test cases and security bugs to source code and road maps.

	EnterpriseDB	MySQL	MariaDB
Database: core	Similar to BSD/MIT	GPL	GPL
Database: enterprise features	Proprietary	Proprietary	GPL
Database: enterprise tools	Proprietary	Proprietary	BSL

PRODUCT COMPARISON

Disaster Recovery

The most basic disaster recovery plans specify off-site standbys and backup/restore processes. MariaDB, MySQL and EnterpriseDB all support off-site standbys with replication as well as full and incremental backups for point-in-time recovery (PITR) with backup and restore tools. However, while all three databases can perform online backups and restore them offline, only MariaDB supports online PITR by rolling back recent transactions (i.e., rewinding the database to a previous point in time).

	EnterpriseDB	MySQL	MariaDB
Point-in-time restore	BART	MySQL Enterprise Backup	Yes
> Non-blocking backups (including DDL)	Yes	No	Yes
> Incremental backups on primaries	Yes	Yes	Yes
> Incremental backups on replicas	No	Yes	Yes
Point-in-time rollback	No	No	MariaDB Flashback
Replication	Yes	Yes	Yes
> Delayed replication	Yes	Yes	Yes

High Availability

There are two common approaches to high availability: replication with automatic failover and multi-master clustering.

MariaDB, MySQL and EnterpriseDB all support replication, but only MariaDB and EnterpriseDB support replication with automatic failover. However, applications using EnterpriseDB will see all of their connections, sessions and in-flight transactions lost in the event of an automatic failover. MariaDB, on the other hand, includes advanced features to ensure automatic failover is completely transparent to applications – migrating connections to the new primary, restoring sessions and replaying any in-flight transactions.

In addition, while MariaDB and MySQL support true, multi-master clustering as well, EnterpriseDB does not. It is limited to asynchronous, bi-directional replication via EnterpriseDB Replication Server – itself a single point of failure. It can not only lead to data loss if a master fails before all changes have been replicated, it can lead to inconsistent data between multiple masters and the need for manual conflict resolution.

	EnterpriseDB	MySQL	MariaDB
Replication	Yes	Yes	Yes
Replication with automatic failover	Yes	No	Yes
> Connection migration	No	No	Yes
> Session restore	No	No	Yes
> Transaction replay	No	No	Yes
Multi-master clustering	No	Group Replication	MariaDB Cluster

Security

The security requirements for databases have increased. While encryption, authentication, authorization and auditing has long been considered the bare minimum, it is no longer enough. The frequency and severity of high-profile data breaches, and the introduction of new regulations (e.g., EU General Data Protection Regulation), has turned advanced data protection features into modern requirements.

Encryption

MariaDB, MySQL and EnterpriseDB all support encrypted connections. However, EnterpriseDB requires a restart in order to reload the SSL/TLS context (e.g., to change the SSL/TLS certificate). Further, whereas MariaDB and MySQL support encrypted tables, logs and backups, EnterpriseDB does not – a critical security gap. MariaDB, in addition, supports external key management with plugins for the AWS Key Management Service (KMS) and eperi Gateway for Databases.

	EnterpriseDB	MySQL	MariaDB
Encrypted tables	No	Yes	Yes
Encrypted logs	No	Yes	Yes
Encrypted backups	No	Yes	Yes
Encrypted connections (SSL/TLS)	Yes	Yes	Yes
> Reload SSL/TLS context	No	Yes	Yes
External key management	No	No	Yes

Authentication

MariaDB, MySQL and EnterpriseDB all support the most common authentication providers, including PAM and Kerberos/NTLM, as well as user/group mapping and password management. EnterpriseDB, in addition, supports SASL/SCRAM authentication.

	EnterpriseDB	MySQL	MariaDB
PAM authentication	Yes	Yes	Yes
LDAP authentication	Yes	Yes	Yes
Kerberos/NTLM authentication	Yes	Yes	Yes
SASL/SCRAM authentication	Yes	No	No
User/group mapping	Yes	Yes	Yes
Password expiration	Yes	Yes	Yes
Password validation (strength)	Yes	Yes	Yes
Account locking	Yes	Yes	Yes

*MariaDB supports LDAP authentication through PAM.

Authorization

MariaDB, MySQL and EnterpriseDB all support authorization with role-based access control (RBAC) and privileges. EnterpriseDB, in addition, supports row-level security while MariaDB and MySQL support user-resource limits (e.g., maximum number of queries and connections per hour).

	EnterpriseDB	MySQL	MariaDB
GRANT/REVOKE privileges	Yes	Yes	Yes
Roles	Yes	Yes	Yes
Row-level security	Yes	No	No
User resource limits	No	Yes	Yes

Auditing

MariaDB, MySQL and EnterpriseDB all support auditing, but with varying output formats. However, only MariaDB and MySQL support JSON templates for applying different rules/filters to different users.

	EnterpriseDB	MySQL	MariaDB
Audit log CSV format	Yes	No	Yes
Audit log XML format	Yes	Yes	No
Audit log JSON format	No	Yes	No
Audit log file output	Yes	Yes	Yes
Audit log syslog output	No	No	Yes
Audit log rule templates/filters	No	MySQL Enterprise Audit	MariaDB Enterprise Audit

Database and data protection

MariaDB and MySQL both have a comprehensive set of security features. However, only MariaDB supports dynamic data obfuscation for anonymization and dynamic data masking for psuedoanonymization – features necessary to protect sensitive and/or personally identifiable information (SPI/PII).

Note

MySQL Enterprise includes masking functions, but it is up to the application developer to use them, and thus optional. With MariaDB and EnterpriseDB, dynamic data masking is configured by the database administrator and is automatically applied before query results are returned.

	EnterpriseDB	MySQL	MariaDB
Dynamic data masking	Yes	No	MariaDB MaxScale
Dynamic data obfuscation	No	No	MariaDB MaxScale
Database firewall	SQL/Protect	MySQL Enterprise Firewall	MariaDB MaxScale
Query throttling	No	No	MariaDB MaxScale
Result limiting	No	No	MariaDB MaxScale

Firewall

MariaDB, MySQL and EnterpriseDB all include a database firewall, necessary to prevent unauthorized and/or unintended access to data, whether it is from internal bad actors or external attacks. MariaDB includes the world's most advanced database firewall (part of MariaDB MaxScale). While MySQL Enterprise Firewall and EnterpriseDB SQL/Protect are limited to whitelisting specific queries (MySQL) or queries on specific tables (EnterpriseDB), MariaDB enables administrators to whitelist or blacklist queries based on syntax.

	EnterpriseDB	MySQL	MariaDB
Query whitelisting	Yes	Yes	Yes
Query blacklisting	No	No	Yes
Query blocking	Yes	No	Yes
> Unbounded queries	Yes	No	Yes
> Queries with a tautological WHERE clause	Yes	No	No
> Specific query	No	No	Yes
> Type (e.g., DELETE)	No	No	Yes
> DDL	Yes	No	Yes
User-defined rules	No	No	Yes
> Query on specific table(s)	Yes	No	Yes
> Query on specific column(s)	No	No	Yes
> Query using specific function(s)	No	No	Yes
> Query using functions on specific column(s)	No	No	Yes
> Query with a wildcard (*)	No	No	Yes
> Query at time	No	No	Yes
Apply to every user/role	No	No	Yes
Apply to specific user/role	Yes	Yes	Yes

Performance and Scalability

MariaDB and MySQL implement a multi-threaded architecture to scale performance with the number of cores/processors. EnterpriseDB is limited by a process-based architecture, but it can use multiple processes to parallelize parts of queries.

However, only MariaDB improves scalability and performance using an advanced database proxy and multiple, purpose-built storage engines. The advanced database proxy can cache query results, route reads and writes to separate database nodes (i.e., read/write splitting) and convert a sequence of inserts within a transaction into a single data stream (i.e., bulk insert streaming). In addition, MariaDB supports general-purpose storage for mixed read/write workloads, write-optimized storage for write-intensive workloads and distributed storage (i.e., transparent sharding) for workloads requiring high scalability and/or concurrency.

	EnterpriseDB	MySQL	MariaDB
Multi-threaded architecture	No	Yes	Yes
SSD-optimized storage (i.e., LSM tree)	No	No	MyRocks
Partitioning	Yes	Yes	Yes
Sharding	No	No	Spider
Table/row compression	No	Yes	Yes
Column compression	Partial	No	Yes
Log compression	Yes	No	Yes
Query parallelization	Yes	No	No
Query result caching	No	No	MariaDB Maxscale
Read/write splitting	Yes	No	MariaDB Maxscale
Causal reads	No	No	MariaDB Maxscale
Bulk insert streaming	No	No	MariaDB Maxscale
Replication server	EnterpriseDB Replication Server	No	MariaDB Maxscale

Development

A database not only has to meet operational requirements (e.g., availability and security), it has to meet the requirements of developers, both new (e.g., JSON) and existing (e.g., stored procedures). It has to support faster development of web, mobile and IoT applications and services while at the same time supporting the maintenance of existing enterprise applications.

MariaDB, MySQL and EnterpriseDB all support JSON and geospatial functions, but only MariaDB and EnterpriseDB have broad support for standard ANSI SQL – everything from set operators and table value constructors to user-defined aggregate functions and out-of-the-box ordered-set aggregate functions.

Schema

	EnterpriseDB	MySQL	MariaDB
Dynamic columns	Yes	No	Yes
Virtual columns	No	Yes	Yes
Array columns	Yes	No	No
Invisible columns	No	No	Yes
Default value expressions	Yes	Yes	Yes
Check constraints	Yes	Yes	Yes
Multiple triggers per type and event	Yes	Yes	Yes

SQL

	EnterpriseDB	MySQL	MariaDB
Set operators (including INTERSECT/EXCEPT)	Yes	No	Yes
Common table expressions	Yes	Yes	Yes
Table value constructors	Yes	No	Yes
Window functions	Yes	Yes	Yes
User-defined aggregate functions	Yes	No	Yes
Ordered-set aggregate functions	Yes	No	Yes
JSON functions	Yes	Yes	Yes
GIS functions	Yes	Yes	Yes

Temporal

Temporal tables enable applications to query data that changes over time based on transaction time (defined by the database) and/or valid time (defined by the application). For example, transaction time can be used to look up an employee's salary last October while valid time can be used to look up an employee's salary next month after their raise takes effect.

MariaDB is the only other relational database besides Oracle Database to fully support temporal tables, though unlike Oracle Database, it does so with standard ANSI SQL.

	EnterpriseDB	MySQL	MariaDB
System-versioned tables	No	No	Yes
> FOR SYSTEM_TIME AS OF	No	No	Yes
> FOR SYSTEM_TIME BETWEEN/AND	No	No	Yes
> FOR SYSTEM_TIME FROM/TO	No	No	Yes
> FOR SYSTEM_TIME ALL	No	No	Yes
> DELETE HISTORY	No	No	Yes
Application-time period tables	No	No	Yes
> FOR PORTION OF FROM/TO	No	No	Yes
Bitemporal tables	No	No	Yes

Stored procedures

	EnterpriseDB	MySQL	MariaDB
Anonymous blocks	Yes	No	Yes
%TYPE and %ROWTYPE variables	Yes	No	Yes
TYPE IS RECORD variables	Yes	No	No
Dynamic SQL (EXECUTE IMMEDIATE)	Yes	No	Yes
Associative arrays (IS TABLE OF)	Yes	No	No
Cursors without arguments	Yes	Yes	Yes
Cursors with arguments	Yes	No	Yes
Packages	Yes	No	Yes

Oracle Compatibility

With enterprise open source databases having matured, organizations are in the process of migrating off of Oracle Database. Oracle Database compatibility not only simplifies the process, it reduces migration costs and time and enables DBAs and developers to continue applying the Oracle Database knowledge they have learned.

MariaDB and EnterpriseDB support Oracle PL/SQL, sequences, dynamic SQL (i.e., EXECUTE IMMEDIATE) and packages. MySQL has no plans for Oracle compatibility, though it is an Oracle product and Oracle Database is Oracle's flagship product.

	EnterpriseDB	MySQL	MariaDB
Packages	Yes	No	Yes
PL/SQL stored procedures/functions	Yes	No	Yes
Sequences	Yes	No	Yes
Dynamic SQL	Yes	No	Yes

Hybrid Transactional/Analytical Processing

With analytics having become a competitive differentiator in every industry, its use is expanding beyond business intelligence and data science to the applications used for online customer engagement. These applications, though transactional, must incorporate powerful, real-time analytics in order to provide data-driven customers with more information, actionable insight and greater value – leading to the need for hybrid transactional/analytical processing (HTAP).

However, relational databases limited to row storage and optimized for transactional processing can no longer keep up with the analytical demands of modern applications. To overcome this limitation, databases must use both row and columnar storage in order to perform both transactional and analytical processing at scale – and MariaDB is the only open source relational database to do so.

MariaDB uses InnoDB and/or MyRocks for row storage and transactional processing, and ColumnStore for distributed, columnar storage and massively parallel analytical processing. It then replicates data from row storage to columnar storage and routes queries to one or the other depending on whether they're transactional or analytical – and it's all transparent to applications.

	EnterpriseDB	MySQL	MariaDB
Distributed, columnar storage	No	No	Yes
Massively parallel processing	No	No	Yes
Spark connector	No	No	Yes
Kafka consumer	No	No	Yes
Query routing (HTAP)	No	No	Yes

CONCLUSION



MariaDB Platform (MariaDB), Oracle MySQL Enterprise Edition (MySQL) and EnterpriseDB Postgres Platform (EnterpriseDB) are the leading enterprise open source databases. However, these databases have different architectures and unique features, and their vendors have various business models.

MySQL and EnterpriseDB include proprietary features in their databases, MariaDB does not. In addition, MariaDB development is open and transparent, leading to collaboration with innovators like Alibaba, Facebook, Google and Tencent. While all three vendors develop proprietary tools, MariaDB uses a Business Source License, guaranteeing they become open source.

MariaDB, MySQL and EnterpriseDB have competitive disaster recovery and high availability features. However, MariaDB has the most comprehensive set of security features, and the most advanced database firewall.

MariaDB and EnterpriseDB have a comprehensive set of development features, more than MySQL, but only MariaDB and EnterpriseDB have Oracle compatibility.

When it comes to standardizing on an enterprise open source database, MariaDB is the clear winner. It provides the best of both worlds.



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