

Global Big Data Conference



**GLOBAL NoSQL and SQL
VIRTUAL BOOTCAMP**

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Workshop

MySQL and Percona XtraDB Cluster

Day 1

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Agenda

- Overview
- MySQL and PXC Architectures
- MySQL Replication methodologies
 - Sync Replications
 - Async Replication
- PXC Installation and configuration
- MySQL Log Files
- Operation of the PXC Cluster
- Overview of Performance Tuning and Monitoring

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Overview

What is this workshop about?

This workshop is about MySQL and PXC but we'll also have a look in other tools that can help us monitor, manage and troubleshoot database and cluster issues like Percona Management and Monitoring (PMM).

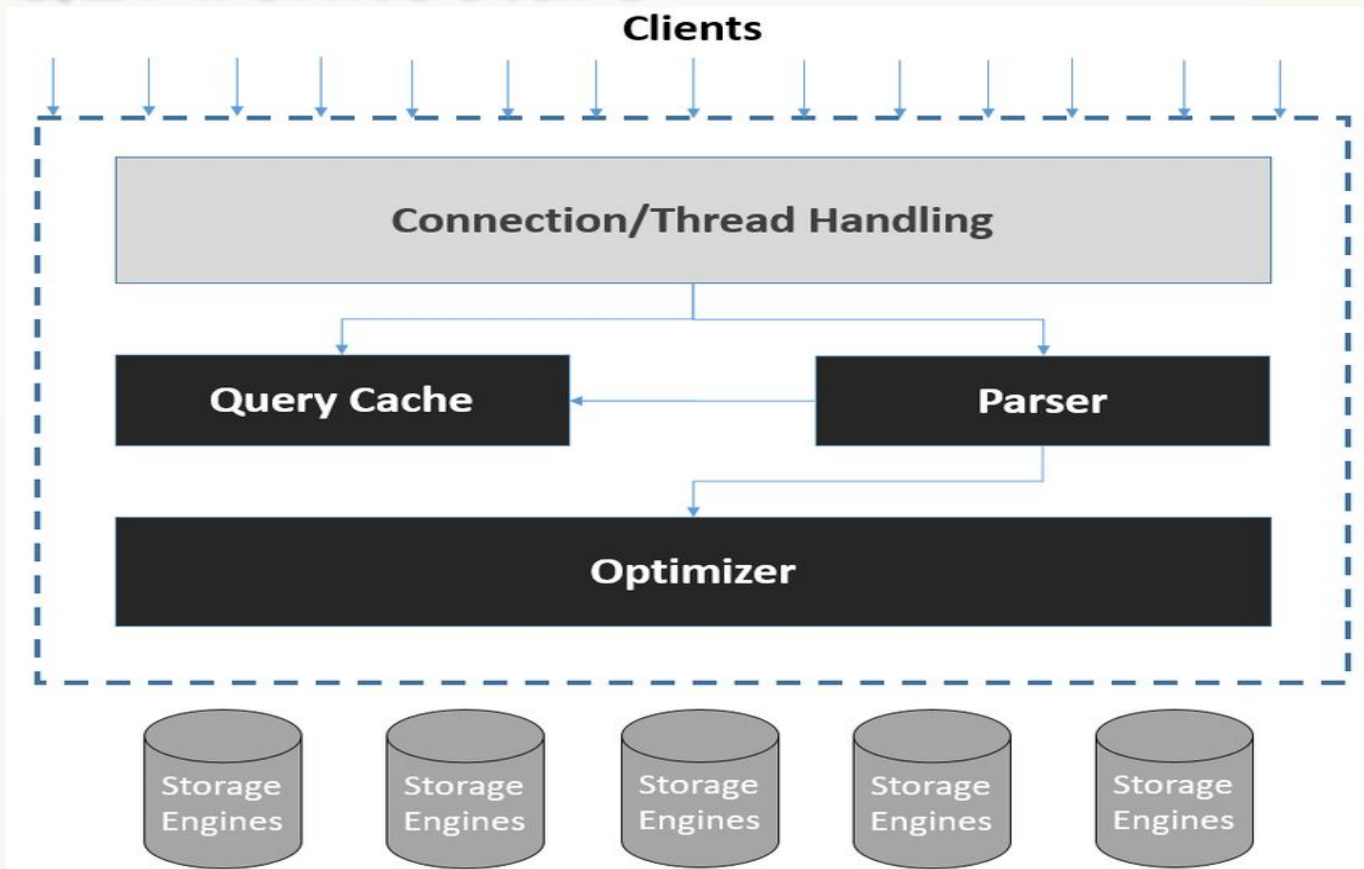
We'll divide this workshop into 3 main sections, one each day of the workshop:

- Introduction to MySQL and PXC: Architecture, installation and configuration
- Administration: User administration, Backup, Restore and Observability
- Troubleshooting and best practices

MySQL and PXC Architectures

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MySQL Architecture



https://www.researchgate.net/figure/MySQL-Architecture-with-core-components_fig2_336141428

MySQL Architecture

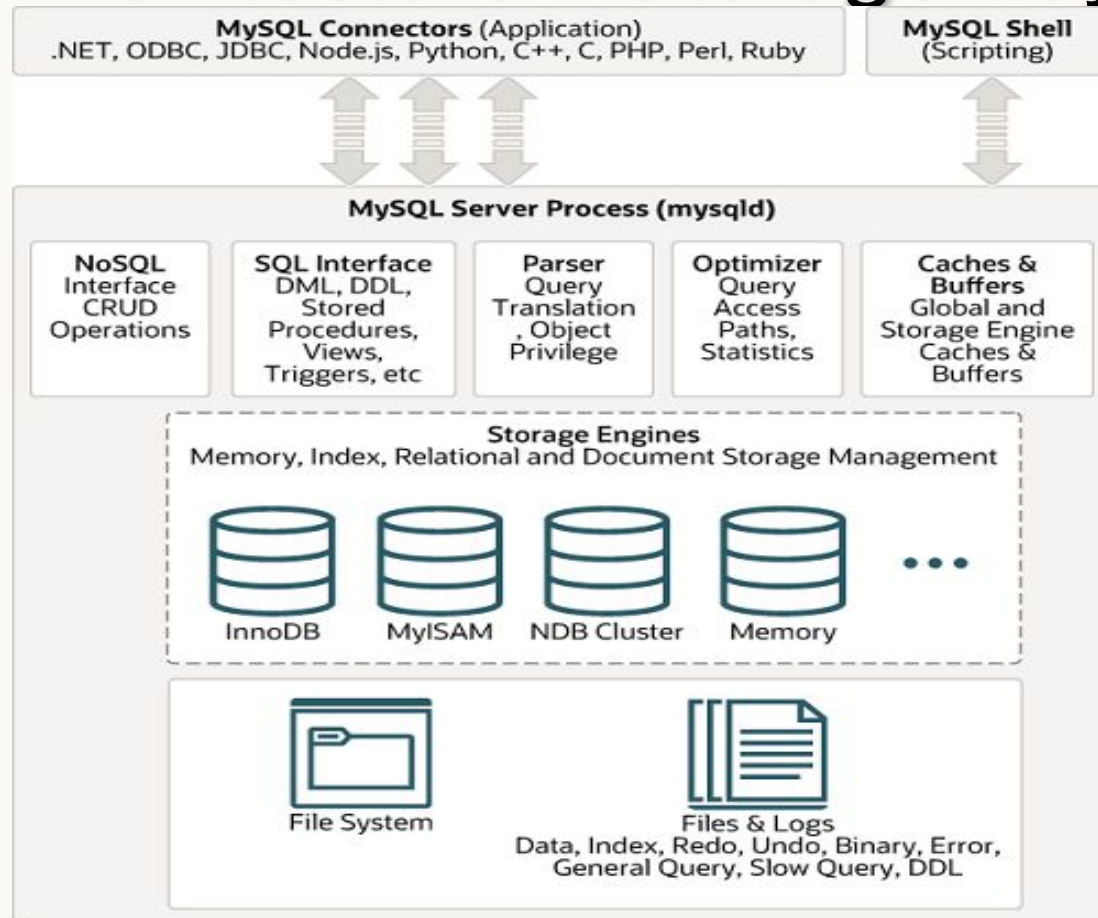
- MySQL is Relational Database Management system
- MySQL follows Client-Server Architecture with 3 main layers:
 - Client Layer: Drivers, connectors and the utility to connect to MySQL server;
 - Server Layer: MySQL instance where actual data getting stored and data processing is happening;
 - Storage Layer: MySQL uses the concept of pluggable storage engines where tables created by user are stored and managed;

MySQL Architecture - Server Layer

- This is the “Brain of MYSQL Architecture”;
- Controls authentication, thread handling, query parsers, optimizer, etc;
- Main components are:
 - Connection/Thread Handling
 - Parser
 - Optimizer
 - Metadata cache
- We will discuss the components further later when using MySQL

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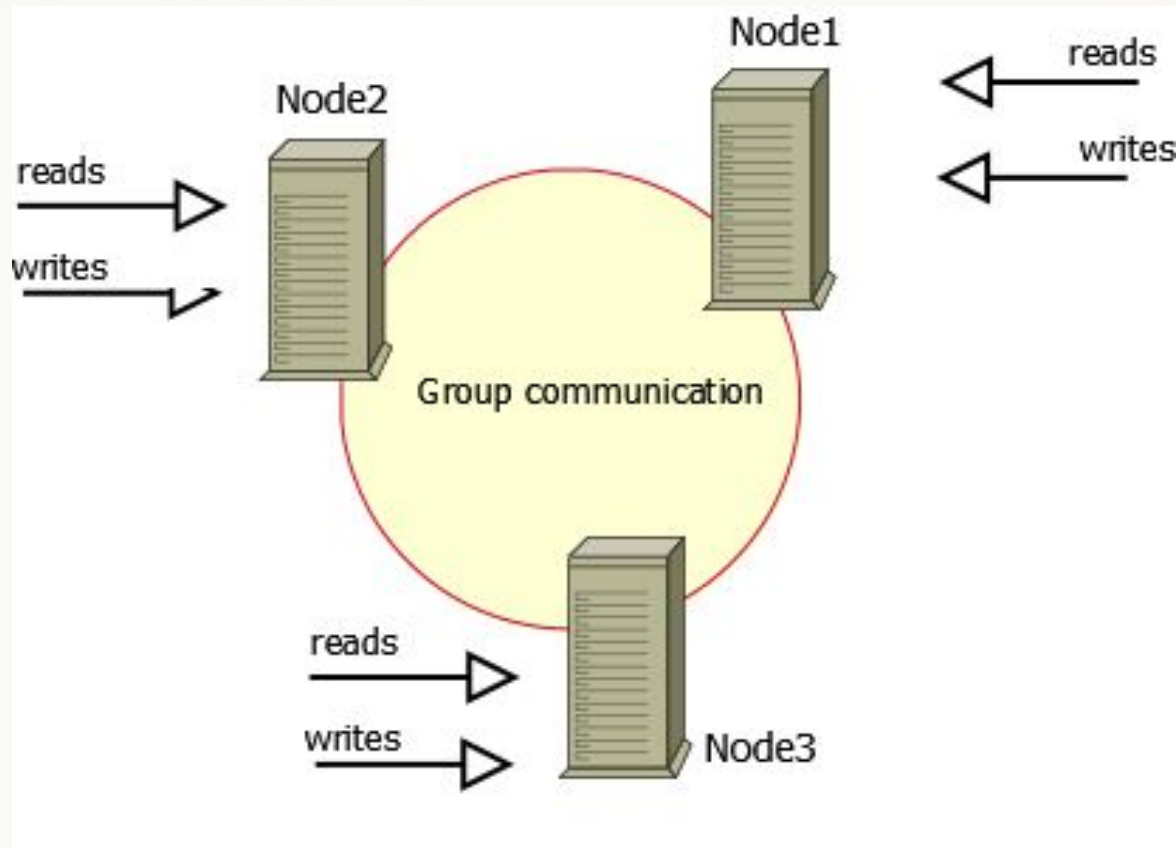
MySQL Architecture - Storage Layer



MySQL Architecture - Storage Layer

- With MySQL, we can use different types of storage called “storage engines”;
- Are the components that handle the SQL operations for different table types;
- MySQL Server uses a pluggable storage engine architecture:
 - Storage engines can be loaded into and
 - Storage engines can be unloaded from a running MySQL server;
- Is responsible for performing the actual data I/O operations for a database;
- Is responsible for enabling and enforcing certain feature sets, for example:
 - Concurrency, Transaction Support,
 - Referential Integrity, Index Support,
 - Memory Caches, Physical Storage;
- **InnoDB** is the default storage engine and the one we'll use here;

PXC Architecture



<https://www.percona.com/blog/2012/01/17/xtradb-cluster-feature-1-high-availability/>

PXC Architecture

- Percona XtraDB Cluster (PXC) is High Availability and Scalability solution for MySQL Users;
- A synchronous certification-based replication solution for MySQL;
- Based on Galera and Percona Server for MySQL which makes it fully compatible with MySQL;
- The internal architecture of PXC has four major components:
 - DBMS: The database server that runs on an individual node. PS for MySQL.
 - wsrep API: This is the interface to the database server and it's the replication provider. It consists of two main elements;
 - Galera Replication Plugin: This plugin enables write-set replication service functionality;
 - Group Communication Plugins: There several group communication systems available to Galera Cluster;

MySQL Replication Methodologies

MySQL Replication - Types

- MySQL supports different methods of replication;
- The traditional method is based on replicating events from the source's binary log;
 - Requires the log files and positions in them to be synchronized between source and replica;
- The newer method based on global transaction identifiers (GTIDs) is transactional;
 - Does not require working with log files or positions within these files;
 - guarantees consistency between source and replica as long as all transactions committed on the source have also been applied on the replica;

MySQL Replication - Replication Format

- There are two core types of replication format:
 - Statement Based Replication (SBR): replicates entire SQL statements;
 - Row Based Replication (RBR): replicates only the changed rows;
- Also exists a third variety which is a mixed of the two above:
 - Mixed Based Replication (MBR): The server decides as per even-basis;

MySQL Replication - Synchronization

- Replication in MySQL supports different types of synchronization;
- The original type of synchronization is one-way, asynchronous replication;
- MySQL also supports synchronous replication and;
- Semisynchronous replication where:
 - A commit performed on the source blocks before returning to the session that performed the transaction until at least one replica acknowledges that it has received and logged the events for the transaction;

PXC: Installation and configuration

PXC - Instalation

- For this workshop we'll use PXC 5.7 and CentOS 7 and OS package manager;
- If you prefer download the packages manually you can go to the download page at <https://www.percona.com/downloads/>
- Let's proceed with REPO installation and configuration:

```
sudo yum -y install https://repo.percona.com/yum/percona-release-latest.noarch.rpm  
sudo percona-release enable pxc-57  
sudo percona-release enable tools
```

- We can now install PXC and some other tools we'll use here:

```
sudo yum -y install Percona-XtraDB-Cluster-57 pmm2-client percona-toolkit sysbench
```

- We need to repeat the same process for all nodes;

PXC - Initial Configuration

- Let's access the **Node1** and start MySQL:

```
sudo systemctl start mysql
```

- When MySQL starts it automatically creates a temporary password for the user;
- We can find the password inside MySQL error log, which is “/var/log/mysqld.log” by default;

```
sudo grep 'temporary password' /var/log/mysqld.log
```

- We can now connect to MySQL and change the password:

```
mysql -u root -p
```

```
ALTER USER 'root'@'localhost' IDENTIFIED BY 'rootPasswd';
```

PXC - Initial Configuration

- Time to play with the configuration file;
- The file we'll use is ***“/etc/percona-xtradb-cluster.conf.d/wsrep.cnf”***;
- Below are the changes we'll make now:

Same for all nodes:

```
wsrep_cluster_name=pxc-workshop
wsrep_cluster_address=gcomm://192.168.200.20,192.168.200.21,192.168.200.22
pxc_strict_mode=ENFORCING
wsrep_sst_method=xtrabackup-v2
wsrep_sst_auth=sstuser:sstPasswd
```

Per node

```
wsrep_node_name=node1
wsrep_node_address=192.168.200.20
```

PXC - Initial Configuration

- Now it's time to restart MySQL on Node1 to apply the configurations;
- It will fail though... Let's check what is the issue!
- `systemctl start mysql@bootstrap.service`
- Issue fixed and server up, time to setup the SST user:

```
mysql -u root -p
CREATE USER 'sstuser'@'localhost' IDENTIFIED BY 'sstPasswd';
GRANT RELOAD, LOCK TABLES, PROCESS, REPLICATION CLIENT ON *.* TO
'sstuser'@'localhost';
FLUSH PRIVILEGES;
```

- Initial configuration done let's start the other nodes.

MySQL and PXC Log Files

MySQL and PXC Log Files

- Not all logs here might exist at all times but we need to know their existence to help us troubleshooting possible issues;
- MySQL Error Log
- MySQL Binary Logs
- Innobackup/Xtrabackup Log

Operation of PXC Cluster

Operation of PXC Cluster

- Bootstrap
- SST
- Checking Cluster Status
- Verifying Replication
- Flow Control

Performance tuning and monitoring

Performance tuning and monitoring

- During this first day we'll have an overview of the tuning and monitoring;
- We'll dive deeper into the topic on the Day 3;
- Most of the performance parameters are related to the storage engine, in our case, InnoDB:
 - MySQL InnoDB Buffer Pool;
 - InnoDB Log file:
 - `innodb_log_file_size`
 - `innodb_log_buffer_size`
 - `innodb_flush_log_at_trx_commit`
- No query cache. Not supported by PXC and even removed on MySQL 8!
- Network can be a bottleneck for writes. Nodes have to acknowledge commit;
- Avoid writing to more than one node at the same time. PXC doesn't scale writes!

Performance tuning and monitoring

- We'll use PMM as monitoring tool.
- It's installed by our Vagrant file but installation instructions can be found here <https://www.percona.com/software/pmm/quickstart#>
- We have already installed the PMM client with our YUM command;
- Configuring PMM client in our nodes:

```
mysql -p
CREATE USER 'pmm'@'localhost' IDENTIFIED BY 'pmmPasswd' WITH MAX_USER_CONNECTIONS 10;
GRANT SELECT, PROCESS, SUPER, REPLICATION CLIENT, RELOAD ON *.* TO 'pmm'@'localhost';

sudo pmm-admin config --force --server-insecure-tls
--server-url=https://admin:admin@192.168.200.10:443
sudo pmm-admin add mysql --username=pmm --password='pmmPasswd'
--query-source=perfschema
```

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Performance tuning and monitoring

- PMM Overview

The screenshot displays the Percona Monitoring and Management (PMM) dashboard. At the top, there are filter buttons for 'Interval' (set to 'auto'), 'Environment', 'Node Name', and 'All'. On the right, navigation links include 'Home', 'Query Analytics', 'Services', and 'PMM'. The main header features the PMM logo and the text 'Percona Monitoring and Management'. Below this, a 'General Information' section is visible. The dashboard is divided into several panels: 'Overview' on the left, 'Percona News' in the center, 'Starred & Recently used Dashb...' on the right, and two summary boxes at the bottom right for 'Monitored nodes' (1) and 'Monitored DB Services' (1). The 'Overview' panel contains links to documentation, community forums, and support. The 'Percona News' panel features a recent article about Marcelo Altmann's promotion to Oracle ACE. The 'Starred & Recently used Dashb...' panel lists several dashboards like 'Home Dashboard Insight', 'PostgreSQL Instance Summary', and 'PostgreSQL Instances Overview'. The bottom right summary boxes show 'Failed security checks' (Security Threat Tool is disabled) and 'PMM Upgrade' (Current version: 2.21.0, You are up to date).

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Thanks!

- We are done here for the day.
- Feel free to ask any questions during the class, on github at <https://github.com/elchinoo/tutorial-pxc> or drop me an email at charly.batista@percona.com
- You can also find me at <https://www.linkedin.com/in/charlybatista>