

클라우드 환경에서 Open Source Database(MySQL) 구축 및 운영



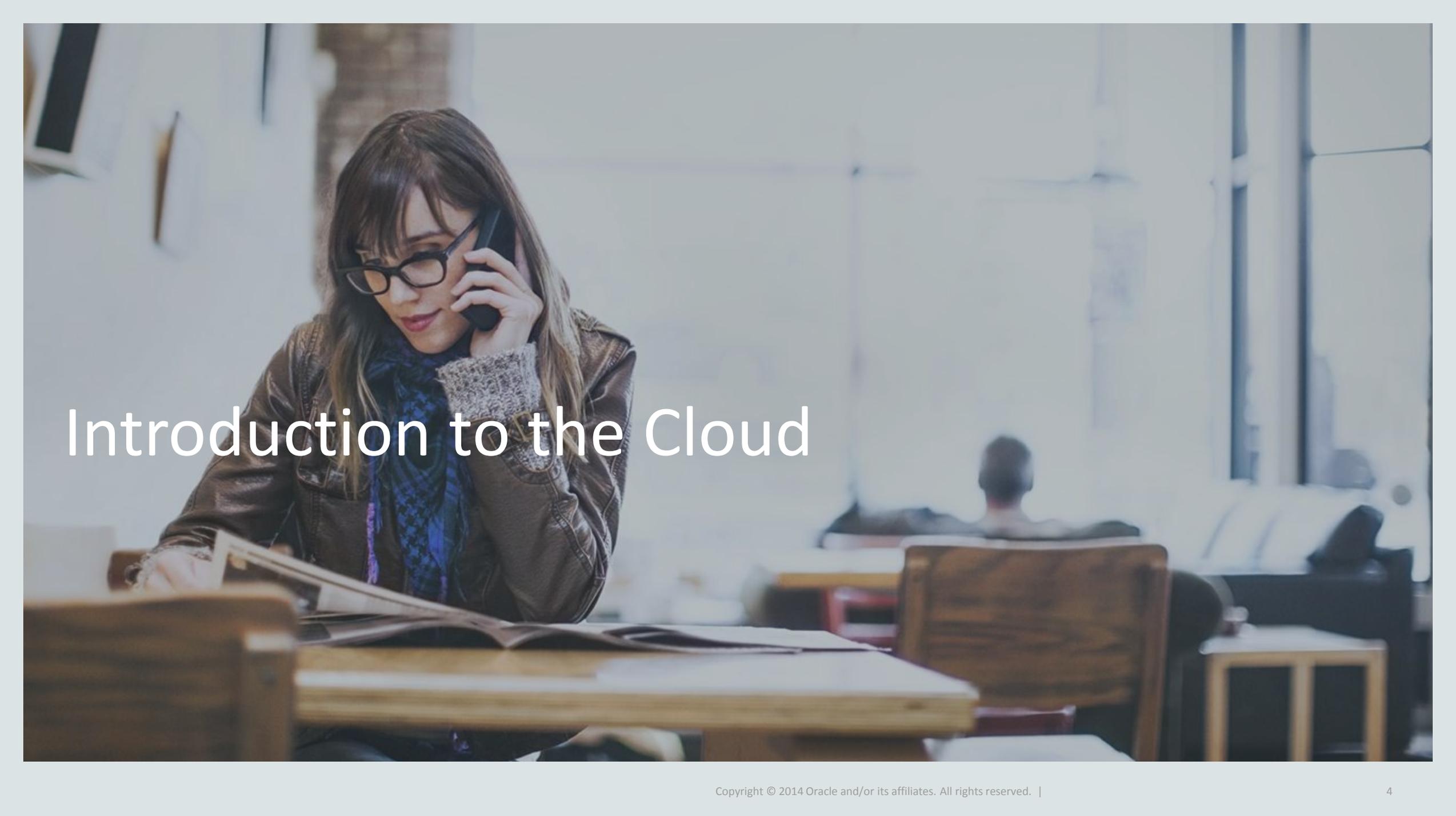
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Using MySQL in the Cloud : Agenda

- 1 Introduction to the Cloud
- 2 How MySQL Fits in
- 3 MySQL and OpenStack
- 4 MySQL and Amazon Web Services
- 5 Conclusion

A woman with long brown hair and glasses, wearing a brown leather jacket and a blue patterned scarf, is sitting at a wooden table. She is holding a black smartphone to her ear with her left hand and looking down at a large open book or document on the table with her right hand. The background is a bright, modern interior with large windows and a person sitting at another table in the distance. The overall scene is dimly lit with a blueish tint.

Introduction to the Cloud

Introduction to the Cloud

Just what is it?

- Method of delivering computing resources as a service
 - Shared resources are provided to computers and other devices as a utility
 - Provided over the network
- Shared resources used to achieve coherence and economies of scale
 - Avoid up front infrastructure costs
 - Elastic provisioning allows for scaling up or down based on demand
- Metered pricing
 - Only pay for the resources that you use

Introduction to the Cloud

Common Terms

- IaaS : providing virtualized access to physical infrastructure
- PaaS : providing a complete platform to run applications on
- SaaS : providing remote access to individual software applications
- XaaS : providing anything (X) as a service
- Private Cloud : an internal cloud used solely by your organization
- Public Cloud : a multi-tenant cloud available to anyone
 - Support Virtual Private Clouds (your resources are logically and/or physically isolated)
- Hybrid Cloud : your own private cloud, augmented by a public one

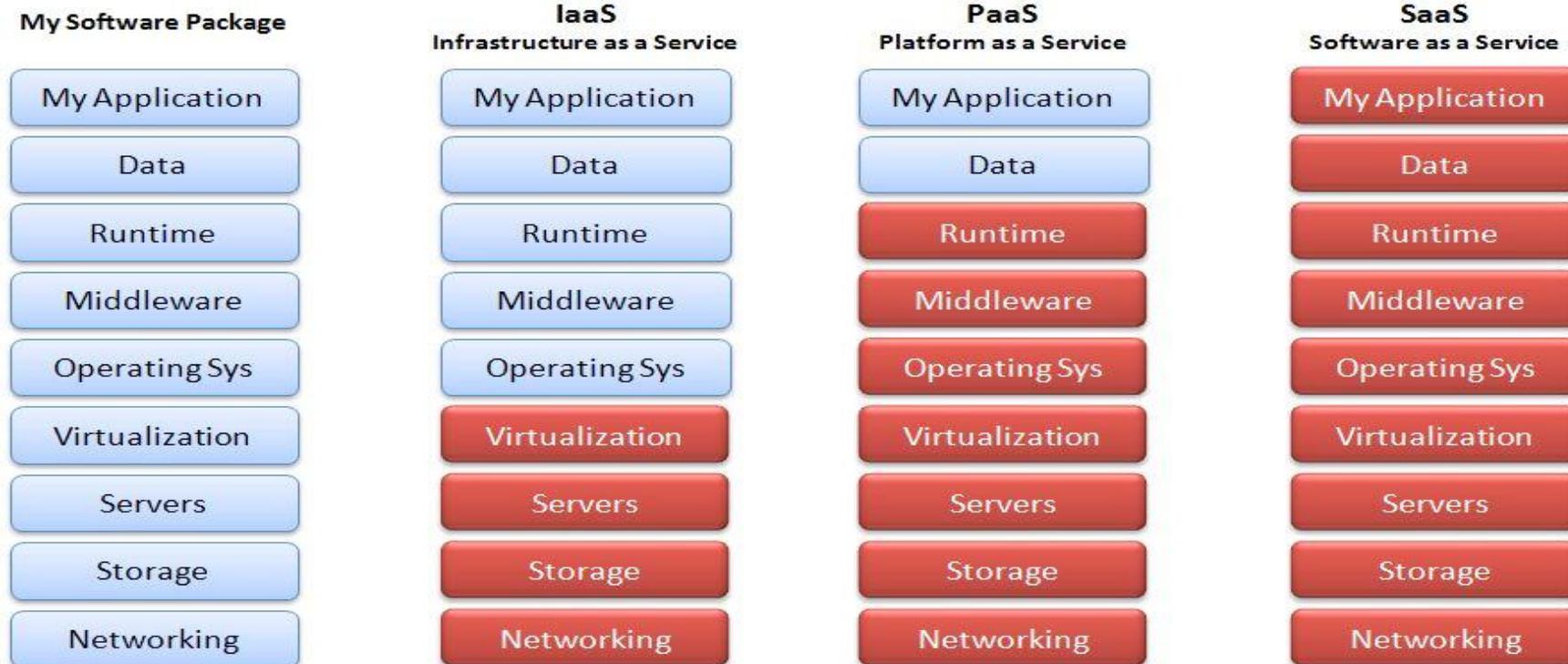
Introduction to the Cloud

Why?

- Agility
 - Virtually infinite resources available on-demand
 - Integrated orchestration and automation
- Lower costs
 - No upfront capital investment
 - Pay only for what you actually use
- Big Data / Cloud-based analytics
 - Detailed analytics tools are built-in
- Deployment options: public, private, virtual private, hybrid

Introduction to the Cloud

Service Models



Legends:

- Managed by Me (blue box)
- Managed by the Vendor (red box)



Introduction to the Cloud

The Market

81%

Of US Companies are *already* using some Public Cloud services

46%

Enterprises expect that much of their IT services to be delivered via Public and/or Private Clouds *in 3 years*

\$107B

The amount businesses will spend on Cloud-delivered IT services *in 2017*

85%

Of new commercial apps are now developed *specifically* for the Cloud

Source: [Market Analysis Perspective: Worldwide SaaS and Cloud Software, 2013 — Software Will Never Be the Same](#)

Introduction to the Cloud

Provider Landscape

- Public Clouds
 - AWS, Oracle Cloud, HP Helion Cloud, Rackspace Cloud, Microsoft Azure, Google Cloud, Digital Ocean, Linode, Mirantis, Joyent, IBM Cloud ...
- Private Clouds
 - OpenStack
 - Included in: Oracle Linux 6 and 7, RHEL 7, Ubuntu 14.04 (Juju and MaaS) ...
 - Available separately for any Linux distro
 - Included in Solaris 11.2
 - Eucalyptus
 - AWS compatible APIs

How MySQL Fits in



How MySQL Fits in The #1 RDBMS in the Cloud



Google Cloud Platform



Google Cloud Platform

Cloud SQL



Familiar Infrastructure

Build and deploy for the cloud faster because Cloud SQL offers standard MySQL databases, the most popular open source database in the world. Instances available up to 16GB RAM, 500GB storage.



Flexible Charging

Our pay per use option makes it economical to get started. If you're running a lightly or sporadically used database, you'll save money by only paying for the time you access your data. The package option allows you to control your costs for more heavily loaded instances.



Security, Availability, Durability

Your data is replicated in many geographic locations as standard, and failover between them is handled automatically. This means your data is safe and your database is available even in the event of a major failure. We also manage your backups, making it easy for you to restore when needed, including point-in-time recovery. Cloud SQL is ISO/IEC 27001 compliant.



Easier Migration; No Lock-in

Standard connections and tools such as mysqldump, MySQL Wire Protocol, and JDBC make it easier to migrate onto (or off!) Google Cloud Platform, and avoids lock-in. Create read replicas of your databases that can be internal or external to Google Cloud Platform.



Control

It's easy to manage and access your instances through a web Console or a command-line interface. Applications and tools can connect to your instances over IPv4 or IPv6. Transfer data to your instance by importing and exporting databases and CSV files.



Fully managed

No worrying about replication, patch management or database management - we take care of it.

Amazon Cloud Service



컴퓨팅 가상 서버 Amazon EC2 클라우드상의 가상 서버 컨테이너 Amazon EC2 Container Service 확장 가능한 컨테이너 관리 서비스 1-Click 웹 앱 배포 AWS Elastic Beanstalk				
	스토리지 및 콘텐츠 전송	데이터베이스	네트워킹	보안 및 자격 증명
	객체 스토리지	관계형	Virtual Private Cloud	ID 관리
	블록 스토리지	NoSQL	직접 연결	액세스 제어
	파일 시스템 스토리지	캐싱	DNS	키 스토리지 및 관리
아카이브 스토리지	데이터 웨어하우스	Load Balancing	성능 및 보안 최적화	
통합 스토리지				
CDN				

다양한 플랫폼 서비스를 통해 클라우드에서의 성공을 가속화

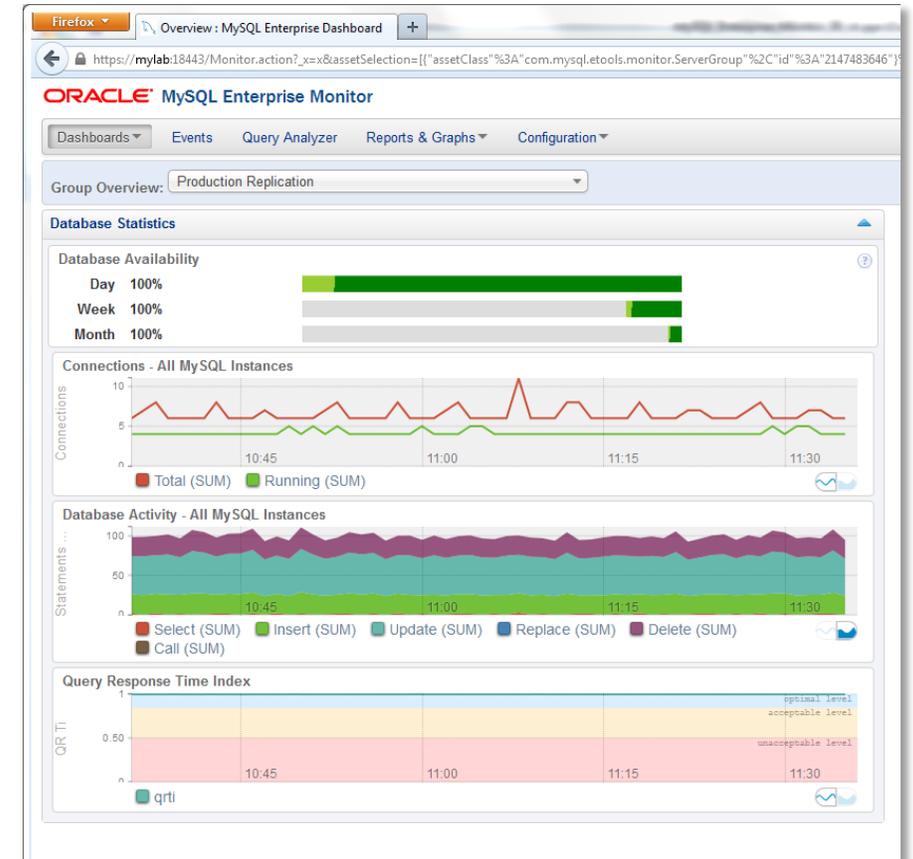
분석	애플리케이션 서비스	개발자 도구	관리 도구	모바일 서비스
Hadoop	대기열	소스 코드 관리	모니터링 및 로그	자격 증명
Elasticsearch	워크플로	코드 배포	리소스 템플릿	앱 테스트
실시간	앱 스트리밍	지속적인 전송	사용 및 리소스 감사	Mobile Analytics
기계 학습	코드 변환		개발/운영 리소스 관리	알림
데이터 웨어하우스	이메일		서비스 카탈로그	개발

How MySQL Fits in Ubiquity in the Cloud

- MySQL is the most popular DBaaS engine
 - The most popular engine on Amazon RDS and Google Cloud SQL
 - The default engine for OpenStack Trove
 - Including HP Helion Cloud Relational Database and Rackspace Cloud Database
- MySQL is used in many of the most popular SaaS offerings
 - SugarCRM, Dropbox, Rightnow, Evernote, and many more ...
- MySQL is a core piece of the Cloud technology stack
 - The default backing store for OpenStack data
 - Including the OpenStack based Public Clouds: HP Helion, Rackspace, Mirantis, ...

How MySQL Fits in MySQL Enterprise Edition : **Monitor**

- Single, consolidated view into entire MySQL environment, **on-premise and in the Cloud**
- Automated, rules-based monitoring and alerts (SMTP, SNMP enabled)
- Query capture, monitoring, analysis and tuning, correlated with Monitor graphs
- Identifies problematic servers
- Real-time Replication Monitor with auto-discovery of master-slave topologies

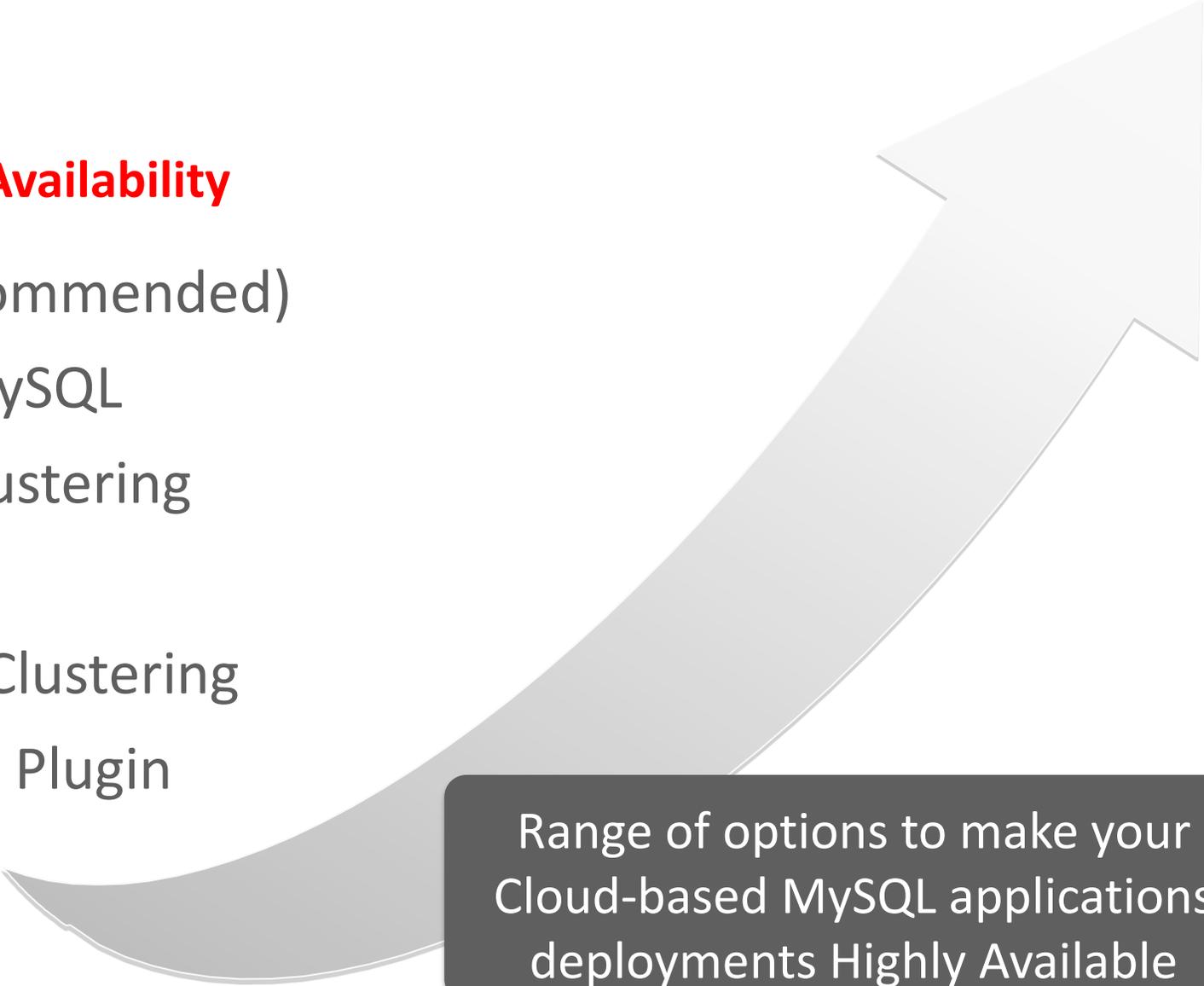


MySQL Enterprise Monitor 3.0
Saves you time. Fixes problems
you cannot find yourself.

How MySQL Fits in

MySQL Enterprise Edition : **High Availability**

- HA with MySQL Fabric (recommended)
- Oracle VM Templates for MySQL
- HA with DRBD and Linux Clustering
- HA with Solaris Clustering
- HA with Windows Failover Clustering
- HA with Oracle Clusterware Plugin



Range of options to make your
Cloud-based MySQL applications
deployments Highly Available

How MySQL Fits in MySQL Enterprise Edition : **Security**

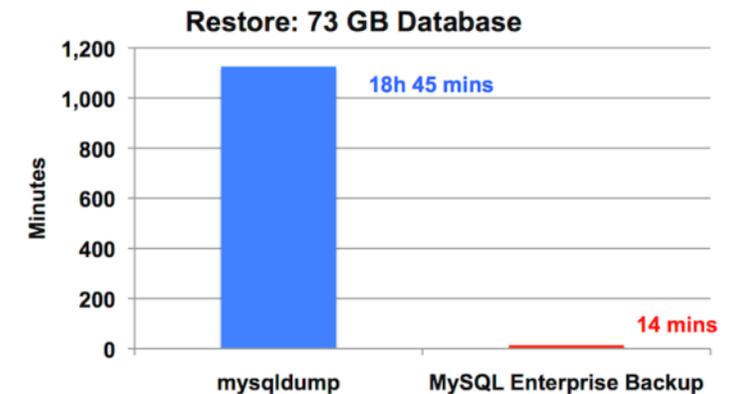
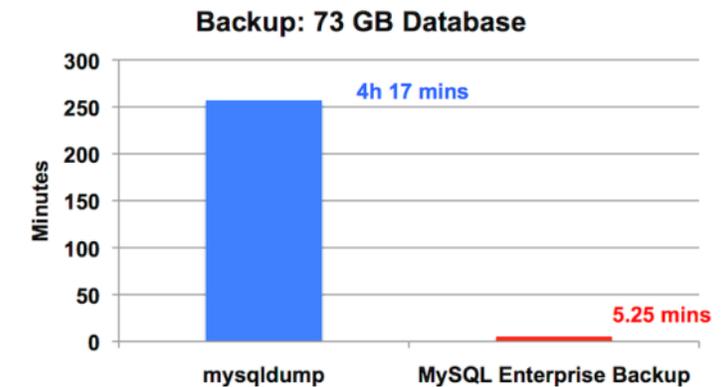
- Encryption and masking
 - MySQL Encryption libraries (including AES256)
 - SSL enabled communication
- Access control
 - MySQL Enterprise authentication (PAM, Windows, etc.)
- Auditing and Monitoring
 - MySQL security advisors
 - Oracle Audit Vault
- Oracle Database Firewall



Security is the #1 concern in the
Cloud

How MySQL Fits in MySQL Enterprise Edition : **Backup**

- Online, non-locking backup and recovery
 - Complete MySQL instance backup (data and config)
 - Partial backup and restore
- Direct Cloud storage backups (S3, etc.)
- Incremental backups
- Point-in-time recovery
- Advanced compressed and encryption
- Backup to tape (SBT)
- Backup validation
- Cross-Platform (Windows, Linux, Unix)



Ensures **quick**, online backup and recovery of your Cloud-based MySQL applications

How MySQL Fits in

MySQL Enterprise Edition : **The Bottom Line**

- Improved resource utilization
 - Fewer VM instances
 - Improved availability
 - Sustained performance at scale
 - Performance monitoring and tuning
 - Integrated HA
- Lower TCO
 - Reduced risk of data loss
 - Reduced impact on production
 - Less manpower required
 - Easy security standards compliance
 - 24/7/365 expert support
- Enhanced DevOps productivity
 - Pre-built VM templates
 - Automated scaling & management
 - Flexible, real-time backups
 - Existing security infrastructure integration
 - Virtual DBA assistant

MySQL and OpenStack



MySQL and OpenStack

OpenStack Components

- Compute Service : Nova
- Object Storage Service : Swift
- Block Storage Service : Cinder
- Image Service : Glance
- Identity Service : Keystone
- Network Service : Neutron
- Telemetry Service : Ceilometer
- Orchestration Service : Heat
- Database Service : Trove
- Dashboard : Horizon

MySQL and OpenStack

Core Tools

- Python
 - The language used throughout OpenStack
- Puppet
 - Default (Chef and Juju are also common) tool used for installation, setup, instrumentation, orchestration, and automation
- MySQL
 - The default backing store for OpenStack data
- Open vSwitch
 - The default tool used for the software defined networking (SDN) in Neutron

MySQL and OpenStack

Installing MySQL

- Standard MySQL distributions and methods
 - <http://dev.mysql.com/downloads/>
 - <https://edelivery.oracle.com/>
- MySQL Linux repos (recommended, includes related tools)
 - <http://dev.mysql.com/downloads/repo/>
- Your vendor repositories
- **You can do this one time in your virtual machine image**
 - Including MEM, MEB, WorkBench, Fabric, Utilities, Connectors, etc.

MySQL and OpenStack

Setting up MySQL as a Service

- Install Trove on the controller node using RedStack
 - <http://docs.openstack.org/developer/trove/dev/install.html>
- Install Trove manually
 - http://docs.openstack.org/developer/trove/dev/manual_install.html
- Still a bit “raw” and very much in flux today
 - Has great potential for the future
 - But probably best to stick with a typical MySQL install today

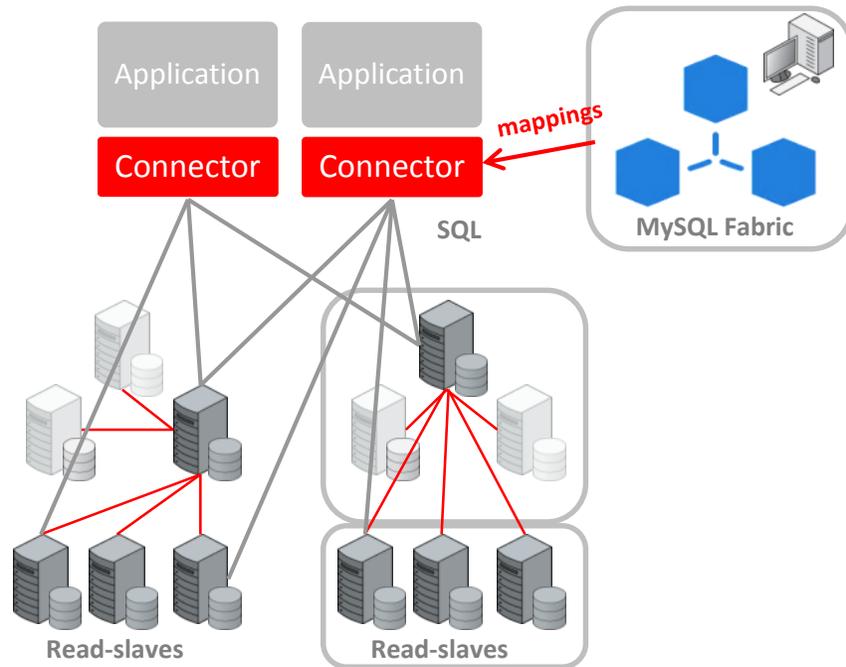
MySQL and OpenStack

Backups

- Instance (VM) backups
 - Create snapshots of the virtual machine(s) where MySQL is running
- Volume backups
 - Create snapshots of the volume(s) containing your MySQL data
- MySQL only backups
 - Logical backups with mysqldump
 - Online/hot backups with MySQL Enterprise Backup (MEB)
 - Support for compression, encryption, incremental backups, PITR, SBT, and Cloud storage APIs

MySQL and OpenStack

Adding High Availability with Fabric

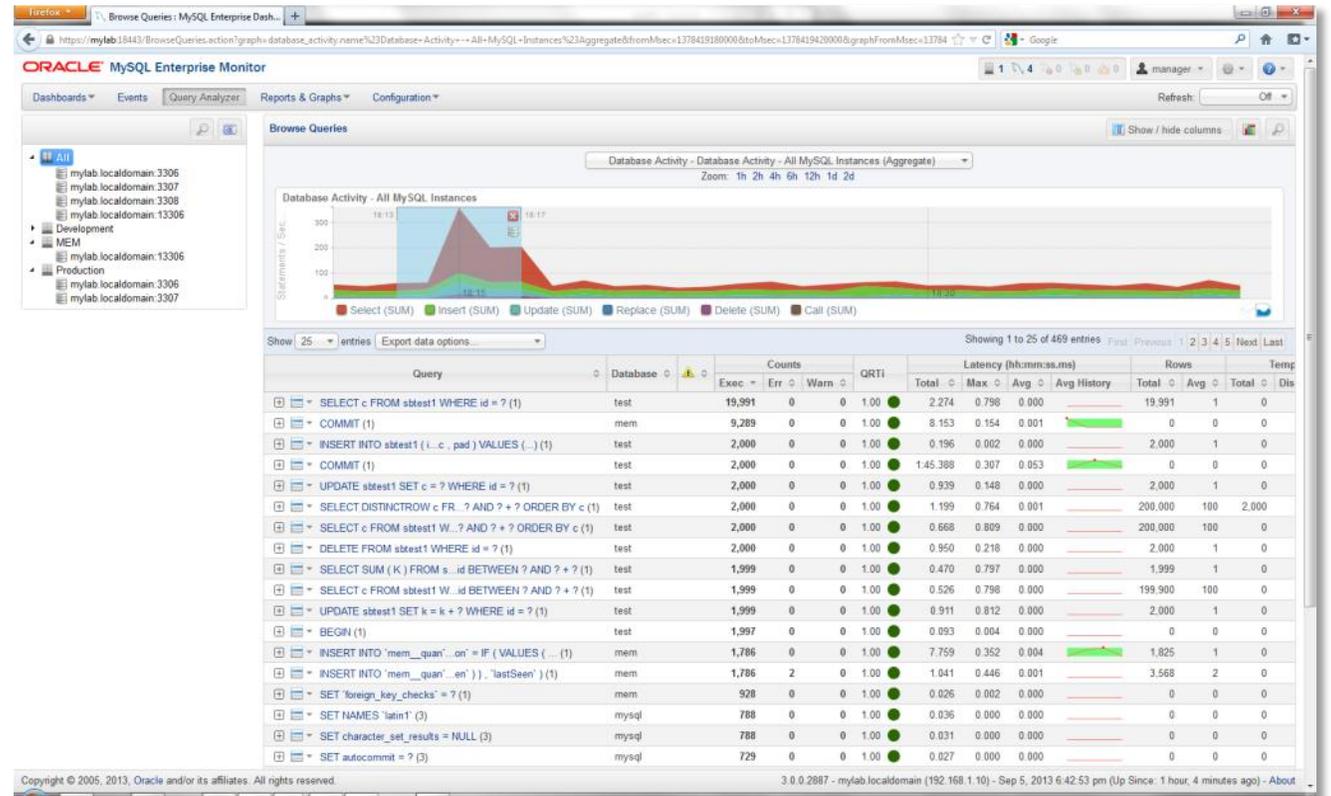


- High Availability features
 - Server monitoring
 - Auto-promotion
 - Transparent application failover
 - Dynamically scale up and down
- Fabric-aware connectors rather than a proxy
 - Python, Java, and PHP
 - Lower latency, bottleneck-free
- Optional sharding features

MySQL and OpenStack

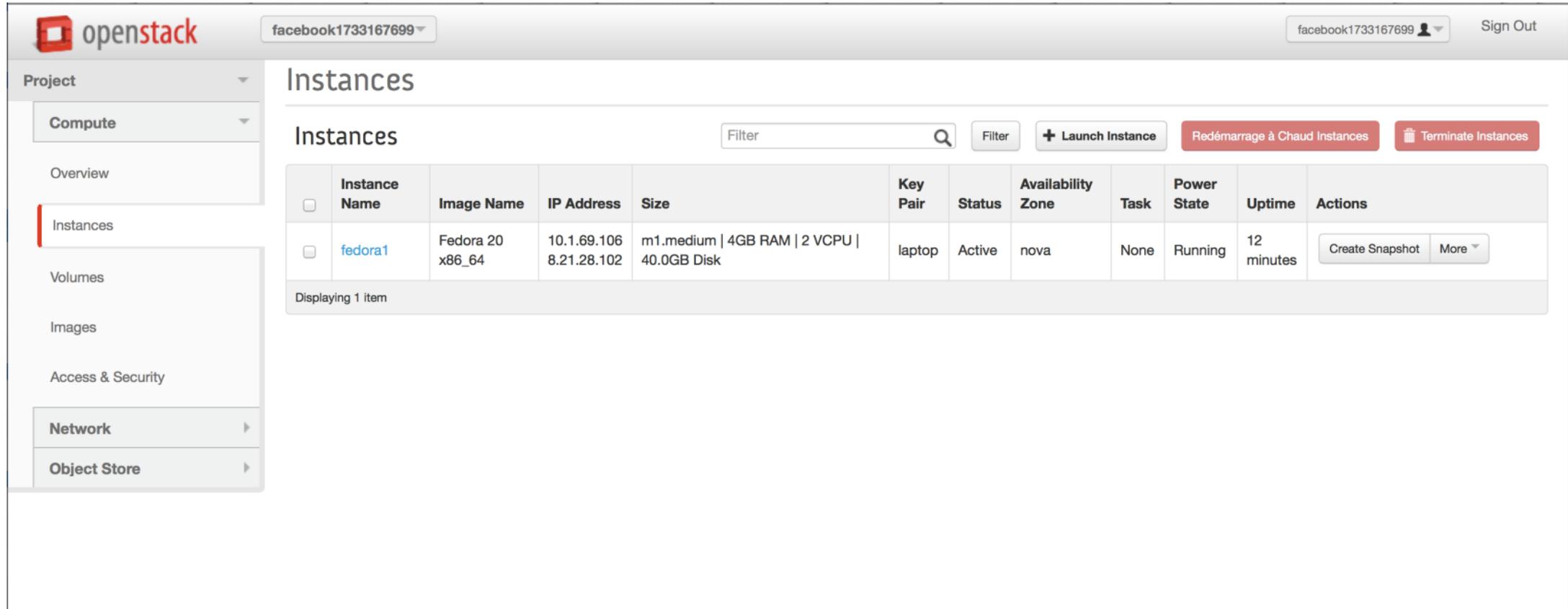
Monitoring MySQL

- Standard official tools
 - MySQL Enterprise Monitor (MEM)
 - MySQL Workbench
 - MySQL command-line client
- Standard third party tools
 - phpMyAdmin
 - Cacti
 - Nagios
 - Many others



MySQL Enterprise Monitor 3.0

MySQL and OpenStack



The screenshot shows the OpenStack dashboard interface. At the top, there is a navigation bar with the OpenStack logo, a user profile dropdown for 'facebook1733167699', and a 'Sign Out' button. On the left side, there is a sidebar menu with categories: Project (Compute, Overview, Instances, Volumes, Images, Access & Security), Network, and Object Store. The main content area is titled 'Instances' and features a search filter, a '+ Launch Instance' button, and two red buttons: 'Redémarrage à Chaud Instances' and 'Terminate Instances'. Below this is a table with the following columns: Instance Name, Image Name, IP Address, Size, Key Pair, Status, Availability Zone, Task, Power State, Uptime, and Actions. One instance is listed: 'fedora1' with image 'Fedora 20 x86_64', IP '10.1.69.106', size 'm1.medium | 4GB RAM | 2 VCPU | 40.0GB Disk', key pair 'laptop', status 'Active', availability zone 'nova', task 'None', power state 'Running', and uptime '12 minutes'. The Actions column for this instance contains 'Create Snapshot' and 'More' buttons. At the bottom of the table, it says 'Displaying 1 item'.

<input type="checkbox"/>	Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Uptime	Actions
<input type="checkbox"/>	fedora1	Fedora 20 x86_64	10.1.69.106 8.21.28.102	m1.medium 4GB RAM 2 VCPU 40.0GB Disk	laptop	Active	nova	None	Running	12 minutes	Create Snapshot More

Here you can see a screenshot of my simple OpenStack setup.

MySQL and OpenStack

```
gonzo:~ matt$ ssh -i ~/.ssh/id_rsa fedora@8.21.28.102
Last login: Wed Jul 9 02:24:12 2014 from 75.97.214.133.res-
cmts.sth3.ptd.net
[fedora@fedora1 ~]$ mysql
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 4
Server version: 5.6.19 MySQL Community Server (GPL)
```

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Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

```
mysql>
```

Here you can see a screenshot of connecting to the running virtual machine instance (seen in the previous screenshot), and logging into MySQL.

I previously installed MySQL 5.6 there using our official YUM repo:

1) yum install

<http://dev.mysql.com/get/mysql-community-release-fc20-5.noarch.rpm>

2) yum install mysql-community*

3) systemctl start mysqld.service

MySQL and Amazon Web Services



MySQL on Amazon Web Services

- 1** ➤ **Using Elastic Compute Cloud (EC2)**
- 2** ➤ **Using Relational Database Service (RDS)**

Using EC2

The Short Version

- Pick an instance type
- Choose your favorite Linux distribution
- Install MySQL
- Optionally Setup Replication
- Setup a Backup

EC2 is raw compute instances.

Approach not substantially different from regular deployments.

Pick an Instance Type

- Amazon has substantially more hardware options available than 2006
- Common choice for Databases is **R3 High Memory**
- Some workloads may better suit I2 Storage Optimized, HS1 High Storage or C3 Compute Optimized

Chose Your Favorite Linux Distribution

- Yum Based
 - CentOS
 - Red Hat
 - Amazon Linux
- Deb Based
 - Debian
 - Ubuntu

Install MySQL

Same Steps as Described for OpenStack

- MySQL 5.6 recommended for all new installations
- For MySQL Community Server:
 - Available from official yum and apt repositories
- For MySQL Enterprise Server:
 - Subscription useful on EC2 (Enterprise Monitor, Backup)
 - Available for download from Oracle eDelivery



Setup Replication

AWS Presents Great HA Opportunities

- **Availability Zones (AZs)** have physical isolation in the same geography.
- **Regions** are different geographies.
- Amazon recommends that applications be built to survive an AZ outage.
 - Easy to achieve.
 - Setup slaves in a different AZ from master.



Setup a Backup

Standard Methods Apply

- mysqldump
- MySQL Enterprise Backup
 - Better option for larger databases
 - Now supports saving to S3!
- EBS Snapshot

MySQL on Amazon Web Services

- 1 Using Elastic Compute Cloud (EC2)
- 2 **Using Relational Database Service (RDS)**

RDS

'Relational Database Service'

- A managed service offering hosted MySQL.
- Amazon takes care of backups, replication & software patching.
- Offers MySQL Versions:
 - 5.1
 - 5.5
 - 5.6

Locked Down

Amazon is the DBA

- Root access not provided.
- Edits to my.cnf configuration via an API or Web Console
 - Not all settings are configurable
 - Can't set innodb_io_capacity or change to Row Based Replication



Does Not Offer MySQL Enterprise Edition Features

- MySQL Enterprise Monitor
 - Find and fix expensive queries as they are introduced.
 - Real-time performance monitoring and alerts.
- MySQL Enterprise Backup
 - Low impact
 - Built-in verification while copying data.



Dedicated DBAs

- May have a preference for EC2-based MySQL
 - Existing tooling DBAs have built may require SUPER privileges
 - Finer level of configuration
- Comfort-zone of understanding what's happening 'under the hood' for each operation
 - For example, if clicking “add storage” will I restart the MySQL server?
 - Useful to provide projections.

Conclusion

- RDS

- Simple entry point to MySQL Community Edition
- Uses latest MySQL 5.6

- EC2

- Allows full control over environment
- Supports MySQL Enterprise Edition
- May be preferred by seasoned DBAs and for more demanding deployments.

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Demo : MySQL and Docker

Docker 설치

How to install Docker on Linux

- My Environment
 - Virtual Box
 - Oracle Linux 6.6
 - MySQL Server 5.7.8



한국어 자료 : <http://documents.docker.co.kr/>

OS 및 커널 Update

\$ yum update

.....

```
ypbind.x86_64 3:1.20.4-31.el6
```

```
yum.noarch 0:3.2.29-69.0.1.el6  
yum-rhn-plugin.noarch 0:0.9.1-  
58.0.3.el6
```

Complete!

- 재시작

\$ shutdown -r now

Docker 설치

- 스크립트를 이용한 docker 설치

```
$ yum install -y curl
```

```
Loaded plugins: refresh-packagekit, security, ulninfo  
Setting up Install Process  
Package curl-7.19.7-46.el6.x86_64 already installed and latest  
version  
Nothing to do
```

```
$ curl -sSL https://get.docker.com/ | sh
```

- 서비스 재 시작

```
$ service docker start
```

```
Starting cgconfig service: [ OK ]  
Starting docker: [ OK ]
```

설치 참고자료 : <https://docs.docker.com/installation/rhel/>

Docker 설정 파일 수정

- /etc/sysconfig/docker 파일을 열어 해당 내용을 추가 후 저장.

```
$ vi /etc/sysconfig/docker
```

```
OPTIONS='
```

```
-s overlay \
```

```
--dns 8.8.8.8 \
```

```
--dns 8.8.4.4 \
```

```
-H tcp://127.0.0.1:4243 \
```

```
-H unix:///var/run/docker.sock \
```

```
--dns-search google-public-dns-a.google.com
```

```
$ service docker restart (or stop & start)
```

Official Repository for MySQL

OFFICIAL REPOSITORY

mysql 

Last pushed: 9 days ago

Repo Info Tags

Short Description

MySQL is a widely used, open-source relational database management system (RDBMS).

Full Description

Supported tags and respective Dockerfile links

- 5.5.46 , 5.5 (5.5/Dockerfile)
- 5.6.27 , 5.6 , 5 , latest (5.6/Dockerfile)
- 5.7.8-rc , 5.7.8 , 5.7 (5.7/Dockerfile)

For more information about this image and its history, please see [the relevant manifest file \(library/mysql\)](#) . This image is updated via pull requests to [the docker-library/official-images GitHub repo](#).

Docker Pull Command

```
docker pull mysql
```

MySQL 이미지 가져오기

- Docker 로부터 MySQL 이미지를 가지고 옵니다. 반드시 버전을 명시하시는게 좋습니다. 아니면 전체버전을 다 가져오기때문에 시간이 오래걸릴 수 있습니다.

\$ docker pull mysql:5.7.8

```
5.7.8: Pulling from library/mysql
ba249489d0b6: Pull complete
19de96c112fc: Pull complete
2e32b26a94ed: Pull complete
637386aea7a0: Pull complete
```

.....

참고자료 : https://hub.docker.com/_/mysql/

MySQL 서버 시작 및 접속

- MySQL 인스턴스 시작

```
$ docker run --name mysql578 -e MYSQL_ROOT_PASSWORD=mysql -d mysql:5.7.8
```

```
$ docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
bb5d732f222e	mysql:5.7.8	"/entrypoint.sh mysql"	16 seconds ago	Up 15		
	seconds 3306/tcp	mysql578				

- MySQL Client를 이용해 MySQL 서버 접속

```
$ docker run -it --link mysql578:mysql --rm mysql:5.7.8 sh -c 'exec mysql -h"$MYSQL_PORT_3306_TCP_ADDR" -P"3306" -uroot -p'
```

Thank you!

