



PERCONA

TECH DAYS

Using PMM to identify and troubleshoot problematic MySQL queries

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Agenda

- Who am I
- Query Analysis
 - RED Method
 - PMM Query Analytics
- Demo using PMM Query Analytics

Michael Coburn, Principal Architect

- MySQL Expert, Product Manager for PMM - 8 years with Percona!
- Runner, Swimmer, Dad
- Latest projects: PXC Operator for Kubernetes, ProxySQL

MySQL Query Performance

MySQL Queries

- What are problematic queries in MySQL?
 - Queries that consume a high level of resources (disk, CPU, memory)
- Two types of queries
 - Queries that run slow individually, for example 3 seconds
 - Queries that run fast individually (< 100ms) but run at a high rate

MySQL Queries

•What can you do about Query Performance?

a. Re-write the query

- *Do less joins*
- *Use Index Hints*

b. Modify the schema: Implement Index changes (add new, or remove old)

- *Index the columns from the WHERE clause, then GROUP BY / ORDER BY, then ranges*

c. Implement caching

- ~~*MySQL Query Cache*~~
- *ProxySQL Query Cache*
- *Memcached/Redis*

MySQL Query Performance

- We'll show two methods of evaluating MySQL query performance
 - RED Method (inspired by USE Method)
 - PMM Query Analytics

USE Method

•USE method by Brendan Gregg to describe infrastructure usage

- USE
 - *Utilization: The percentage of time a resource is in use*
 - *Saturation: The amount of work the resource must accomplish (the queue)*
 - *Errors: A count of errors*

•Challenges

- measure saturation/amount used of memory
- I/O errors

RED Method

RED Method

•RED Method by Tom Wilkie

- Rate: The number of requests per second
- Errors: The number of Failed requests
- Duration: The amount of time to process a request

•Micro-services focused, based on the Four Golden Signals:

- Latency: The time it takes to service a request
- Traffic: A measure of how much demand on the system
- Errors: The rate of failed requests
- Saturation: A measure of how full the queue is

RED Method

- Peter Zaitsev developed a RED Method dashboard
 - [RED Method for MySQL Queries - Designed for PMM2](#)
- Query Rate
- Total Error Rate
- Total Query Latency
- Rows Examined per Query (bonus)

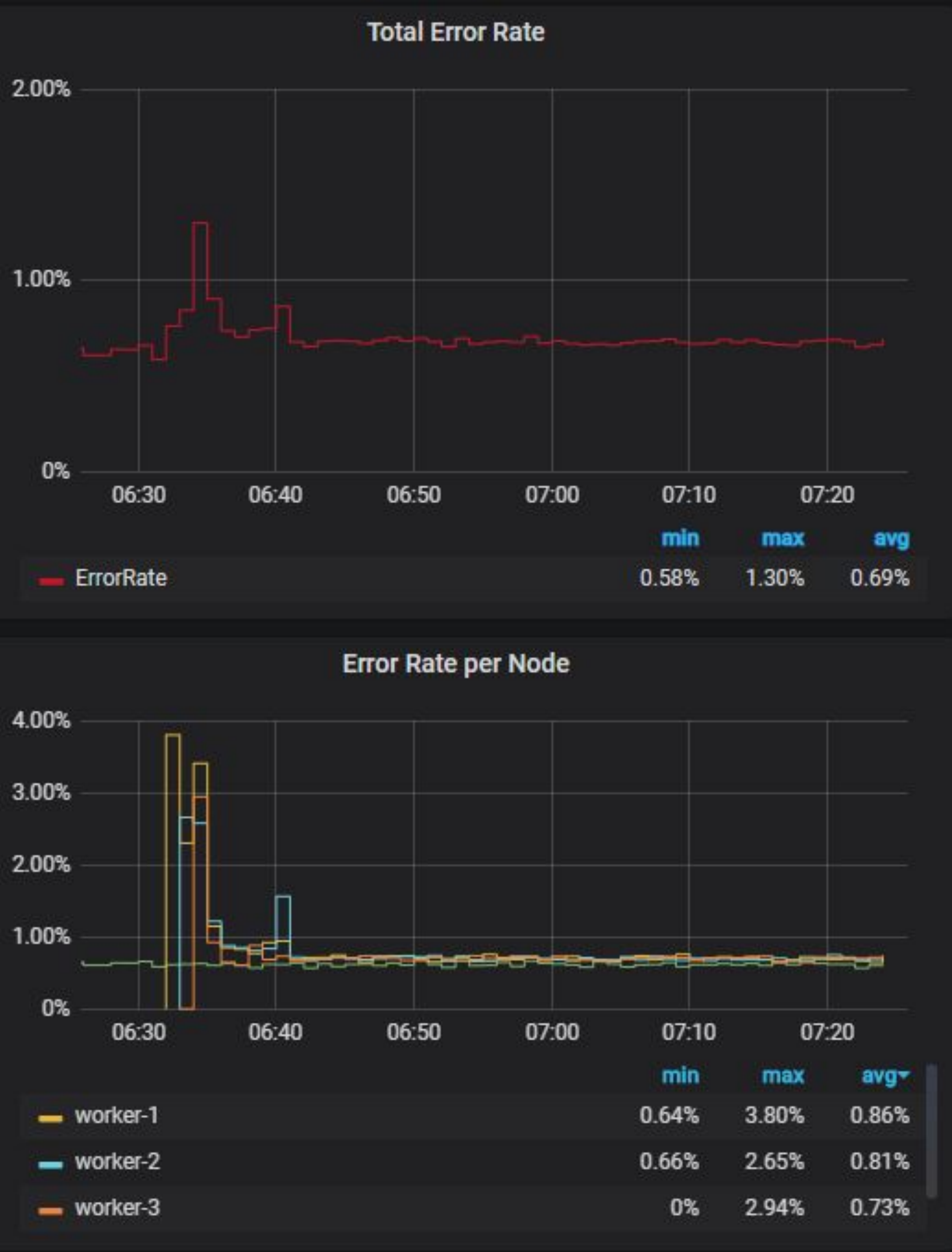
Query Rate

- queries/time
- Queries Per Second QPS



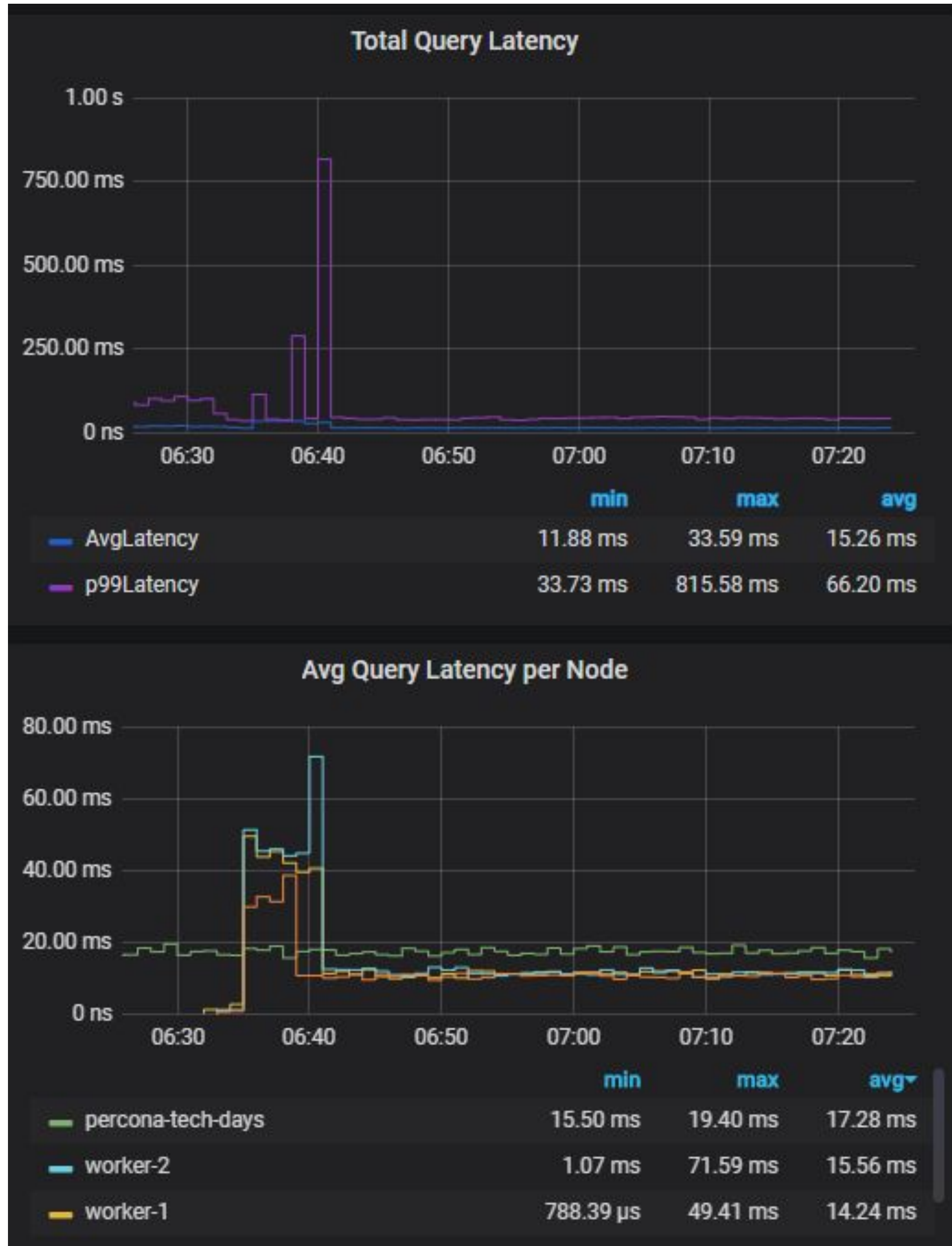
Total Error Rate

- Total errors for all instances
- Error rate per node
- `queries_with_errors/queries`



Total Query Latency

- Avg vs P99 for all Instances
- Per node Avg latency
- `query_time/query_count`



Rows Examined per Query

- $\text{rows_examined}/(\text{rows_sent}+\text{rows_affected})$
- Measures the efficiency of Indexes



PMM Query Analytics

Queries Taking the most Time (slowest queries)

.Query Time

| # | Query | Query Time |
|---|---|------------|
| | TOTAL | 12.73 ms |
| 1 | <code>select count(k) from sbtest1 where k between ? and ? or k between ? and ? or k between ? and ? ...</code> | 119.55 ms |
| 2 | <code>select t.table_schema, t.table_name, column_name, `auto_increment`, pow(?, case data_type wh...</code> | 26.44 ms |
| 3 | <code>select avg(length(c)) from sbtest1 where id between ? and ??</code> | 15.47 ms |
| 4 | <code>select event_name, count_star, sum_timer_wait from performance_schema.events_waits_summ...</code> | 3.72 ms |


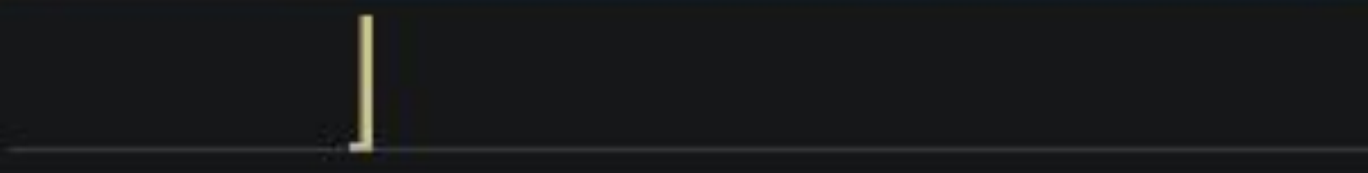
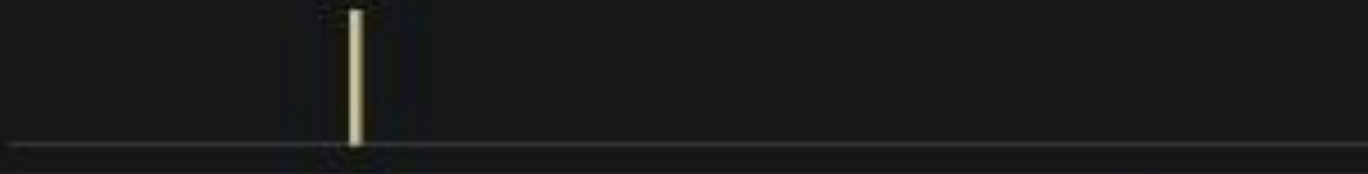




Queries Causing the greatest Load

- Load (average active sessions)

| # | Query | Load |
|---|---|---|
| | TOTAL |  2.54 load |
| 1 | <code>select count(k) from sbtest1 where k between ? and ? or k between ?...</code> |  1.98 load |
| 2 | <code>insert into sbtest1(k, c, pad) values(?+)</code> |  0.37 load |
| 3 | <code>commit</code> |  0.06 load |
| 4 | <code>create index k_1 on sbtest1(k)</code> |  0.06 load |
| 5 | <code>update sbtest1 set k=k? where id=?</code> |  0.01 load |
| 6 | <code>select c from sbtest1 where id=?</code> |  0.01 load |

Queries Waiting on Disk

•InnoDB IO Read Wait

| # | Query | InnoDB IO Read Wait |
|---|--|--|
| | TOTAL |  0.02 load |
| 1 | create index k_1 on sbtest1(k) |  <0.01 load |
| 2 | create table sbtest1(id integer not null auto_increment, k integer def... |  <0.01 load |
| 3 | update sbtest1 set k=k? where id=? |  <0.01 load |
| 4 | select count(k) from sbtest1 where k between ? and ? or k between ?... |  <0.01 load |
| 5 | update sbtest1 set c=? where id=? |  <0.01 load |
| 6 | delete from sbtest1 where id=? |  <0.01 load |

Queries Reading from Disk

•InnoDB IO Read Ops

| # | Query | | InnoDB IO Read Ops |
|---|--|---|---|
| | TOTAL | |  68.01 (per sec) |
| 1 | create index k_1 on sbtest1(k) | ① |  38.09 (per sec) |
| 2 | select count(k) from sbtest1 where k between ? and ? or k between ?... | ① |  6.87 (per sec) |
| 3 | update sbtest1 set k=k? where id=? | ① |  6.00 (per sec) |
| 4 | delete from sbtest1 where id=? | ① |  5.95 (per sec) |
| 5 | update sbtest1 set c=? where id=? | ① |  5.94 (per sec) |

Query Detail

•At-a-Glance Query metrics

| Metric | Rate/Second | Sum | Per Query Stats |
|-----------------------|---------------------|--|-----------------|
| Query Count | 16.04 QPS | 346.47k 9.65% of total | 1.00 |
| Query Time | 1.98 load | 11:54:33 90.31% of total | 123.74 ms |
| Lock Time | <0.01 (avg load) | 42.10 sec 8.7% of total 0.1% of query time | 121.51 µs |
| Rows Sent | 16.04 (per sec) | 346.47k 0.5% of total | 1.00 |
| Rows Examined | 4.99m (per sec) | 107.72b 99.59% of total 310.90k per row sent | 310.90k |
| Bytes Sent | 1.14 KB (per sec) | 24.60 MB 0.73% of total 71.00 Bytes per row sent | 71.00 Bytes |
| InnoDB Read Bytes | 112.59 KB (per sec) | 2.43 GB 10.1% of total 16.38 KB per Read Ops | 7.02 KB |
| InnoDB IO Read Ops | 6.87 (per sec) | 148.43k 10.1% of total | 0.43 |
| InnoDB IO Read Wait | <0.01 load | 0:01:25 19.59% of total 0.2% of query time | 244.81 µs |
| InnoDB Pages Distinct | 4.24 k | 91.50 m 83.91% of total | 264.08 |

Schema Information

•CREATE TABLE

- What is my primary key
- What indexes do I have

•SHOW TABLE STATUS

- Row count (est.)
- Table size
(data_length+index_length)

•SHOW INDEXES

- Index cardinality

```
CREATE TABLE `sbtest1` (  
  `id` int NOT NULL AUTO_INCREMENT,  
  `k` int NOT NULL DEFAULT '0',  
  `c` char(120) NOT NULL DEFAULT '',  
  `pad` char(60) NOT NULL DEFAULT '',  
  PRIMARY KEY (`id`),  
  KEY `k_1` (`k`),  
  KEY `k_2` (`k`,`c`)  
) ENGINE=InnoDB AUTO_INCREMENT=1000001 DEFAULT CHARSET=utf8mb4 COLLATE=utf8mb4_0900_ai_ci
```

| Status | | | | | | | | | | | | | | | | | |
|---------|--------|---------|------------|--------|----------------|-------------|-----------------|--------------|-----------|----------------|----------------------|----------------------|------------|--------------------|----------|----------------|---------|
| Name | Engine | Version | Row_format | Rows | Avg_row_length | Data_length | Max_data_length | Index_length | Data_free | Auto_increment | Create_time | Update_time | Check_time | Collation | Checksum | Create_options | Comment |
| sbtest1 | InnoDB | 10 | Dynamic | 494030 | 202 | 100253696 | 0 | 0 | 4194304 | 500017 | 2020-09-10T16:17:25Z | 2020-09-10T11:35:23Z | null | utf8mb4_0900_ai_ci | null | NULL | NULL |

| Indexes | | | | | | | | | | | | | | |
|---------|------------|----------|--------------|-------------|-----------|-------------|----------|--------|------|------------|---------|---------------|---------|------------|
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
| sbtest1 | 0 | PRIMARY | 1 | id | A | 986400 | null | null | NULL | BTREE | NULL | NULL | YES | null |
| sbtest1 | 1 | k_1 | 1 | k | A | 311489 | null | null | NULL | BTREE | NULL | NULL | YES | null |
| sbtest1 | 1 | k_2 | 1 | k | A | 297959 | null | null | NULL | BTREE | NULL | NULL | YES | null |
| sbtest1 | 1 | k_2 | 2 | c | A | 986400 | null | null | NULL | BTREE | NULL | NULL | YES | null |

Demo of PMM Query Analytics



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