



MySQL Enterprise Edition on Amazon EC2 vs Amazon RDS

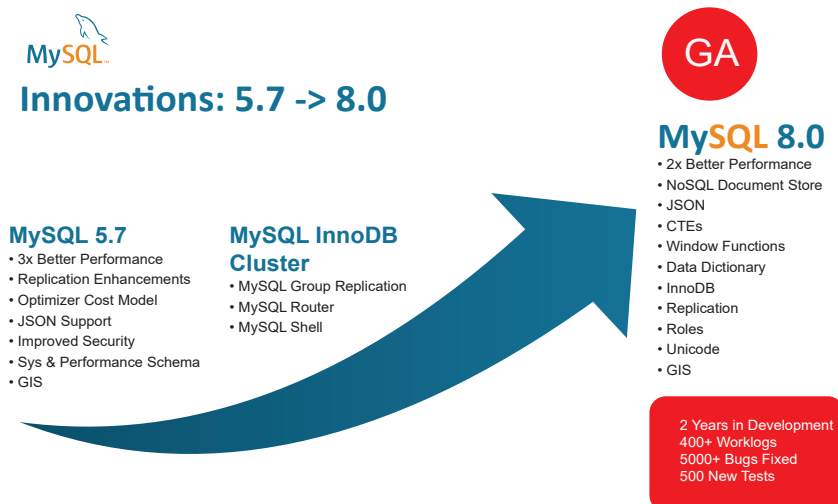
EXECUTIVE SUMMARY

Your organisation has made a conscious decision to move to a public cloud provider. So the decision now, is should we choose a 'Database-as-a-Service' (a forked version of MySQL on RDS) or run MySQL Enterprise Edition on 'Infrastructure-as-a-Service' (EC2)? This paper looks at the two options and discusses the risks and benefits.

TOP REASONS		Oracle MySQL EE on EC2	Amazon RDS
Freedom	You can select the MySQL version of your choice	✓	✗
No Proprietary Lock-in	You can get your data out with a matching version of MySQL	✓	✗
Hybrid Development	You can synchronize MySQL cloud version with your on premise version	✓	✗
Backup Data Corruption Checks	Critical backup corruption checks that speed up recovery time	✓	✗
Patching and Updates	Product updates with MySQL point releases	✓	✗
Security Control	You can continue to enforce your own data security policies	✓	✗
Performance Tuning Control	You will have full control over the database configuration for performance management	✓	✗
Leverage your DBAs	Your current team of DBAs can use its expertise to manage on premise and EC2	✓	✗

So what is MySQL?

MySQL is the world's most popular open-source database. With its proven performance, reliability and ease-of-use, MySQL has become the leading database of choice for web-based applications, used by high profile web properties including Facebook, Twitter, YouTube, Yahoo! and many more. Oracle ownership provides the largest MySQL engineering and support organization, drives MySQL innovations that result in new capabilities to power the next generation web, cloud, mobile and embedded applications.



So What is Amazon Relational Database Service (Amazon RDS)?

Amazon Relational Database Service (Amazon RDS) is a web service that makes it easier to set up, operate, and scale a relational database in the cloud. It provides cost-efficient, resizable capacity for an industry-standard relational database and manages common database administration tasks.

With RDS, Amazon takes over many of the difficult or tedious management tasks required for a relational databases - such as backups, software patching, automatic failure detection and recovery. However, to deliver this managed service experience, Amazon RDS does not provide shell access to the underlying operating system and limits access to certain system procedures / tables that require advanced privileges within the database itself.

So What is Amazon EC2?

Amazon Elastic Compute Cloud (Amazon EC2) provides scalable computing capacity in the Amazon Web Services (AWS) cloud. Using Amazon EC2 eliminates the need to invest in hardware up front, so you can develop and deploy applications faster. You can use Amazon EC2 to launch as many or as few virtual servers as you need, configure security, networking and manage storage. Amazon EC2 enables you to scale up or down to handle changes in requirements or spikes in popularity, reducing your need to forecast traffic.

With EC2, you have to deploy your own MySQL software on the platform. This is not provided, configured, supported or managed by Amazon.

Considerations for RDS vs EC2

It's important for companies/organisations to have a very good understanding of their internal IT systems, platforms, development and support teams. If they have large, mature systems with hard or even regulated requirements with a group of experienced DBA's to look after these, then moving to a managed service will most probably be a bad choice. On the other hand, if they're a startup or designing a new system without many (or any) experienced Database Administrators (DBA's), a managed service will probably be a serious consideration.

The pros to using RDS are it's obvious ease of deployment, flexible usage, horizontal (read) scaling and the fact that users don't need as much internal competence - as a lot of this is taken care of for you.

A drawback in RDS is that it normally costs companies more in the long term. This is because users do not have full access controls and are restricted to operating above an abstraction layer (where they can't control the OS for instance). This results in certain critical aspects of the solution being closed or disabled. When things go wrong, companies require expertise in MySQL to understand what is going on. They are not able to actually see the database analytics, this therefore contributes towards operational complexity. If the solution is mission-critical or a high-performance system is operating 24x7, the fact that backups and patching windows are controlled by RDS will result in major difficulties.

So, a trade off on flexibility and operational control for ease of deployment without DBA's may not be so cost effective in the long-term and a DBA team may be required anyway. Also, it's not that hard for a DBA team to create automatic deployment code for databases on IaaS and in that scenario. Effectively, customers will be able to get the best of both worlds.

Huge consideration needs to be made when considering moving any mission critical systems to RDS as that choice could result in situations where the companies find themselves restricted by inflexibility and unable to make fundamental modifications when using the solution.

Taking a prepackaged database to IaaS instead, provides much more flexibility and control.

MySQL is the same in Amazon RDS as it is in Amazon EC2 right?

No, RDS is a fork of MySQL (A **fork** is a modified version of the original code that is not supported by the original code maker). It does not use the complete set of features of MySQL. Furthermore, the MySQL Enterprise Edition is not available on RDS. Amazon RDS doesn't currently support the following MySQL features:

- MySQL Enterprise Authentication
- MySQL Enterprise TDE
- MySQL Enterprise Encryption
- MySQL Enterprise Masking
- MySQL Enterprise Firewall
- MySQL Enterprise Audit
- MySQL Shell
- MySQL InnoDB Cluster
- MySQL Document Store

As a result of these missing features, you cannot:

- Leverage the MySQL Document Store functionality (cannot load the X Plugin).
- Leverage The MySQL high end High Availability option with InnoDB Cluster or semi-sync replication.
- Leverage the MySQL security features. There are weaknesses around security since RDS does not allow you to load Oracle MySQL security plugins and they do not allow Oracle MySQL open-source plugins for password validation.

In addition, you are bound to the MySQL version Amazon can support, you cannot decide the specific versions you want to run or when to upgrade to the next version. Also, you have no control over configuration nor can you use "set persist" to configure your MySQL instances.

MySQL Database Support

As stated above, Amazon RDS uses a forked version of the MySQL Community Edition's free open-source database. This may be fine for non-mission critical development projects, but support for the Amazon RDS environment does not include support for the MySQL engine. Customers are completely reliant on Amazon for MySQL version and patch upgrades for the database engine in the RDS environment. As a consequence, Amazon RDS can only suggest workarounds for any bugs that are discovered in MySQL as they have no commercial support relationship with Oracle MySQL for the database engine. Any hot fixes that you are entitled to as a MySQL supported customer are not deployable in RDS. Bugs are fixed only once (it is fixed in Oracle MySQL's open-source version *and* if Amazon decides to adopt this release in RDS).

Restriction of services on Amazon RDS

As RDS is a Relational Database Service and Amazon controls what features are available and when to add new features. Although Amazon may have all the security accreditations you would expect from any Public Cloud provider, the lack of control of which features to enable in Amazon RDS is a security risk within itself. For regulated industries, especially in the Public Sector, there are mandates to only enable features that are required, and thus limiting the size of the attack surface for security threats and breaches.

MySQL Enterprise Backup Data Corruption Checks

Backing up a file system by copying block for block from one storage device to another will at best provide a mirror image of the original data. It does not guard against the corruption of data. For example if the data being copied is corrupted then the copy will include that corruption.

MySQL Enterprise Backup provides 'checksum' data integrity/corruption checks before the commitment of the data to an archived state. MySQL Enterprise Backup which is not available in the community edition, the forked Amazon RDS version or any other Amazon overlay service.

By having this check, data corruption issues can be caught early and corrected so ensuring the integrity of the backup. Business owners and DBAs can then be confident that their data can be restored (in part or in whole).

Cross Cloud Development Issues

Another challenge when using forked versions of MySQL such as RDS is that they differ from any on-premise setup and have no consistency between different cloud vendors. Any cross cloud development will require both internal development and operational teams to be aware of these differences. If deploying MySQL in a hybrid environment (on premise and at different cloud vendors), it would be advised to also uniform any deployment using the same release / tools. By using EC2 (or similar IaaS platforms) and orchestrating/installing MySQL using for example Ansible or using Docker environments, all your MySQL installations will be the same.

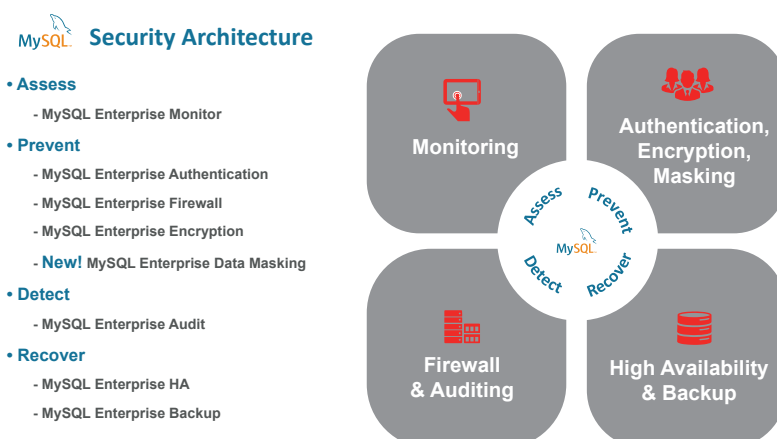
How up-to-date is Amazon RDS with current versions of Oracle MySQL?

Security and best-in-class performance requires staying on top of the available patch updates of any software. However at the time of this writing (May 2019) RDS minor versions of MySQL differ by up to 10 months (MySQL 8.0 - 3 months, MySQL 5.7 - 4 months, MySQL 5.6 - 10 months, MySQL 5.5 - 10 months). This exposes applications to security risks, which can be avoided by using MySQL Enterprise Edition on EC2.

How does MySQL Enterprise Edition satisfy Regulatory Compliance Requirements like GDPR, PCI, etc?

Many organizations struggle to achieve compliance with the ever increasing number of regulatory requirements and data privacy acts such as GDPR, PCI, HIPPA and many more. MySQL Enterprise Edition provides a powerful suite of tools to help meet these compliance requirements. These requirements can be organized into 4 main categories:

- **Assess:** Use MySQL Enterprise Monitor to identify security vulnerabilities such as weak password policies.
- **Prevent:** Tools to create a resilient database infrastructure and implement the appropriate safeguards such as encrypting data at rest and in motion,
- **Detect:** MySQL Enterprise Audit helps organizations to identify who accessed what information to aid in the timely discovery of cybersecurity events.
- **Recover:** MySQL Recover restores normal operations to help reduce the impact from a cybersecurity event.

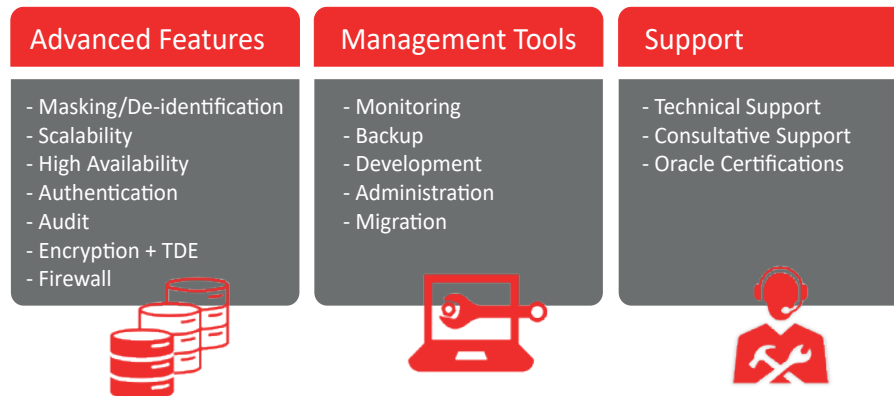


What's the benefit of running MySQL Enterprise Edition on Amazon EC2?

With many millions of active installs, MySQL Enterprise Edition is the commercial version of the leading open source database solution behind most of today's web applications. It is fast, reliable, easy to use, and runs on a broad range of platforms. MySQL Enterprise Edition includes the most comprehensive set of advanced features, management tools and technical support so customers can achieve the highest levels of MySQL scalability, security, reliability, and uptime. It reduces the risk, cost, and complexity in developing, deploying, and managing business-critical MySQL applications.



The highest levels of MySQL Performance, Security & Uptime



What MySQL Enterprise Edition includes:

MySQL Enterprise Backup

MySQL Enterprise Backup performs online, non-blocking backups of your MySQL databases. Perform full, incremental and partial backups for all InnoDB data while MySQL is fully available for transactional operations. All backup operations are executed in parallel for quick results and also support compression options that reduce the size of backup images by 90%. Recovery options include backward compatible full recovery, precise one-click, point-in-time recovery and partial recovery for restoring a specific set of objects.

MySQL Enterprise High Availability

MySQL Enterprise High Availability enables you to meet the availability requirements of even the most demanding, mission-critical applications. MySQL InnoDB Cluster delivers an integrated, native, HA solution for your databases using MySQL Servers with Group Replication, MySQL Router and MySQL Shell. It leverages proven MySQL features including InnoDB, GTIDs, binary logs, multi-threaded slave execution, multi-source replication and Performance Schema. A MySQL InnoDB Cluster can be set up in less than five minutes and managed using the scriptable AdminAPI in the MySQL Shell.

MySQL Enterprise Scalability

MySQL Enterprise Scalability enables you to meet the sustained performance and scalability requirements of ever increasing user, query and data loads. MySQL Thread Pool provides an efficient thread-handling model, designed to reduce overhead in managing client connections and statement execution threads.

MySQL Enterprise Authentication

MySQL Enterprise Authentication provides ready to use external authentication modules to easily integrate with existing security infrastructures including Linux Pluggable Authentication Modules (PAM) and Windows Active Directory. MySQL Enterprise Authentication enables organizations to implement a Single Sign On mechanism and leverage existing security rules and process from centralized directories.

MySQL Enterprise Transparent Data Encryption (TDE)

MySQL Enterprise Transparent Data Encryption (TDE) enables data-at-rest encryption by encrypting the physical files of the database. Data is encrypted automatically, in real time, prior to writing to storage and decrypted when read from storage. As a result, hackers and malicious users are unable to read sensitive data from tablespace files, database backups or disks. MySQL Enterprise TDE uses a two-tier encryption key architecture, consisting of a master encryption key and tablespace keys, which provides easy key management and rotation.

MySQL Enterprise Encryption

To protect sensitive data throughout its lifecycle, MySQL Enterprise Encryption provides industry standard functionality for asymmetric encryption (Public Key Cryptography). MySQL Enterprise Encryption provides encryption, key generation, digital signatures and other cryptographic features to help organizations protect confidential data and comply with regulatory requirements such as HIPAA, Sarbanes-Oxley, and the PCI Data Security Standard.

MySQL Enterprise Masking and De-identification

MySQL Enterprise Masking and De-identification provides an easy to use, built-in database solution to help organizations protect sensitive data from unauthorized uses by hiding and replacing real values with substitutes. All major industry regulations require data masking of PII (personally identifiable information), PANs (Primary Account Number) and other confidential data so that only authorized personnel can access the data.

MySQL Enterprise Firewall

MySQL Enterprise Firewall blocks SQL Injection attacks that can result in loss of valuable personal and financial data. Whitelist creation, real-time threat monitoring, SQL statement blocking and alerting enable DBAs protect data assets. Acting as an intrusion detection system, MySQL Enterprise Firewall notifies administrators to SQL statement activity that does not match an approved whitelist.

MySQL Enterprise Audit

MySQL Enterprise Audit enables you to quickly and seamlessly add policy-based auditing compliance to existing applications. You can dynamically enable user level activity logging, implement activity-based policies, manage audit log files and integrate MySQL auditing with Oracle and third-party solutions.

MySQL Enterprise Monitor

The MySQL Enterprise Monitor and MySQL Query Analyzer enable you to improve the performance and availability of your MySQL instances, the applications that use them, and the supporting infrastructure. The MySQL Enterprise monitor continuously monitors MySQL queries and performance related server metrics and alerts developers and DBAs on significant deviations from the baseline performance trends. The Replication Dashboard displays MySQL instrumentation information and the Topology View displays the current configuration of your Replication Groups, enabling you to quickly see the status of each node and each replication subsystem. Best practice Advisors recommend changes to configuration and variable settings to improve performance. Harnessing the power of trend analysis, MySQL Enterprise Monitor can alert you to problems before they become critical and accurately predict future capacity requirements.

Oracle Premier Support

Oracle offers 24x7, global support for MySQL. The MySQL Support team is composed of seasoned MySQL developers, who are database experts and understand the issues and challenges you face.

Oracle Premier Support for MySQL Enterprise Edition includes the following features:

- 24x7 production support
- Unlimited support incidents
- Knowledge Base
- Maintenance releases, bug fixes, patches and updates
- MySQL consultative support

Is Oracle MySQL investing in product updates?

MySQL have added more than 400 features (worklogs), added an additional 500 new tests and solved over 5,000 bugs in MySQL 8.0. They also have development teams in the US, India and Sweden. Sweden, the birthplace of MySQL and where they still have many of the original MySQL developers within the organisation. Since Oracle acquired MySQL, the development and support teams have more than doubled and other teams such as QA/testing and support have also seen threefold increases in team sizes. Through the Solution Consultants, Support Consultants and Engineers, Oracle MySQL are continuously listening to their customers' requirements and feature requests which do get added to future releases. Furthermore, commercial customers have the opportunity to join the Advisory board where they get the opportunity to meet the senior developers and MySQL board to discuss development roadmaps and future plans.

More Investment, More Innovation



SUMMARY

In this paper we have explored in detail Amazon's RDS and EC2 cloud offerings and the strengths of the commercial version of MySQL (MySQL Enterprise Edition), but in the opening executive summary we asked the question, should we choose a 'Database as a Service' (a forked version of MySQL on RDS) or run MySQL Enterprise Edition on 'Infrastructure as a Service' (EC2)?

It's clear that Amazon EC2 provides the most flexible option and opens the door for a tailored and customised database infrastructure environment to meet your specific needs, yet minimises costs and resources, when delivered with MySQL Enterprise Edition.

But the answer very much depends on careful evaluation of your requirements. Does your organisation require advanced security features that meet the latest industry standard regulations? Do you require MySQL experts to optimise performance, help manage product updates and support with both cloud and on-premise environments?

Contact Oracle's MySQL Enterprise Edition team to learn more and simplify your journey to the Cloud.

ADDITIONAL RESOURCES

MySQL Enterprise Edition 8.0 Whitepaper

<https://www.mysql.com/why-mysql/white-papers/whats-new-mysql-8-0/>

MySQL Enterprise Edition and EU General Data Protection Regulation (GDPR)

<https://www.mysql.com/why-mysql/white-papers/mysql-enterprise-edition-gdpr/>

A Guide to MySQL and PCI Data Security Standard Compliance

<https://www.mysql.com/why-mysql/white-papers/mysql-pci-data-security-compliance/>

MySQL Document Store: Top 10 Reasons

<https://www.mysql.com/why-mysql/white-papers/mysql-document-store-top-10-reasons/>

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