

Foglight for MySQL

Cartridge Guide

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MySQL Cartridge Introduction

With over 65,000 downloads per day and six million installations worldwide, MySQL has become the most widely deployed open source database solution and is second most widely deployed database solution period! Originally released in 1995, adoption has steadily grown and with the acquisition by Oracle, MySQL now sets the standard as a robust low-cost alternative to high-cost enterprise data stores.

Early adopters included Internet pioneers such as Google, eBay, Craigslist and Yahoo, but the list of customers has steadily grown and now includes financial industry giants as Dun & Bradstreet, JP Morgan Chase, and telecom giants Nokia as well as pharmaceutical powerhouse Eli Lilly. Whether you are building and supporting commercial websites, distributing enterprise applications or engineering advanced communications networks, the technologies used to run your organization must be readily adaptable for you to remain competitive.

MySQL Cartridge Overview

Based on Quest Software's leading application performance management solution; Foglight for MySQL provides combines world-class monitoring and alerting with operational best-practices designed to ensure the performance and availability of your MySQL databases. Utilizing standard API's, the cartridge provides integration to MariaDB and MySQL Versions 5.0 and above. The robust nature of the Agent ensures its ability to collect granular performance data and display that information through intuitive, easy-to-use dashboards. Based on vast experience building and deploying monitoring solutions, Foglight for MySQL ensures the performance and availability of this critical component. The solution leverages best practices for collecting, storing and representing data as well as detecting environmental abnormalities.

True Enterprise Information Correlation

At the core of the solution is Quest Software's Foglight. Foglight's rich architecture combines a central repository, rules and notification engine, data visualization platform to provide an application performance management that is second to none. This platform permits MySQL data to be combined with data from other enterprise domains to create a true end-to-end view of your critical applications and services. MySQL data collection intervals are pre-defined but are user adjustable for each functional area of the database. Once data has been collected, it is stored in the Foglight repository for a period defined by the administrator. The repository centralizes data collection and facilitates data visualization and trend analysis. Combining MySQL data with other metrics collected by Foglight produces a solution that provides the operator with unprecedented visibility into applications and business services.

Dashboards

Data is displayed through database specific dashboards. Foglight for MySQL provides a series of specific dashboards for MySQL databases and tables. These dashboards are easily complimented and extended utilizing Foglight's powerful drag-and-drop dashboarding capabilities. Operators can easily save dashboards as 'bookmarks' and return to them as needed. Dashboards and/or Reports can be created based on any data stored in the central repository and is not limited to data from a specific database such as MySQL.

Diagnostics is made possible through drill-downs from included dashboards. Each dashboard was designed to provide at-a-glance health state for domains. Additional diagnostic information is made

available through drill-downs providing the critical information necessary to troubleshoot complex issues. Since most enterprises rely on a complex technology stack to ensure business continuity, Foglight provides the ability to correlate, view, alert and report on technology from most standard enterprise applications.

Rules Engine

Alerting is often the first indication that a problem exists or may exist if preventative measures are not taken in a timely manner. A notable strength of the solution lies in its ability to leverage both MySQL Error Log alerts and the Foglight rules engine. Error Log messages are propagated to Foglight where they are assigned a severity and can be acknowledged or cleared. Foglight provides the ability for notifications to be sent to administrative and support personnel. The Foglight rules engine permits the operator to easily construct or modify any rule based on any metric using standard operators and variables. A robust set of rules is included with the solution and is defined in this document.

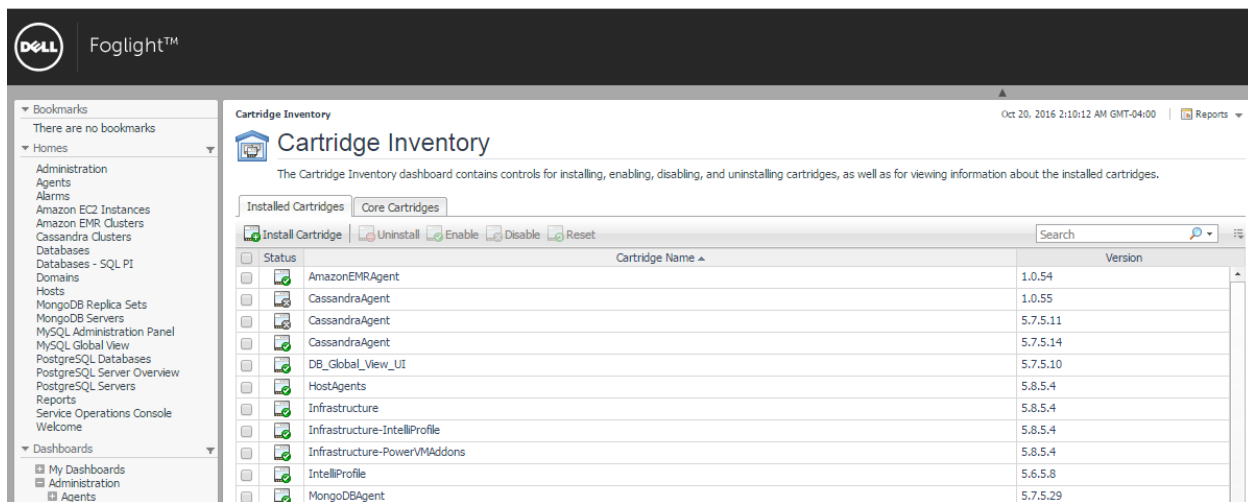
Statement Digests

Statement digest monitoring extends the rich functionality of the MySQL Cartridge, providing the ability for Foglight to collect and analyze information from your MySQL server's performance_schema for versions 5.6.5 and greater, or the Slow Query Log for lesser versions. Queries are normalized and aggregated in order to provide meaningful results on the performance of unique query structures without exposing non-relevant or protected string values.

This functionality allows users to quickly identify slow running and problematic queries and helps administrators better understand the efficiency of these queries in both development and production environments with a minimal amount of overhead. Further information provides an accurate picture of how queries perform when the server is under a realistic workload with detailed metrics on performance throughout the query's execution, along with an explain plan available on request. Coupled with Foglight's historical data collection and powerful rules engine, this ensures you will be alerted on all negative performance trends or spikes in query performance.

MySQL Cartridge Installation

1. Open Foglight Web Console.
2. From the navigation pane, select: **Administration**.
3. Click “Licenses” in the Administer Server section.
4. Install the appropriate license key to run the cartridge.
5. Return to the **Administration** dashboard.
6. Click “Cartridges” in the Administer Server section.
7. Load the **MySQLAgent-5_x.car** file by clicking the Install Cartridge button. Leave the “Enable on Install” check box checked when installing the cartridge.
8. Once the installation is completed on the Foglight Management Server, the MySQL Agent Cartridge will appear in this list below as an installed cartridge.



The screenshot shows the Foglight web console interface. The top navigation bar includes the Dell logo and the text "Foglight™". On the left, there is a navigation pane with sections for "Bookmarks" (containing "There are no bookmarks") and "Homes" (listing various system components like Administration, Agents, Alarms, Amazon EC2 Instances, Amazon EMR Clusters, Cassandra Clusters, Databases, Databases - SQL PI, Domains, Hosts, MongoDB Replica Sets, MongoDB Servers, MySQL Administration Panel, MySQL Global View, PostgreSQL Databases, PostgreSQL Server Overview, PostgreSQL Servers, Reports, Service Operations Console, and Welcome). The main content area is titled "Cartridge Inventory" and includes a subtitle: "The Cartridge Inventory dashboard contains controls for installing, enabling, disabling, and uninstalling cartridges, as well as for viewing information about the installed cartridges." Below this, there are tabs for "Installed Cartridges" and "Core Cartridges". The "Installed Cartridges" tab is active, showing a table of installed cartridges. The table has columns for "Status", "Cartridge Name", and "Version". The "Status" column contains checkboxes and green checkmark icons. The "Cartridge Name" column lists various agents, and the "Version" column shows their respective versions. A search bar is located at the top right of the table.

Status	Cartridge Name	Version
<input type="checkbox"/>	AmazonEMRAgent	1.0.54
<input type="checkbox"/>	CassandraAgent	1.0.55
<input type="checkbox"/>	CassandraAgent	5.7.5.11
<input type="checkbox"/>	CassandraAgent	5.7.5.14
<input type="checkbox"/>	DB_Global_View_UI	5.7.5.10
<input type="checkbox"/>	HostAgents	5.8.5.4
<input type="checkbox"/>	Infrastructure	5.8.5.4
<input type="checkbox"/>	Infrastructure-IntelliProfile	5.8.5.4
<input type="checkbox"/>	Infrastructure-PowerVMAddons	5.8.5.4
<input type="checkbox"/>	IntelliProfile	5.6.5.8
<input type="checkbox"/>	MongoDBAgent	5.7.5.29

MySQL Agent User Permissions

The Foglight MySQL agent requires certain minimum privileges for the MySQL Database User to be able to monitor a MySQL database.

Create a MySQL Database User by logging into the MySQL server and granting the privileges identified below.

User privileges required for the MySQL agent on the host machine:

- SELECT
- REPLICATION CLIENT (if monitoring replication)
- PROCESS
- SUPER (for MySQL versions below 5.1.24)

If monitoring a replication slave server with the agent, that database user must have:

- SELECT
- REPLICATION CLIENT

Example 1:

```
CREATE USER '<user>'@'<localhost or DB HostName or IP>' IDENTIFIED BY '<password>';
GRANT SELECT, REPLICATION CLIENT, PROCESS ON *.* TO '<user>'@'<localhost or DB HostName or IP>';
FLUSH PRIVILEGES;
```

e.g.

```
CREATE USER 'MySQLUser'@'localhost' IDENTIFIED BY 'MySQLpassword';
GRANT SELECT, REPLICATION CLIENT, PROCESS ON *.* TO 'MySQLUser'@'localhost';
FLUSH PRIVILEGES;
```

or

Example 2:

```
GRANT SELECT, REPLICATION CLIENT, PROCESS ON *.* TO '<user>'@'<localhost or DB HostName or IP>' IDENTIFIED BY '<password>';
FLUSH PRIVILEGES;
```

e.g.

```
GRANT SELECT, REPLICATION CLIENT, PROCESS ON *.* TO 'MySQLUser'@'localhost' IDENTIFIED BY 'MySQLpassword';
FLUSH PRIVILEGES;
```

Configuring an SSL Connection

The below instructions cover common steps used to configure an SSL connection from the MySQL Agent client. For full information on secure connections and server-side configuration, refer to the [Using Secure Connections](#) section of the MySQL documentation for your version.

In order to use SSL, your MySQL server must be built with OpenSSL or yaSSL. To check whether SSL is enabled, run this query:

```
SHOW VARIABLES LIKE 'have_ssl';
```

If the query returns YES, your server can use SSL. If it returns DISABLED, the server must be started with the SSL options listed in the above mentioned section. SSL and RSA certificates and keys must also be generated in order to use SSL. Information on generating those can be found [here](#).

The client requires a client certificate and certificate authority (CA) certificate. These are named client-cert.pem and ca.pem respectively if generated by the MySQL server and should be located in the data directory. First, the client certificate needs to be converted into DER format. This can be performed by downloading OpenSSL and running the following command:

```
openssl x509 -outform DER -in client-cert.pem -out client.cert
```

Then, the certificates must be imported into the FglAM keystore. You can use the bundled keytool, which will be located in the Foglight Agent Manager\jre\1.8.0.72\jre\bin directory, or the equivalent on your system, with these commands:

```
keytool.exe -import -file ca.pem -keystore truststore -alias mysqlServerCACert
```

```
keytool.exe -import -file client.cert -keystore keystore -alias mysqlClientCertificate
```

If you have not changed the password for the keystore, the default password will be “changeit”. Next, edit the baseline.jvmargs.config file in the Foglight Agent Manager\state\default\config directory and add the following parameters with file paths and passwords appropriate for your system. Escape any quotes with a ‘\’.

```
vmparameter.0 = "-Djavax.net.ssl.keyStore=\"C:/Program Files/Common Files/Dell/Foglight Agent Manager/jre/1.8.0.72/jre/bin/keystore\"";  
vmparameter.1 = "-Djavax.net.ssl.keyStorePassword=changeit";  
vmparameter.2 = "-Djavax.net.ssl.trustStore=\"C:/Program Files/Common Files/Dell/Foglight Agent Manager/jre/1.8.0.72/jre/bin/truststore\"";  
vmparameter.3 = "-Djavax.net.ssl.trustStorePassword=changeit";
```

Then, restart the FglAM and continue with the agent configuration, setting the “Use SSL” option in the Agent Properties to true.

Configuring the MySQL Slow Query Log

For MySQL servers version 5.6.5 or greater, it is recommended that you monitor statement digests through the `performance_schema`, as it collects more information. However, some limited information can be gathered through the slow query log.

Configuration of the Slow Query Monitor first requires that slow query logging is enabled. This can be accomplished in one of three ways. 1) Change the server runtime parameters while the server is running. 2) Provide certain command-line options when starting the server. 3) Edit the MySQL configuration file to enable and configure the log.

We recommend using option three (3). Choosing option 3 will ensure that the MySQL Server is always started with the correct parameters. Option one (1) can be used to avoid doing an initial restart of the server in order to enable the slow query log. As of version 5.1.29, the following options may be used:

Option	Sample Value	Required	Note
<code>slow_query_log</code>	1	Yes, defaults to 0	1 enables the log, 0 disables it
<code>slow_query_log_file</code>	C:\Program Files\MySQL\slow_query.log	Yes, defaults to <i>hostname-slow.log</i>	Any path name is acceptable
<code>long_query_time</code>	0.5	Yes, defaults to 10	Units are in seconds, can also use 0 or microseconds
<code>log_short_format</code>	FALSE	Yes, defaults to FALSE	Must be set to FALSE
<code>log_slow_admin_statements</code>	OFF	No, defaults to OFF	Logs admin statements like ANALYZE, OPTIMIZE, ALTER TABLE, etc.
<code>log_queries_not_using_indexes</code>	ON	No, defaults to OFF	Logs queries expected to retrieve all rows
<code>log_slow_slave_statements</code>	OFF	No, defaults to OFF	Logs statements on a replication slave server
<code>min_examined_row_limit</code>	0	No, defaults to 0	Logs statements that have examined minimum # of rows

See section 5.2.5 of the online MySQL documentation for more information on the slow query log specific to your version. Some of these properties may become deprecated in future versions or not exist in versions before 5.1.12.

Additionally, it is important to understand that the server does not write queries handled by the query cache to the slow query log, nor does it write queries that would not benefit from the presence of an index as the table has either zero or one row. Also of note is that the server does not automatically rotate the slow query log. If you wish to rotate your log file, you may simply delete or rename the current log file manually or with a utility program and the server will create a new log file itself. It is recommended you do this at a period of low activity so as to not cause the agent to miss reading important data.

MySQL Agent Properties

When an agent connects to the Foglight Management Server, it is provided a set of properties that is then used to configure its correct running state.

Default Agent properties are installed with the Foglight Cartridge for MySQL. However, the user will typically edit the default agent properties. Agent properties may apply only to a specific agent instance, or may be applicable across multiple agents.

For more information about working with agent properties, see the Foglight *Administration and Configuration Guide*.

To modify the agent properties for a new agent instance:

Open Foglight.

1. From the navigation pane, select: **Dashboards > Administration > Agents > Agent Status**. The Agent Status screen appears.
2. Deploy the MySQL agent package.
3. Create a MySQL agent instance.
4. Click on a MySQL agent type row. The selected row is highlighted with a yellow background.
5. Click the **Edit Properties** button.
6. Select **Modify the default properties for this agent**.
7. Edit the agent properties for the MySQL agent instance:
 - [Setting Connection Parameters \(mandatory\)](#)
 - [Setting Slave Connection Parameters \(optional\)](#)
 - [Setting Collection Intervals \(optional\)](#)
8. Click the **Activate** button.

Setting Connection Parameters (mandatory)

- **Database Host** – Host where MySQL server is running. Default is “localhost”. (e.g.<hostname> or <IP address>)
- **Database Port** – Port the MySQL database is running. Default is 3306.
- **Database Name** – Name of a valid MySQL database that the user is allowed to connect to. Note: This is for connection purposes only. All non-system databases will still be monitored. The ‘mysql’ database is usually an acceptable entry.
- **Database User** – User that can connect to the MySQL server being monitored.
- **Database Password** – Password of the user that can connect to the MySQL database being monitored.
- **Use SSL** – Requires the connection to the MySQL server to use SSL (TLS). For more information on enabling SSL, refer to the [Configuring an SSL Connection](#) section.
- **Use Cleartext** – Enables the cleartext authentication method that sends the unhashed password to the MySQL server. It is recommended that SSL be enabled if this is done.

Setting Administration (optional)

- **Enable Administration** – Set to true in order to use the MySQL Administration Panel for this agent. See the MySQL Administration Panel for more information. Default is false.
- **Enable Explain Plans** – Set to true in order to enable Explain Plan requests from the Administration Panel and Statement Digests pages. Default is false.
- **Admin User** – User that will be employed only to perform administrative actions on the monitored MySQL server. This user must have the privileges to perform the requested actions or the action will fail.

- **Admin Password** – Password of the user that will be employed to perform administrative actions on the server.

Setting Replication Parameters (optional)

- **Monitor Master Status?** – Set to true to monitor the Master replication status on the MySQL server.
- **Monitor Slave Status?** – Set to true to monitor the Slave replication status on the MySQL server.
- **Monitor Replication Slave?** – Set to true to monitor the Slave replication status (and only this) on the replication slave server, of which the parameters below pertain to.
- **Database Host** – Host where MySQL Replication Slave Server is running.
- **Database Port** – Port the Slave Connection is running on.
- **Database Name** – Name of MySQL Replication Server Database to be monitored.
- **Database User** – User that can connect to the MySQL Replication Server database being monitored.
- **Database Password** – Password of the user that can connect to the MySQL Replication Server database being monitored.

Setting Slow Query Log Monitoring Parameters (optional)

— Query Log Monitoring

Monitor Slow Query Log?	<input checked="" type="radio"/> True <input type="radio"/> False
File Access	Local
Collection Period	1200
Line Limit (0 = no limit)	0
File Path	C:\Program Files\MySQL
File Name (can use regex pattern for local only)	slow_query_log.log
Remote Hostname or IP	hostname
SSH User	root
SSH Password	*****

- **Monitor Slow Query Log** - Enable this collection by setting to True.
- **File Access** – If the MySQL Agent is running locally on the same machine as the MySQL server it is monitoring, you may select Local. The other option, Remote_SSH, allows an SSH connection to a remote server in order to retrieve the slow query log.
- **Collection Period** – How often collection occurs, in seconds. It is recommended that this setting be at least 30-60 minutes or more. Currently, unique queries can only be aggregated within their own collection period, so a lengthier collection period will provide a more accurate analysis of a unique query without having to navigate through too many data collections.
- **Line Limit** – Restricts the amount of lines read from the slow query log during each collection. Unless a truly exceptional amount of data is being generated to the slow query log (in which case the long_query_time parameter should probably be increased), this parameter should remain at 0. A value of -1 will cause the agent to read all previous data during its first collection

rather than marking the current file position and reading from that point during its next collection.

- **File Path** – File path to slow query log directory.
- **File Name** – File name of slow query log. Optionally, for Local collection only, a regex string may be used and the most recently modified file matching the regex string name will be used.

If using remote file access, the following values must be provided

- **Remote Hostname or IP** – A hostname or IP address valid from the MySQL Agent's location.
- **SSH User** – An SSH user with access to the slow query log's location and file permissions to perform a read action.
- **SSH Password** – The password for the provided SSH user.

Setting Performance_Schema (optional)

- **Statements** – If the MySQL server version is 5.6.5+ and the performance_schema engine is enabled, the agent will collect statement digest information at this interval. Default set to 300 seconds.

Setting Collection Intervals (optional)

The Collection Interval fields in the agent properties are used to set the sample frequencies. Default collection frequencies (in seconds) have already been set for each table below.

- **Blocked Transactions** – Default set to 60 seconds.
- **Buffer Pool** (i.e. Innodb_Buffer_Pool) – Default set to 300 seconds.
- **Configuration Monitoring** - Default set to 300 seconds.
- **Connection_Status** – Default set to 60 seconds.
- **Database Information** – Default set to 300 seconds.
- **Galera** – Default set to 60 seconds.
- **Handler** – Default set to 300 seconds.
- **Index Structure** - Default set to 3600 seconds.
- **Index/Table-level Compression** – Default set to 1800 seconds.
- **InnoDB Compression** – Default set to 300 seconds.
- **InnoDB Engine** (i.e. Innodb_Storage_Engine) – Default set to 300 seconds.
- **Joins** – Default set to 300 seconds.
- **Key Buffer** – Default set to 300 seconds.
- **Network Interface** – Default set to 300 seconds.
- **Query Cache** – Default set to 300 seconds.
- **Replication** – Default set to 300 seconds.
- **Sort Buffer** – Default set to 300 seconds.
- **Tables** – Default set to 1800 seconds.
- **Table Locks** – Default set to 60 seconds.
- **Thread Pool** – Default set to 300 seconds.
- **Top Sessions** – Default set to 300 seconds.
- **Transaction Log** (i.e. Innodb_Transaction_Log) – Default set to 1800 seconds.
- **Users** – Default set to 3600 seconds.

Options (optional)

- **Agent Host Name** – If a hostname alias is being used for monitoring purposes that is different than the one provided by the MySQL server, provide that here. If using the Infrastructure cartridge for OS monitoring, this name should match any alias provided for OS monitoring in order to link the data correctly.
- **Skip Startup Connection Test** – When the agent is first activated, it performs a connection test to ensure that a connection can be made to the MySQL server. If it cannot, it is assumed there is a persistent failure due to incorrect configuration or other issues which need to be resolved and the agent will show as failed until fixed and restarted. In cases like a restart when the agent and the MySQL server are located on the same machine and you expect the agent to activate before the server is accessible, you may want to disable this. If you wish to skip the connection test, set to true.
- **Minimum TRX Block Time (sec)** – This is the minimum wait time for a transaction to be considered deadlocked and thus valid for inclusion in the Blocked Transactions collection. The default time is 15 seconds.
- **Include Views in Table Collection** – Option to include Views in the table collection. Set to false by default.

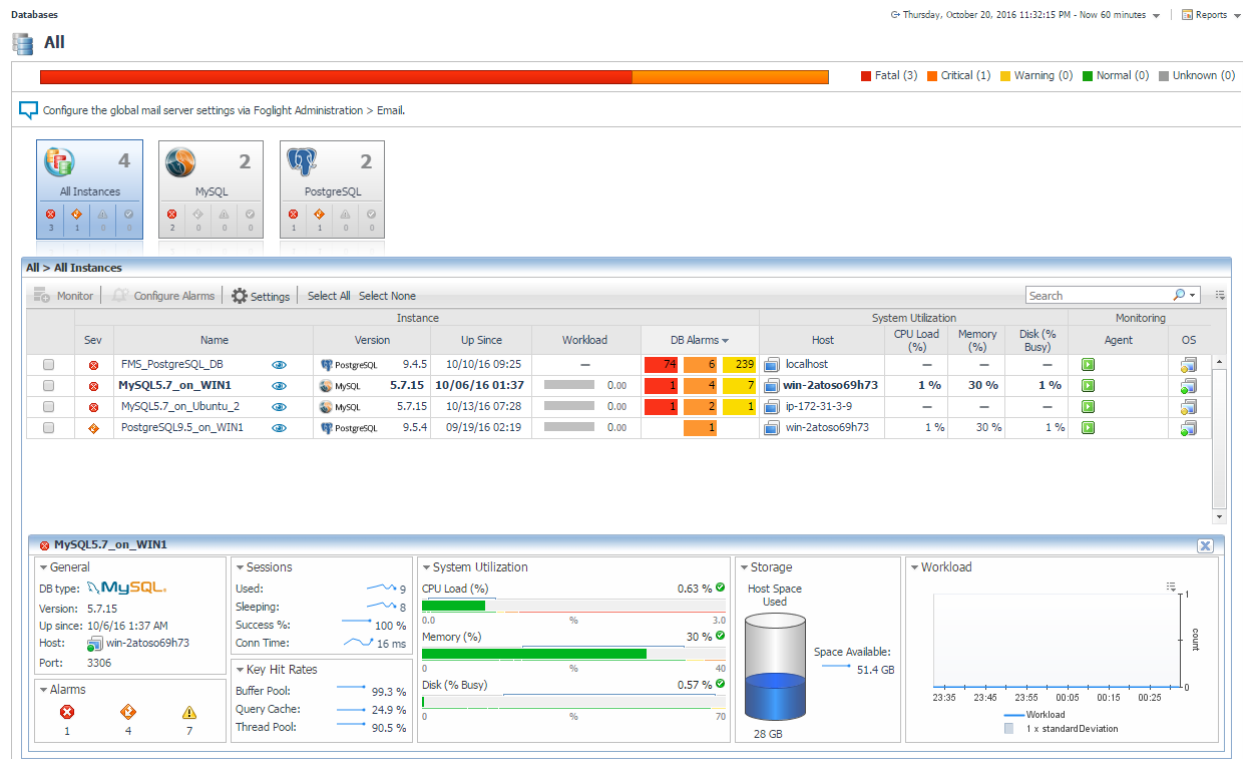
MySQL Dashboards

The installation of the MySQL Cartridge includes the MySQL Dashboards. The MySQL Cartridge offers several principal dashboards:

- Databases
- MySQL Global View (deprecated)
- MySQL Server
- MySQL Server Metrics
- Tables
- MySQL Administration Panel
- Replication Data Sample
- MySQL Statement Digests

Drill downs from these dashboards are available to expose more granular data. It should be noted that there is a great deal of additional information that is collected that is not displayed in these primary dashboards. Should an operator wish to have that information displayed, Foglight allows for the creation of simple drag and drop dashboards.

Databases



Foglight for MySQL is now incorporated into the Databases dashboard along with any other monitored database types in your environment. Like other products, the list of databases can be filtered by type and severity level and includes basic information, alarms, and host utilization metrics. Clicking on the eye icon will bring up the Quick View with more key information. Clicking the name will drill down to the MySQL Server View.

Global View Dashboard

MySQL Global View Thursday, July 17, 2014 11:32 AM - Now 4 hours Reports

Search

	Name	Host	Instance		Start Time	Workload	Alarms			Query Cache		Thread Pool		InnoDB Buffer Pool
			Port	Version			F	C	W	Hit Ratio	Queries	Hit Ratio	Threads Running	Hit Ratio
✖	MySQLAgent_on_5.6	WIN2008x64-2	63306	5.6.16	7/16/14 3:30 PM	0.03	1	2	2	0 %	0	94 %	3	92 %
✖	MySQLAgent_on_5.5	WIN2008x64-2	43306	5.5.36	7/14/14 3:30 PM	n/a	1	2	2	0 %	0	93 %	1	92 %
⚠	MySQLAgent_on_FMS	WIN2008x64-2	13306	5.1.45	7/14/14 3:30 PM	n/a	0	2	0	7 %	5 K	98 %	1	100 %

The MySQL Global View dashboard displays the following metrics, in row format, for each MySQL agent instance deployed:

- **Instance Group**
 - Health Indicator – Shows the overall health of the deployed instance.
 - Name – The “Instance Name” of the MySQL agent. This is the name entered when the MySQL agent instance was created.
 - Host – Host Name of the MySQL agent instance.
 - MySQL Version – The version of the MySQL database being monitored.
- **Alarms Group**
 - Fatal – Provides a count of the “Fatal” alerts for this agent.
 - Critical – Provides a count of the “Critical” alerts for this agent.
 - Warning – Provides a count of the “Warning” alerts for this agent.
- **Query Cache Group**
 - Hit Ratio – Provides a historical trend and a current value of the Query Cache Hit Ratio for the selected time range.
 - Queries – Provides a historical trend and a current value of the number of SQL statements that are in cache for the selected time range.
- **Thread Pool Group**
 - Hit Ratio – Provides a historical trend and a current value of the ratio of the number of threads that were used from the pool to the total number of connections made for the selected time range.
 - Threads Running – Provides a historical trend and a current value of the number of active (non-sleeping) threads for the selected time range.
- **InnoDB Buffer Pool**
 - Hit Ratio – Provides a historical trend and a current value of the InnoDB BufferPool Hit Ratio for the selected time range.

To get additional information for some of the metrics, the MySQL Global View dashboard provides a dwell capability (by hovering over the metric) and drill down (clicking on the metric) functionality built-in.

The dwell (hovering over the metric) functionality provides a graphical trend for the selected metric over a specified time range

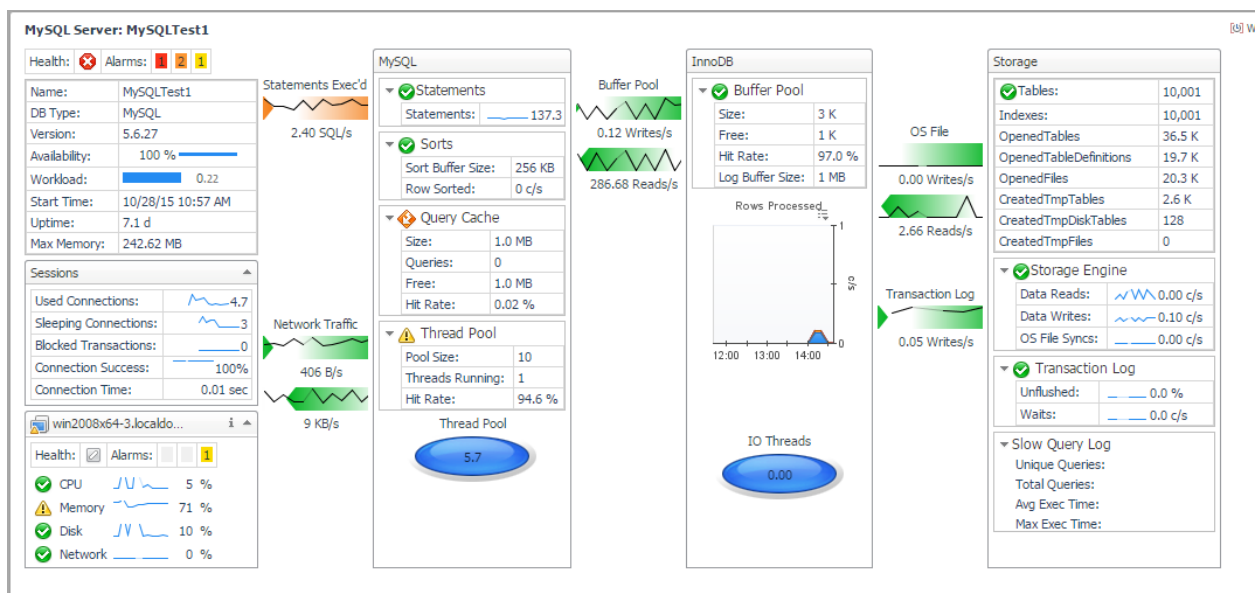
The following metrics in the MySQL Global View dashboard feature the dwell functionality:

- Instance -- Host
- Alarms – Fatal, Critical and Warning (when MySQL alerts are triggered)
- Query Cache – Hit Ratio
- Query Cache – Queries
- Thread Pool – Hit Ratio
- Thread Pool – Threads Running
- InnoDB BufferPool – Hit Ratio

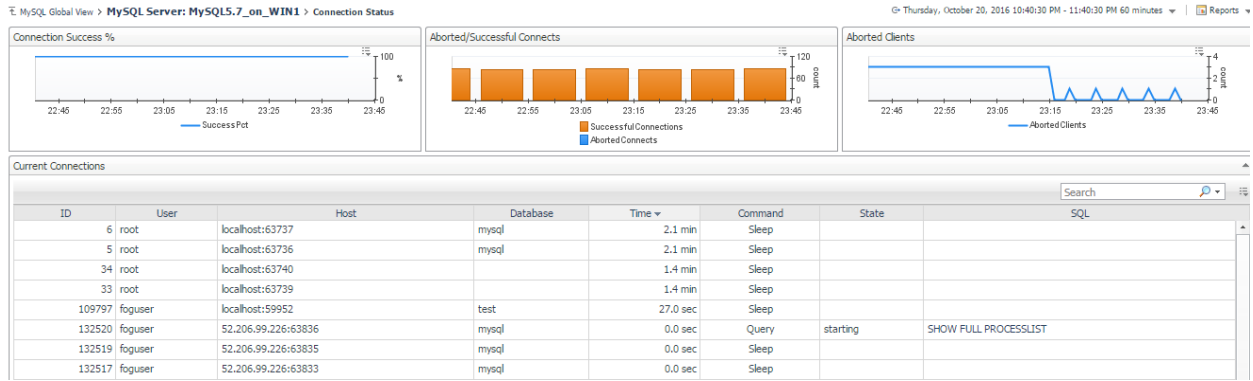
The drill down (clicking on the metric) functionality provides a graphical trend of different metrics for the selected group over a specified time range

The following metrics in the MySQL Global View dashboard feature the drill down functionality:

- Instance (Name) – will drill down to the MySQL Server dashboard. Please see the [MySQL Server Dashboard](#) section for more detail information. This dashboard has a “MySQL Agent Selector” option in the right panel.



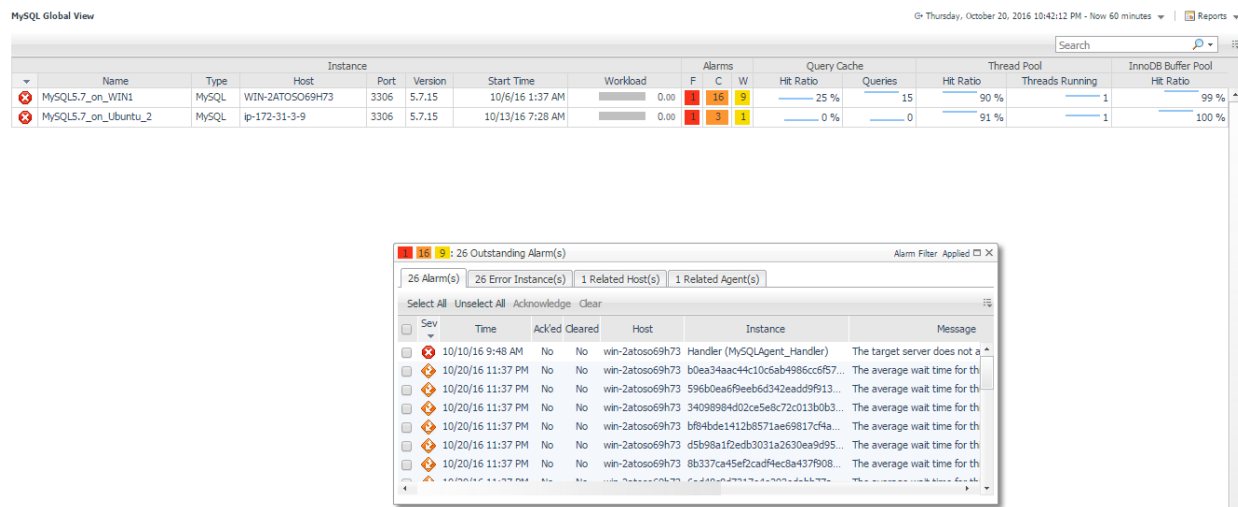
A drill-down from either the Connections or Max Connections component of the MySQL Server view takes the operator to a view of the top sessions and the SQL being executed.



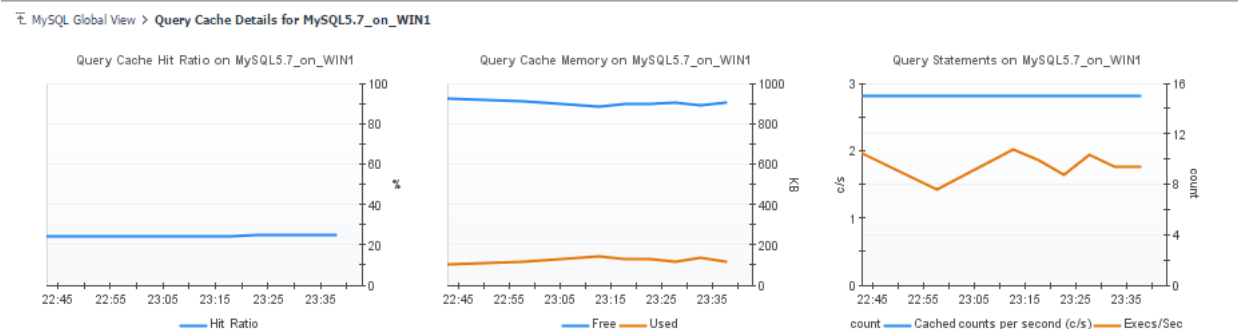
- Instance (Host) – will drill down to the Host Monitor view for the select “<Host>”. Please see OSCartridges User Guide for more detail information on this dashboard.



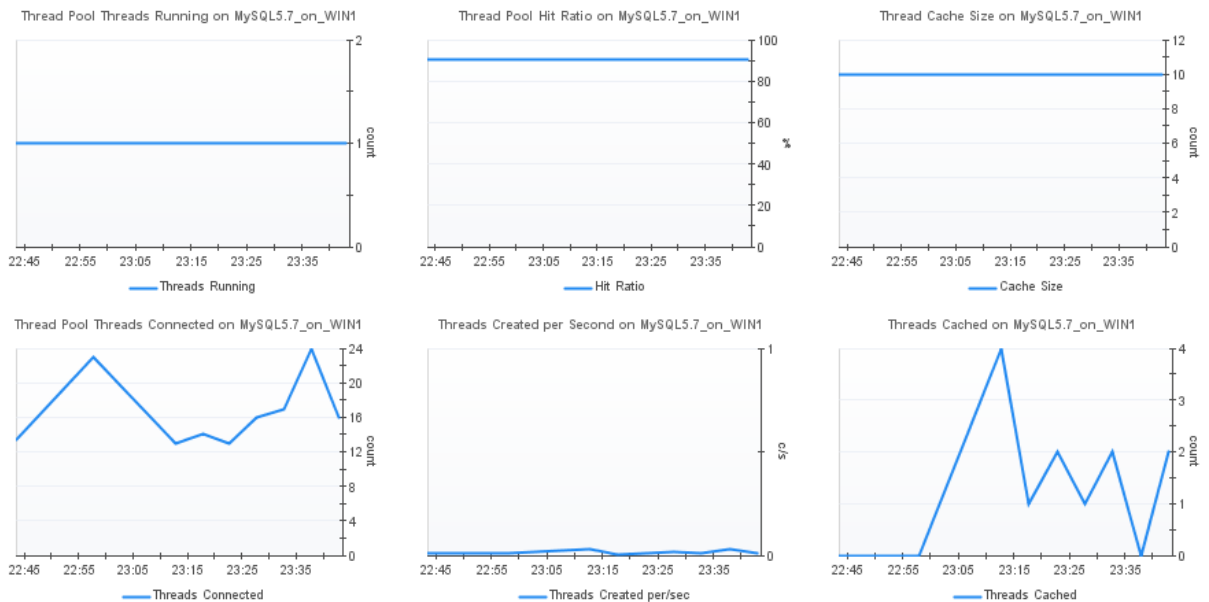
- Alarms – Fatal, Critical and Warning will drill down to the MySQL alarms view



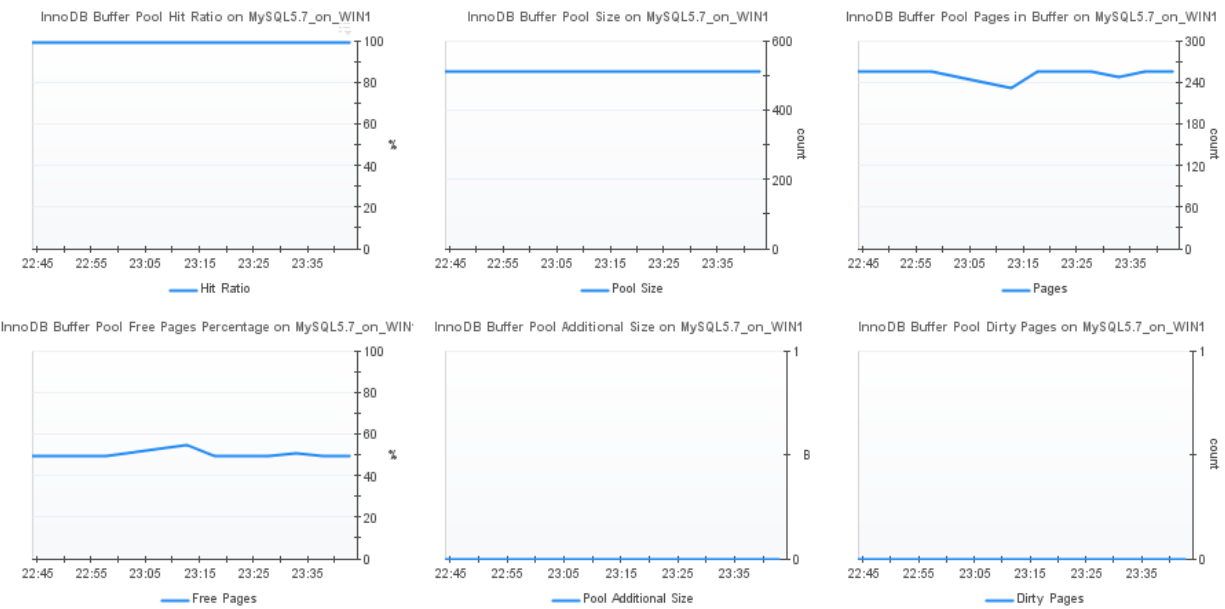
- Query Cache(Hit Ratio and Queries) – will all drill down to the “Query Cache Details for <Instance Name>” view.
 - The Query Cache Detail View provides the following graphs for the selected time range.
 - Query Cache Hit Ratio
 - Query Cache Memory (Free and Used)
 - Query Statements (Caches and Execs/Sec)



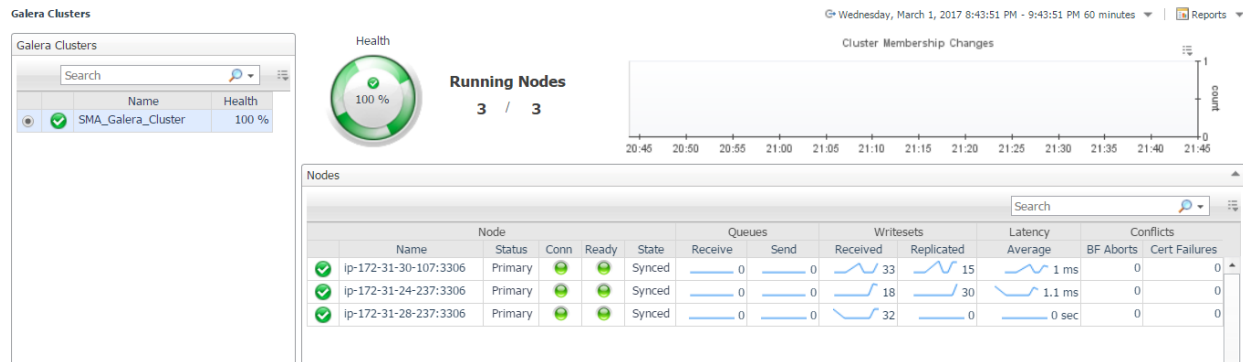
- Thread Pool (Hit Ratio and Threads Running)– will all drill down to the “Thread Pool Details for <Instance Name>” view.
 - The Thread Pool Detail View provides the following graphs for the selected time range.
 - Thread Pool Threads Running
 - Thread Pool Hit Ratio
 - Thread Cache Size
 - Threads Connected
 - Threads Created (per second)
 - Threads Cached



- InnoDB BufferPool (Hit Ratio) – will drill down to the “InnoDB Buffer Pool Details for <Instance Name>” view.
 - The Query Cache Detail View provides the following graphs for the selected time range.
 - InnoDB Buffer Pool Hit Ratio
 - InnoDB Buffer Pool Size
 - InnoDB Buffer Pool Pages in Buffer
 - InnoDB Buffer Pool Free Pages (%)
 - InnoDB Buffer Pool Additional Size
 - InnoDB Buffer Pool Dirty Pages

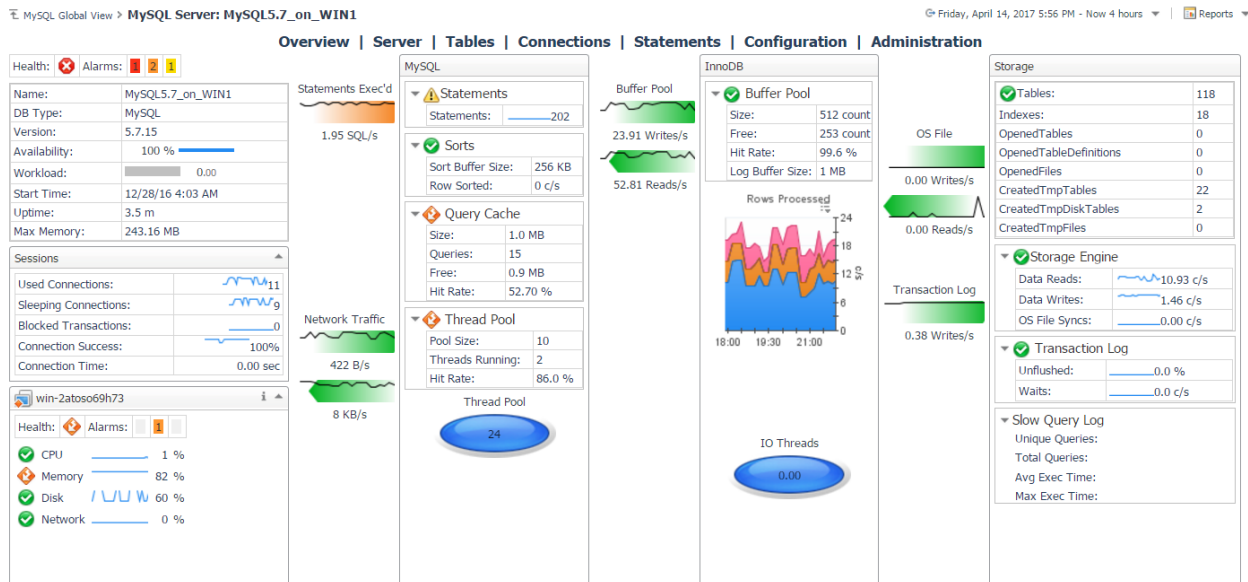


Galera Clusters



The Galera Clusters dashboard displays all monitored Galera clusters in your environment. The table on the left lists the Galera clusters and current state and health - the percentage of monitored Galera nodes connected to the cluster. When a cluster is selected, the right panel shows a cluster summary, including a health spinner with a time plot popup, the number of running/monitored nodes, cluster membership changes for the selected time window, and a list of nodes. The nodes table displays each monitored node in the cluster with current states, queue sizes, writeset counts, latency, and conflicts. Clicking on the node name drills down to the [Galera Node](#) page.

Server Overview



The MySQL Server dashboard provides detail information for the MySQL instance being monitored.

This dashboard can be accessed in two ways.

- It is available under the “MySQL” branch in the navigation panel on the left.
- It is also accessible by drilling down on “Name” under the “Instance” section in the MySQL Global View dashboard.

The MySQL Server dashboard displays metrics, in a Spotlight-like format, for each MySQL agent instance deployed. There also exists an agent selector in the right action panel under the general tab so that other deployed instance information can also be accessed through this dashboard.

The following metrics are being collected by the MySQL Server dashboard.

- **Database Information**
 - Name – The name of the database being monitored.
 - Version – The version of the MySQL sever being monitored.
 - Availability – The availability of the MySQL instance being monitored.
 - Uptime – The time that the database has been up.
- **Sessions**
 - Used Connections – The number of current connections to the MySQL server.
 - Sleeping Connections – The number of used connections which are in a sleep state.
 - Blocked Transactions – The number of current transactions that appear to be in a deadlocked state (available in 5.5+).

- Connection – The number of connection attempts (successful or not) to MySQL server.
 - Connection Success – The percentage of successful connections made to the server in the last sample period.
 - Connection Time – The time it took MySQL took fully establish the connection.
- **Host Summary**
 - Health – Health indicator for the overall health of the host.
 - Alarms – Number of alerts triggered on the host.
 - CPU – Historical trend and current value of the CPU on the monitored host.
 - Memory – Historical trend and current value of the Memory on the monitored host.
 - Disk – Historical trend and current value of the Disk Utilization on the monitored host.
 - Network – Historical trend and current value of the Network usage on the monitored host.
- **MySQL**
 - **Sorts**
 - Sort Buffer Size – Buffer size that each thread needs to allocate to do a sort.
 - Rows Sorted – The number of rows sorted per second.
 - **Query Cache**
 - Size – Query Cache Size of memory.
 - Queries – The number of SQL statements that are in the cache.
 - Free – Memory in the query cache that are free.
 - Hit Rate – The % of SQL queries that were in the query cache.
 - **Thread Pool**
 - Pool Size – The maximum number of threads that can be cached.
 - Threads Running – The number of active (non sleeping) threads.
 - Hit Rate – The number of threads that were used from the pool in comparison to the total number of connections made.
 - **Thread Pool** – The number of currently open connections. When hovering over Thread Pool, it will provide historical trend for the selected time rang.
- **InnoDB**
 - **Buffer Pool**
 - Size – Size of InnoDB buffer pool
 - Free – Size of InnoDB free buffers
 - Hit Rate – Percent buffer hit rate
 - Log Buffer Size – Size of the InnoDB Log Buffer
 - **Rows Processed** – When hovering over Rows Processed, it will provide historical trend for the selected time range. The graph provides the following:
 - RowsInsertedPerSec – Number of rows inserted per second.

- RowsReadPerSec – Number of rows read per second.
 - RowsUpdatedPerSec – Number of rows updated per second.
 - RowsDeletedPerSec – Number of rows deleted per second.
- **IO Threads** – The number of helper threads performing InnoDB I/O. When hovering over IO Threads, it will provide historical trend for the selected time range.
- **Storage**
 - **Tables** – Provides the number of tables in the MySQL instance being monitored.
 - **Storage Engine**
 - Data Reads – Number of physical data reads per second
 - Data Writes – Number of physical data writes per second
 - OS File Syncs – Number of Operating System fsync calls per second
 - **Transaction Log**
 - Unflushed – Percent of InnoDB log buffer that has yet to be flushed to disk. If this is too high then buffer needs to be tuned.
 - Waits – Number of times InnoDB has to wait for log to be flushed to disk per second.
 - **Slow Query Log**
 - Unique Queries – Number of unique queries in the current collection.
 - Total Queries – Total number of queries in the current collection.
 - Avg Execution Time – Average length of time for queries to fully execute in the current collection.
 - Max Execution Time – Maximum length of time for queries to fully execute in the current collection.

The following flows exist in the MySQL Server dashboard. When hovering over each flow, it will provide a historical trend for the selected time range.

- Flows to/from the **Connection Information column** and the **MySQL column**:
 - StatementExecPerSec – The number of SQL statements per second that are currently being executed.
 - BytesReceivedPerSec – The number of bytes received per second.
 - BytesSentPerSec – The number of bytes sent per second.
- Flows to/from the **MySQL column** and the **InnoDB column**:
 - BufferPoolWriteReq – The number of logical write requests done to the InnoDB buffer pool.
 - BufferPoolReadReq – The number of logical read requests done to the InnoDB buffer pool.
- Flows to/from the **InnoDB column** and the **Storage column**:
 - OSFileWritesPerSec – Number of Operating System writes per second.
 - OSFileReadsPerSec – Number of Operating System reads per second.
 - WritesPerSec – Number of times InnoDB has written the log to disk per second.

Server Metrics

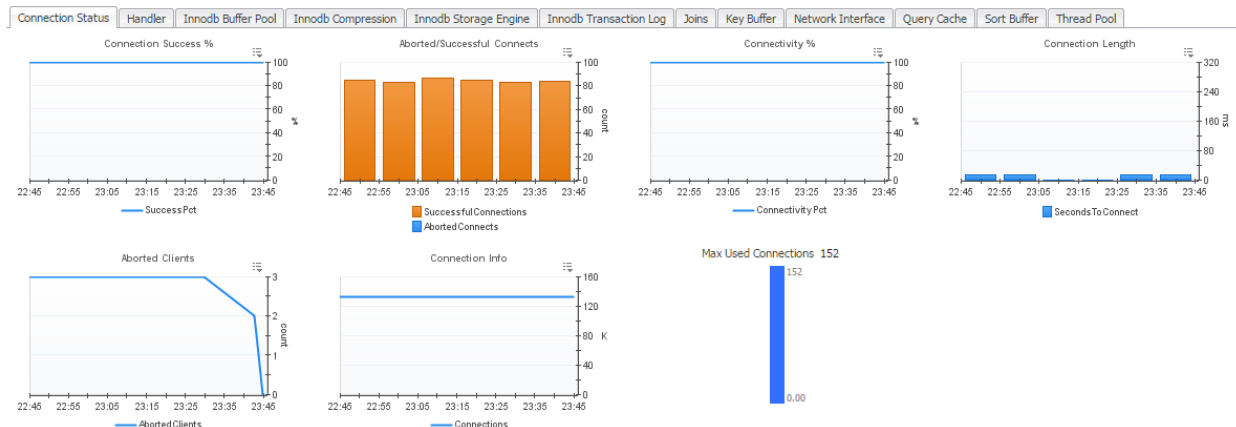
The Server Metrics Dashboard is accessible through either the navigation panel or by clicking on the Sorts, Query Cache, Thread Pool, Buffer Pool, or Storage Engine table data in the MySQL Server Dashboard. When accessing the Server Metrics dashboard from the MySQL Server dashboard the selected tab will default to the same category as the table that was clicked.

Server Metrics Health Overview



Located at the top of the Server Metrics page, overview boxes show the current health state and all active alarms for each component of the agent's data collection. Clicking or dwelling over the health icon or outstanding alarms will bring up additional information related to the state of that component.

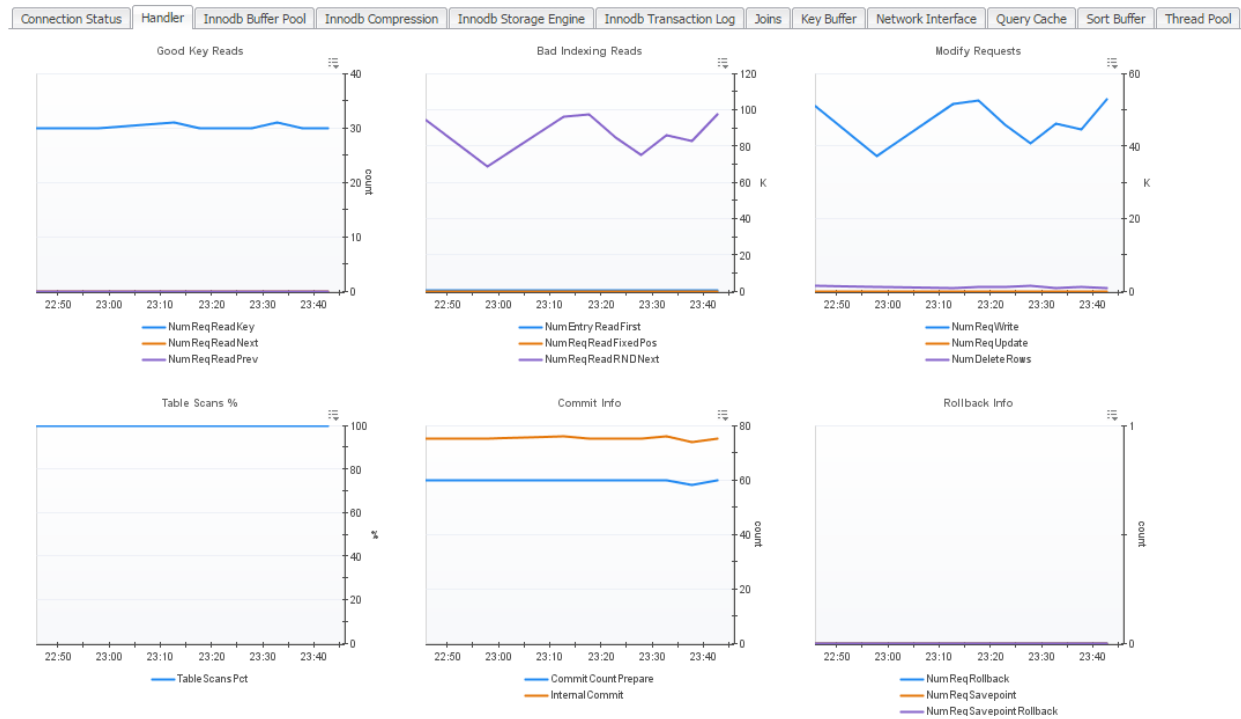
Connection Status



Charts and Metrics (left to right):

- **Max Used Connections** - The maximum number of connections that have been in use simultaneously since the server started.
- **Connection Info** - The number of connection attempts (successful or not) to the MySQL server.
- **Connectivity %** - The probability of making a successful new connection.
- **Connection Length** - The number of seconds MySQL took to establish a new connection.

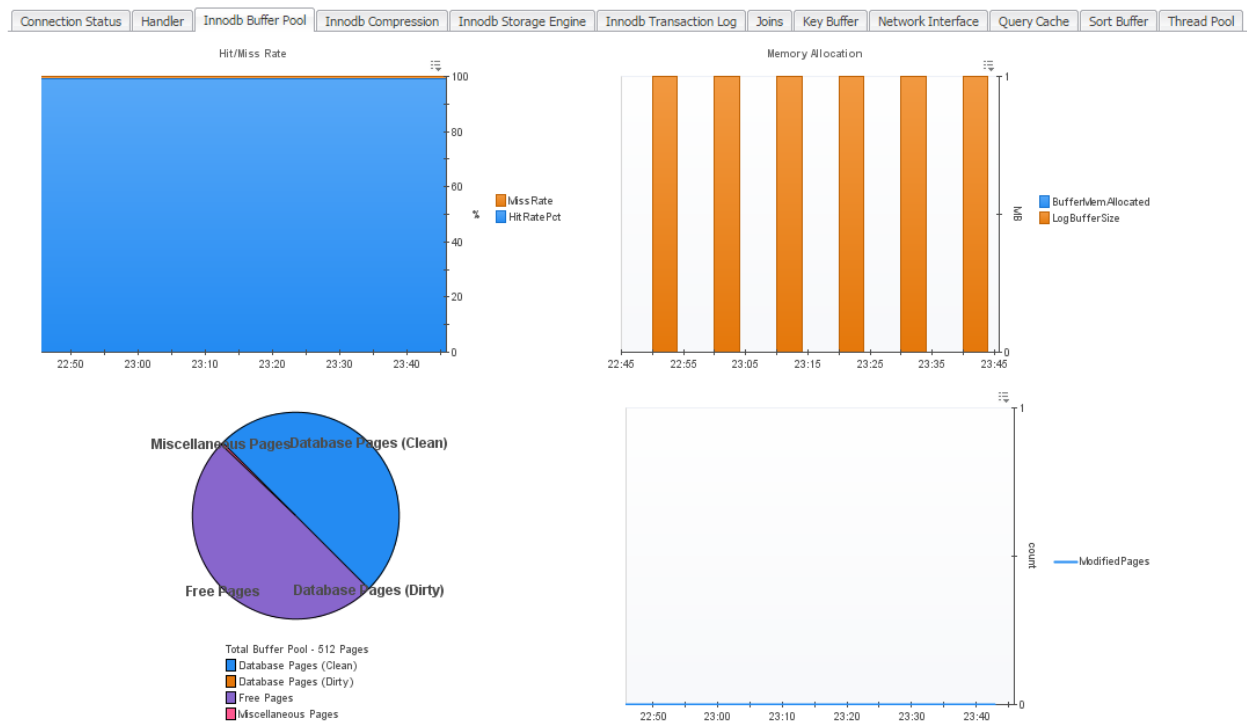
Handler



Charts and Metrics (left to right, top to bottom):

- **Good Key Reads** – Number of reads employing table keys, usually indicative of good indexing.
- **Bad Indexing Reads** – Number of reads which typically indicate bad indexing.
- **Modify Requests** – Requests related to modifying table data through writing, updating, or deleting rows.
- **Commit Info** – MySQL metrics related to transaction commits.
- **Rollback Info** - MySQL metrics related to transaction rollbacks.

InnoDB Buffer Pool



Charts and Metrics (left to right, top to bottom):

- **Hit/Miss Rate** – Hit and Miss rate percentages for InnoDB Buffer Pool.
- **Memory Allocation** – Amount of memory allocated to the InnoDB Buffer Pool and Log Buffer Size.
- **Buffer Pool Pages** – Breakdown of Buffer Pages by type.
- **Modified Pages** – Number of Buffer Pages being modified.

InnoDB Compression

Connection Status

Handler

InnoDB Buffer Pool

InnoDB Compression

InnoDB Storage Engine

InnoDB Transaction Log

Joins

Key Buffer

Network Interface

Query Cache

Sort Buffer

Thread Pool

InnoDB_Page_Size

16.00 KB

InnoDB_File_Per_Table

ON

InnoDB_CMP_Per_Index

OFF

InnoDB_CMP_Level

6

InnoDB_CMP_Pad_Pct_Max

50

InnoDB_CMP_Failure_Threshold_Pct

5

Compression by Mem Page Size

Page Size	Buffer Pool	Pages Used	Pages Free	Relocation Ops	Relocation Time
1 KB	0	0 count	0 count	0 count	0 us
2 KB	0	0 count	0 count	0 count	0 us
4 KB	0	0 count	0 count	0 count	0 us
8 KB	0	0 count	0 count	0 count	0 us
16 KB	0	0 count	0 count	0 count	0 us

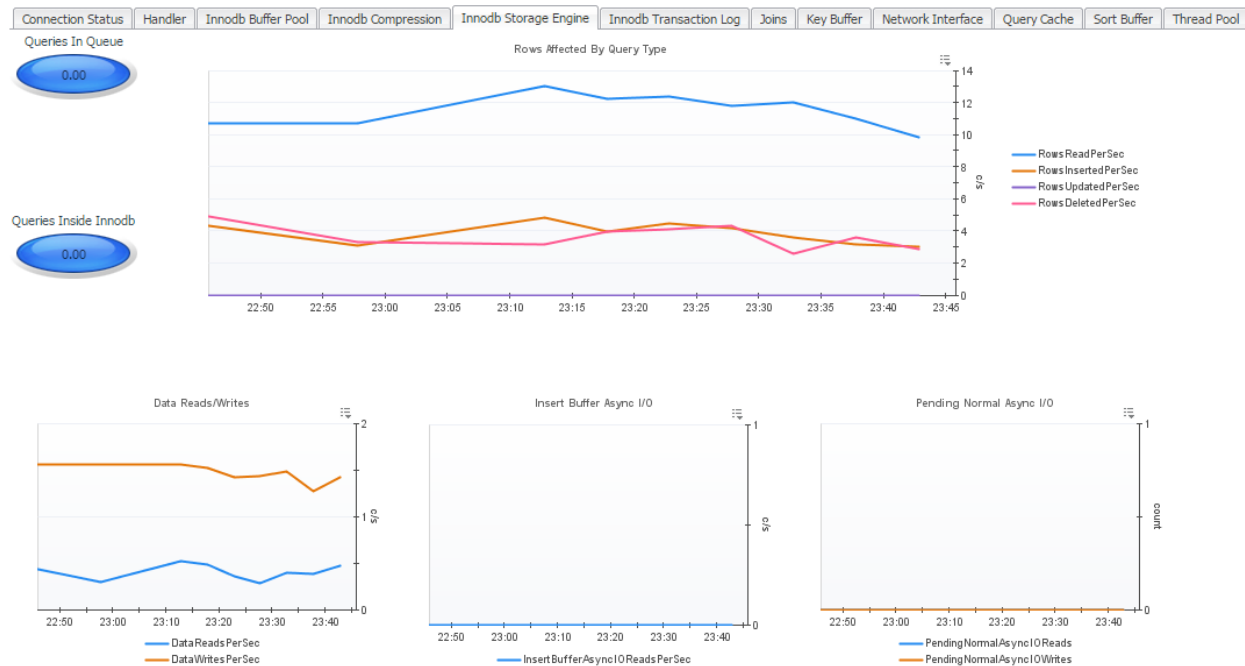
Compression by Page Size

Page Size	Cmp Ops	Cmp Ops OK	Cmp Time	Cmp Time Avg	UCmp Ops	UCmp Time	UCMP Time Avg
1 KB	0 count	100%	0 sec	0 ms	0 count	0 sec	0 ms
2 KB	0 count	100%	0 sec	0 ms	0 count	0 sec	0 ms
4 KB	0 count	100%	0 sec	0 ms	0 count	0 sec	0 ms
8 KB	0 count	100%	0 sec	0 ms	0 count	0 sec	0 ms
16 KB	0 count	100%	0 sec	0 ms	0 count	0 sec	0 ms

Charts and Metrics (left to right, top to bottom):

- **Properties** - InnoDB compression-related variables
- **Compression by Mem Page Size** – Compression metrics grouped by memory page size.
- **Compression by Page Size** – Compression metrics grouped by page size.

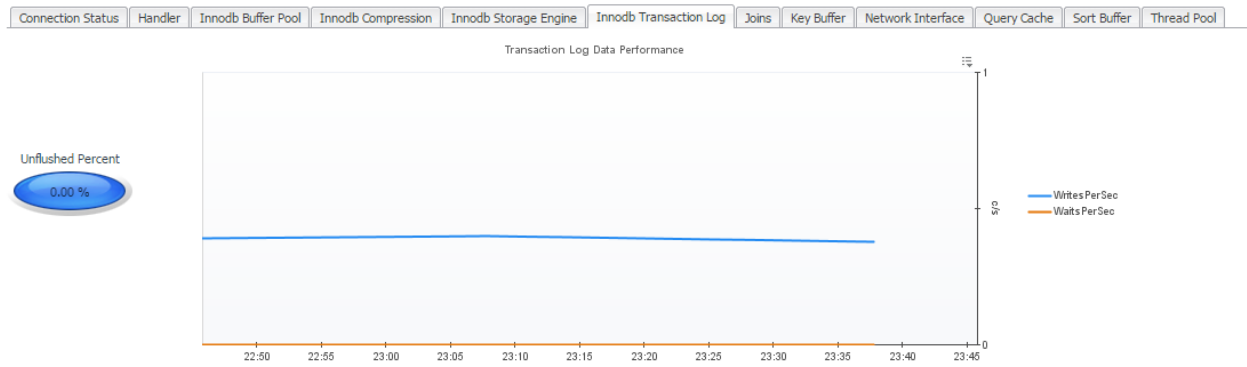
InnoDB Storage Engine



Charts and Metrics (left to right, top to bottom):

- **Queries in Queue** – The number of queries waiting to enter InnoDB.
- **Queries inside InnoDB** – The number of queries active inside InnoDB.
- **Rows Affected by Query Type** – The amount of rows per second which are being affected, shown according to the type of query affecting them.
- **Data Reads/Writes** – The number of physical data reads and writes per second.
- **Insert Buffer Async I/O** – The number of insert buffer asynchronous I/O reads and writes per second.
- **Pending Normal Async I/O** – The number of pending normal asynchronous I/O reads and writes per second.
- **Mutex Info** – Information relating to InnoDB waiting for a mutex.
- **RW Locks** – Information relating to InnoDB waiting for a read/write lock to be released.
- **OS File I/O** – The rate of Operating System reads, writes, and fsync operations per second.
- **Transactions Rate** – The InnoDB transaction rate graphed over time.
- **Transaction Purge Lag** – The transaction purge lag graphed over time.

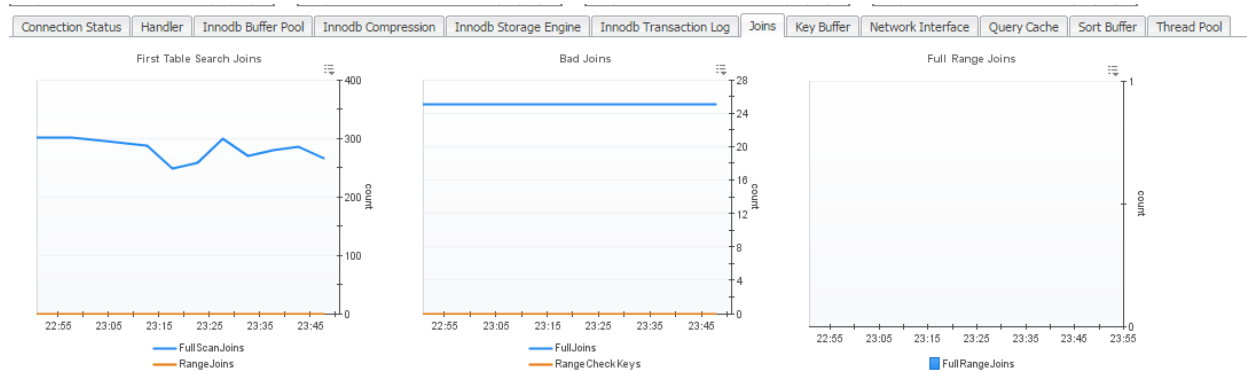
InnoDB Transaction Log



Charts and Metrics (left to right):

- **Unflushed Percent** – The percent of InnoDB log buffer that has yet to be flushed to disk.
- **Transaction Log Data Performance** – The rate of writes and waits for the Transaction Log to be flushed to disk.

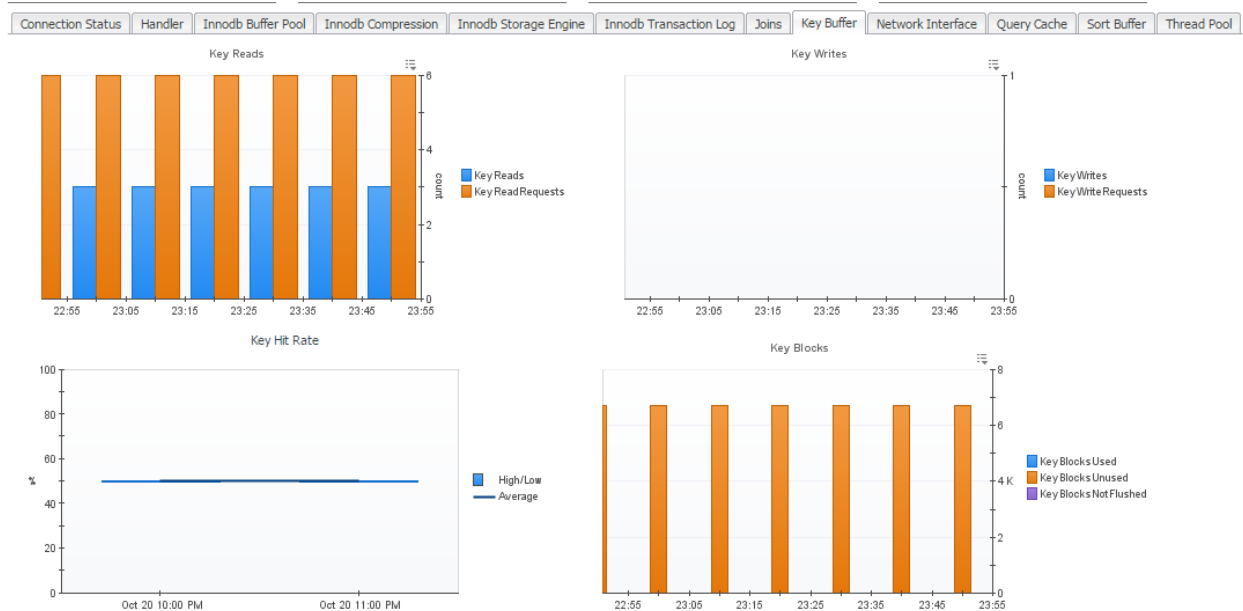
Joins



Charts and Metrics (left to right):

- **First Table Search Joins** – The number of joins operating on the first table.
- **Bad Joins** – Inefficient joins which do not use keys or indexes.
- **Full Range Joins** – The number of joins that used a range search on a reference table.

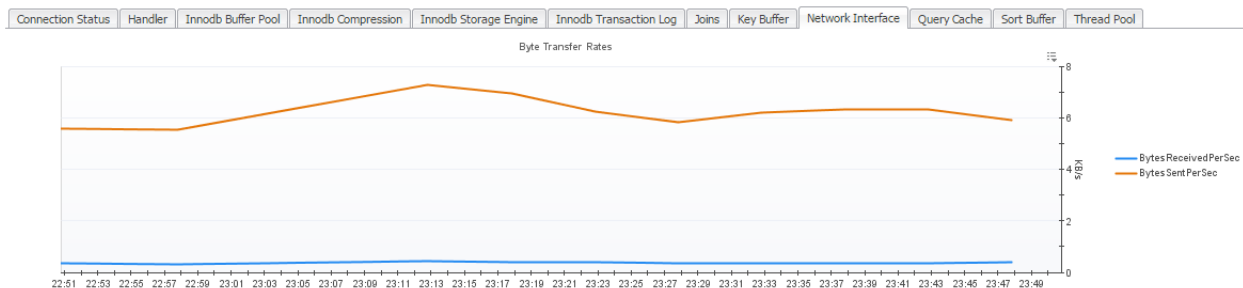
Key Buffer



Charts and Metrics (left to right, top to bottom):

- **Key Reads** – The number of reads or read requests for a key block.
- **Key Writes** – The number of write or write requests for a key block.
- **Key Hit Rate** – The rate of physical reads from a disk to requests to read from the cache.
- **Key Blocks** – A status breakdown of key blocks in the key caches.

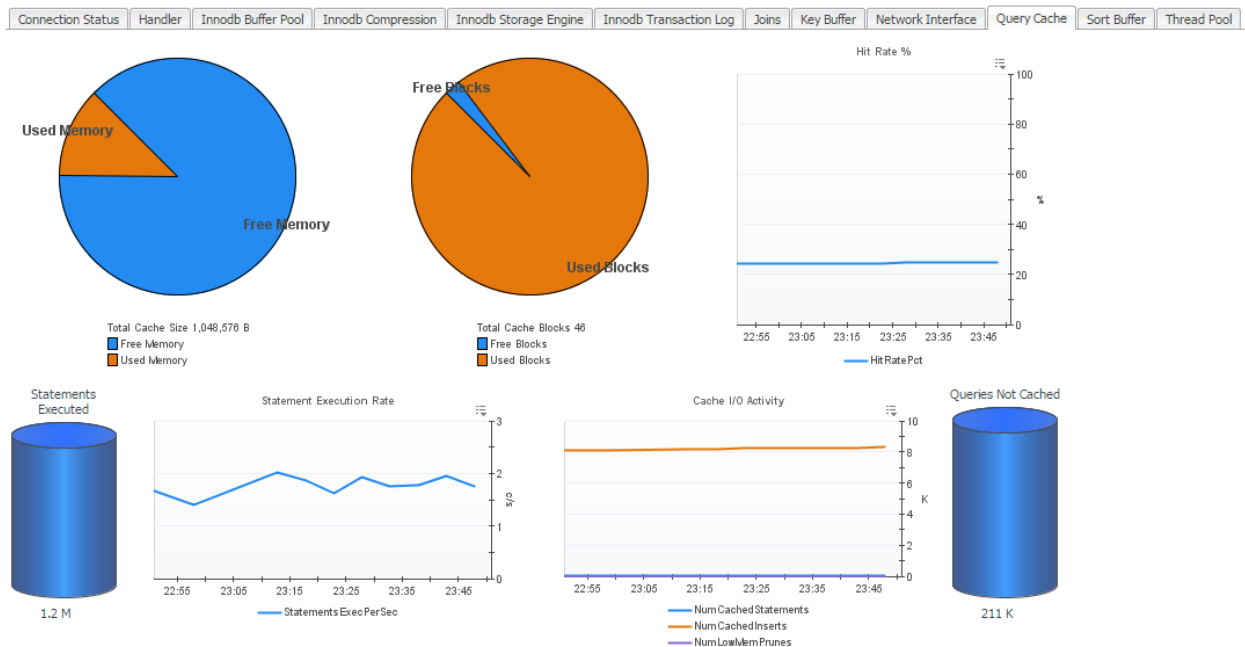
Network Interface



Charts and Metrics (left to right):

- **Byte Transfer Rates** - The number of bytes received and sent per second from and to the network

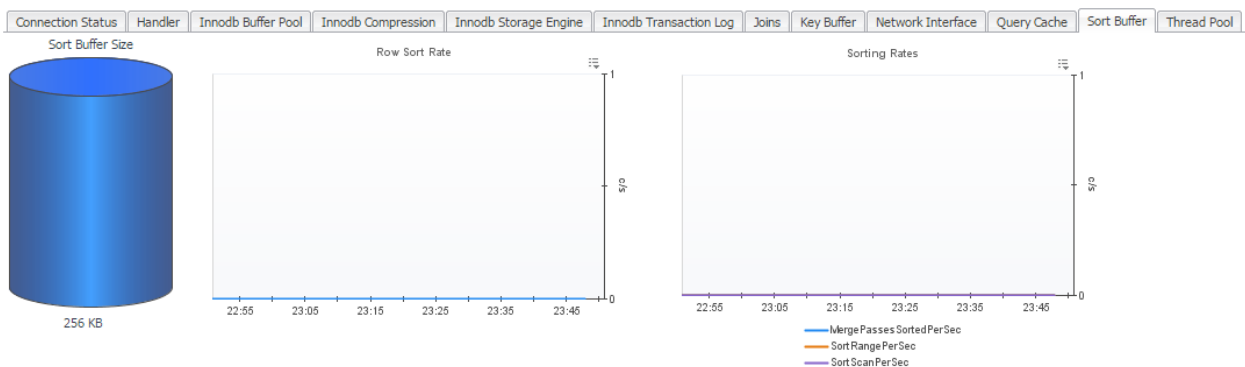
Query Cache



Charts and Metrics (left to right, top to bottom):

- **Cache Memory Usage** – A breakdown of the total cache size into free and used memory.
- **Cache Memory Blocks** – A breakdown of the total cache blocks into free and used blocks.
- **Hit Rate %** - The percent of SQL queries used from the Query Cache.
- **Statements Executed** – The number of SQL statements currently being executed.
- **Statement Execution Rate** – The number of SQL statements per second that are currently being executed.
- **Cache I/O Activity** – The number of statements being added to the cache, existing in the cache, and being dropped from the cache.
- **Queries Not Cached** – The number of non-cached queries.

Sort Buffer



Charts and Metrics (left to right):

- **Sort Buffer Size** – The buffer size that each thread needs to allocate to do a sort.

- **Row Sort Rate** – The number of rows being sorted per second.
- **Sorting Rates** – The sorting rates per second broken down by type of sort.

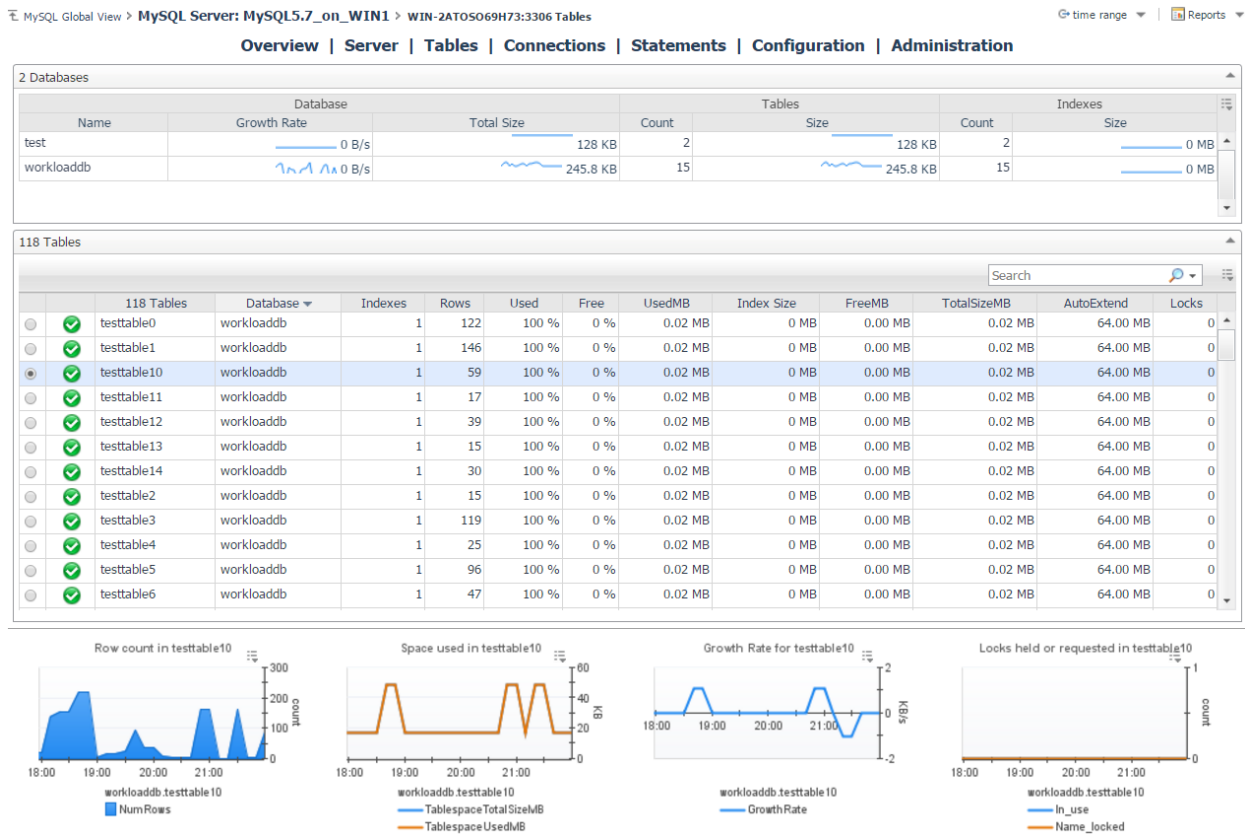
Thread Pool



Charts and Metrics (left to right, top to bottom):

- **Hit Rate Percent** – The number of threads that were used from the pool in comparison to the total number of connections made.
- **Threads Created Rate** – The number of new threads created per second.
- **Thread Pool Cache** – The number of threads in the Thread Pool and currently open connections.
- **Active Threads** – The number of currently open connections and active threads.

Tables



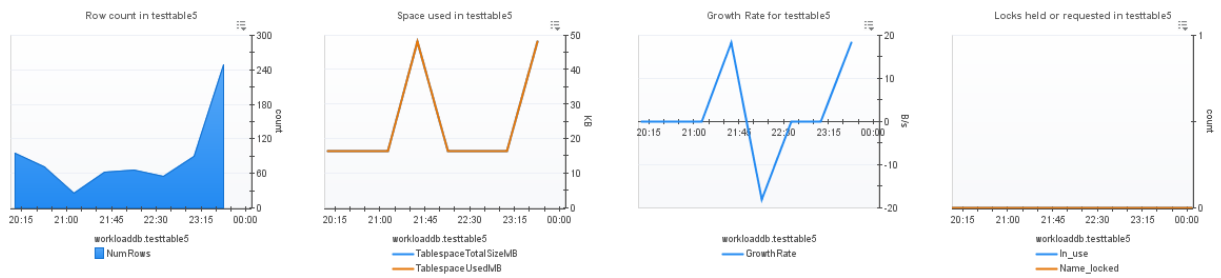
The Tables dashboard provides pertinent table information for the MySQL instance being monitored.

The Databases table shows aggregated metrics for tables in that database, including growth rate and table and index counts and sizes.

The Tables table displays the following metrics, in row format, for each MySQL agent instance deployed:

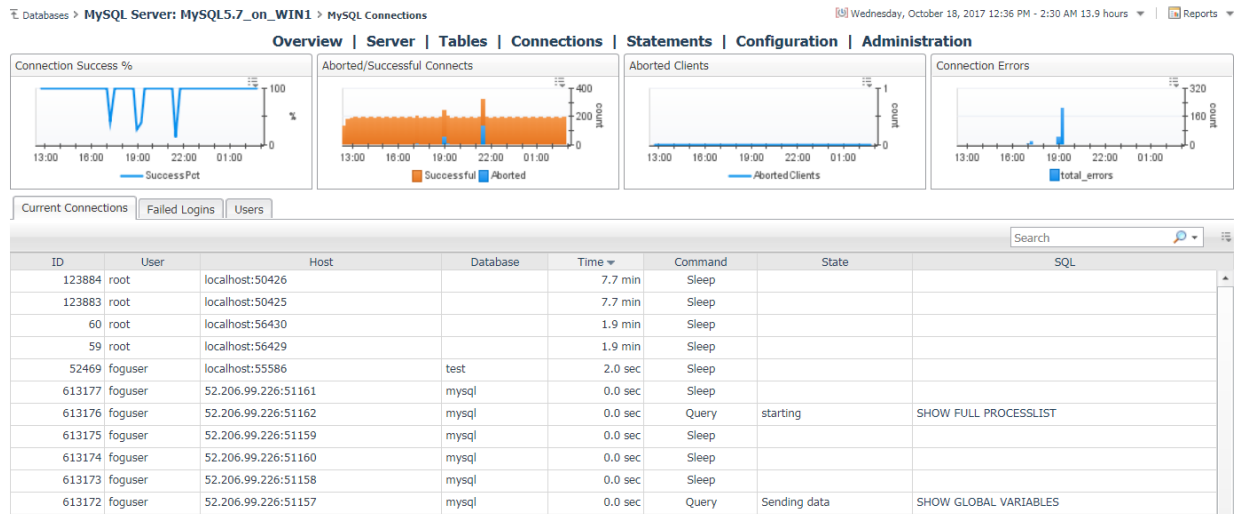
- **Selector button** – used to select a specific table for the graphs below.
- **Health Indicator** – Indicates the overall health of the deployed instance.
- **<Count> Tables** – provides the name and a total count of tables in the MySQL instance being monitored
- **Rows** – The number of rows in the table
- **Used** – Percentage of used space in the table
- **Free** – Percentage of free space in the table
- **UsedMB** – Megabytes of used space in the table
- **FreeMB** – Megabytes of free space in the table
- **TotalSizeMB** – Megabytes of total size in the table
- **AutoExtend** – The increment size for extending the size of an auto-extending table when it becomes full.

The graphs below provide the following information for the selected table.



- **Row Count** – Graphs the number of rows in the tablespace for the selected time range
- **Space Used** – Graphs the Table's Used Space vs. Total Size for the selected time range.
- **Growth Rate** – Shows growth/shrinkage of selected table size.
- **Locks Held or Requested** – Shows locks held or requested for selected table/

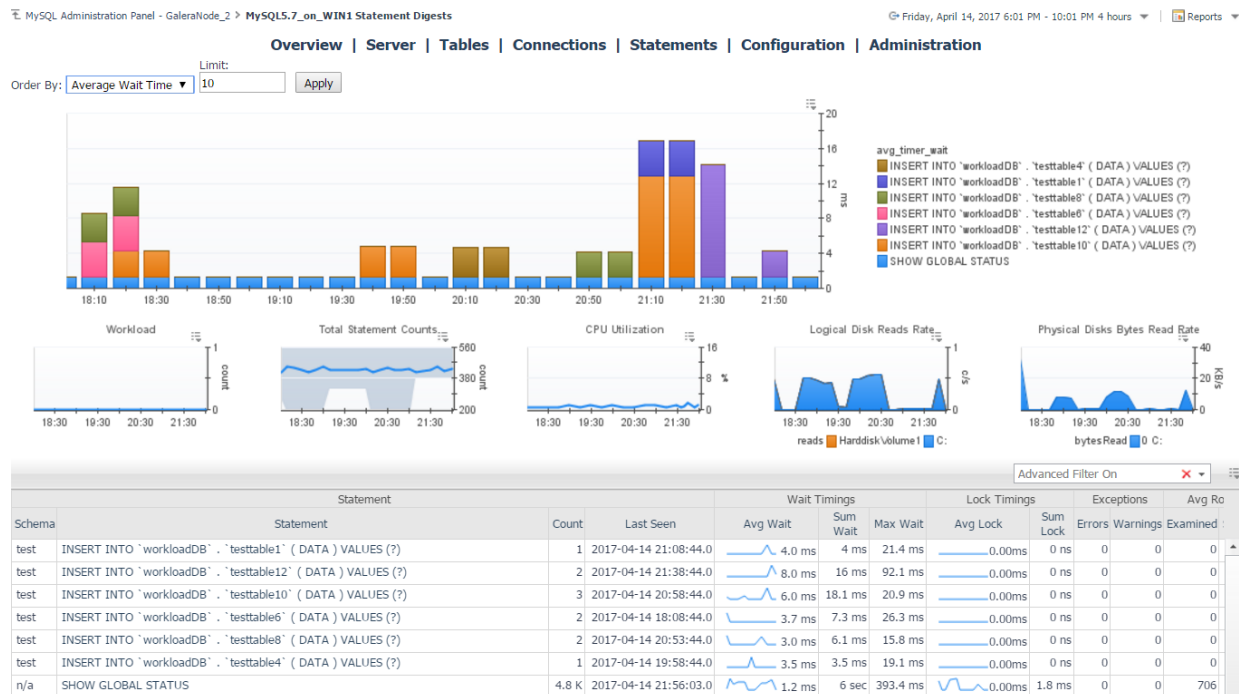
Connections



The Connections page shows graphs of some key connection metrics and three tabs with more information:

- **Current Connections** - The MySQL process list at the time of the last sample
- **Failed Logins** – This section shows all hosts that have made failed login attempts in the selected time range, along with error counts for all connection error types.
- **Users** - A list of MySQL users and privileges, along with password status, current connections, and total connections in the selected time range.

Statements



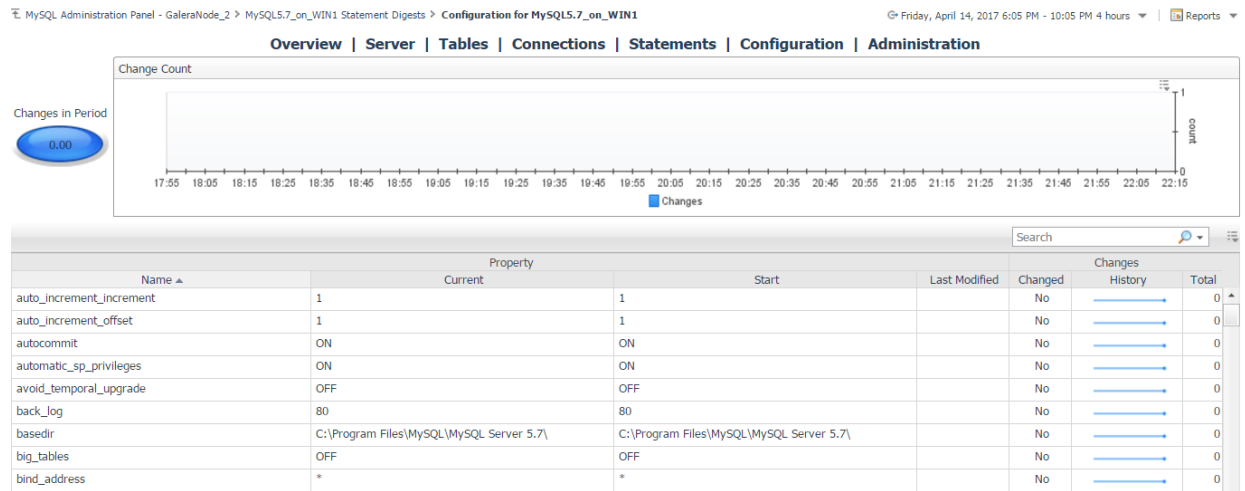
The MySQL Statement Digests dashboard is available for MySQL 5.6.5+ servers with the `performance_schema` engine enabled. Statement digests are normalized statements which have the same operation plan. Even if values in the statement differ, the server is performing the same operations and can therefore be aggregated for the purposes of analysis. The agent collects these from the server along with raw and calculated statistical data and provides them to the FMS.

The main time plot displays the top *X* statements by one of several metrics that can be selected using the provided dropdown. Below that are several graphs which can be correlated with statement performance to determine impact on the system.

On the bottom half of the page is a table listing all statement digests gathered from the server. The number of statement digests which the server maintains varies by version and is set with `performance_schema_digests_size`. If the number of digest types exceeds that, excess statements will be put into a single digest, also collected. All statistics shown in the table are period values for the selected time range with the exception of First/Last seen and Min/Max Wait Time. By default, an advanced filter is set for the table to exclude statements performed on the system databases `mysql`, `performance_schema`, and `information_schema`. This can be disabled by clicking the 'x' in the filter text box. Selecting a row of the table will update the bottom portion with graphed metrics related to the selected digest.

Page actions available in the right-hand panel include the MySQL Agent Selector and an action to Delete Old Statements. When the MySQL server is restarted or the `performance_schema`'s statement digests table is truncated, digest statistics will be reset. If a previously collected statement is executed on the server again, it will be merged with the historical data preserved by Foglight. If it is never executed again, it will become a dead object. The Delete Old Statements action is a convenience action to delete these dead topology objects and remove them and their history from the FMS.

Configuration



The configuration page tracks the MySQL server configuration. The metric indicator and change count graph shows numbers of changes if the selected time range. The table displays every server variable, showing the name, value at beginning and end of the selected time range, the date of the last modification since server monitoring began, and a history of changes for that variable.

Galera Node



The Galera Node page shows Galera-related information for a MySQL server configured as a Galera node. This page shows the current status of the Galera nodes as well as relevant server variables and informational and performance metrics for writesets, flow control, latency, transactions, and replicated data size. At the top right is a summary for the Galera cluster which the node is a part of, showing the number of collected / monitored nodes for the cluster and listing each node in the cluster and their current states. By clicking the name of a different node, the page will update to feature information on the selected node.

Administration Panel

MySQL Administration Panel - GaleraNode_2

Friday, April 14, 2017 6:00 PM - 10:00 PM 4 hours | Reports

Overview | Server | Tables | Connections | Statements | Configuration | Galera | Administration

Connections
Kill Connection, Kill Query

Tables
Describe, Analyze, Optimize, Repair, Flush Table, Drop Table, Drop View

Flush
Flush Hosts, Flush Logs, Flush Privileges, Flush Query Cache, Flush User_Resources

Reset
Reset Master, Reset Slave, Reset Query Cache

Explain
Retrieve Explain Plan

Administration Log

Timestamp	Fog. User	DB User	Success	Admin Statement	Exec. Time	Result
4/14/17 9:59 PM	ikramer	foglight	true	[DESCRIBE `workloadDB`.`testtable1;]	0.0 ms	[[COLUMN_NAME COLUMN_TYPE IS_NULLABLE COLUMN_KEY COLUMN_DEFAULT EXTRA id int(11) NO PRI null auto_increment data varchar(100) YES null cur_timestamp timestamp(6) NO CURRENT_TIMESTAMP(6) on update CURRENT_TIMESTAMP]]
4/14/17 9:59 PM	ikramer	foglight	true	[ANALYZE TABLE `workloadDB`.`testtable1;]	32.0 ms	[Table Op Msg_type Msg_text workloadDB.testtable1 analyze status OK]
4/14/17 9:59 PM	ikramer	foglight	true	[DESCRIBE `workloadDB`.`testtable7;]	0.0 ms	[[COLUMN_NAME COLUMN_TYPE IS_NULLABLE COLUMN_KEY COLUMN_DEFAULT EXTRA id int(11) NO PRI null auto_increment data varchar(100) YES null cur_timestamp timestamp(6) NO CURRENT_TIMESTAMP(6) on update CURRENT_TIMESTAMP]]

The MySQL Administration Panel features server operations which can be performed through the console by permitted users. The actions currently available represent the initial offering and later versions will incorporate more possibilities. An action is performed by clicking the icon in the relevant category, which will bring up a menu dialog with options and confirmation of the requested action. Actions can only be performed on one server at a time. The active server can be switched using the MySQL Agent Selector in the right-hand pane. Only agents where administration is enabled will be shown.

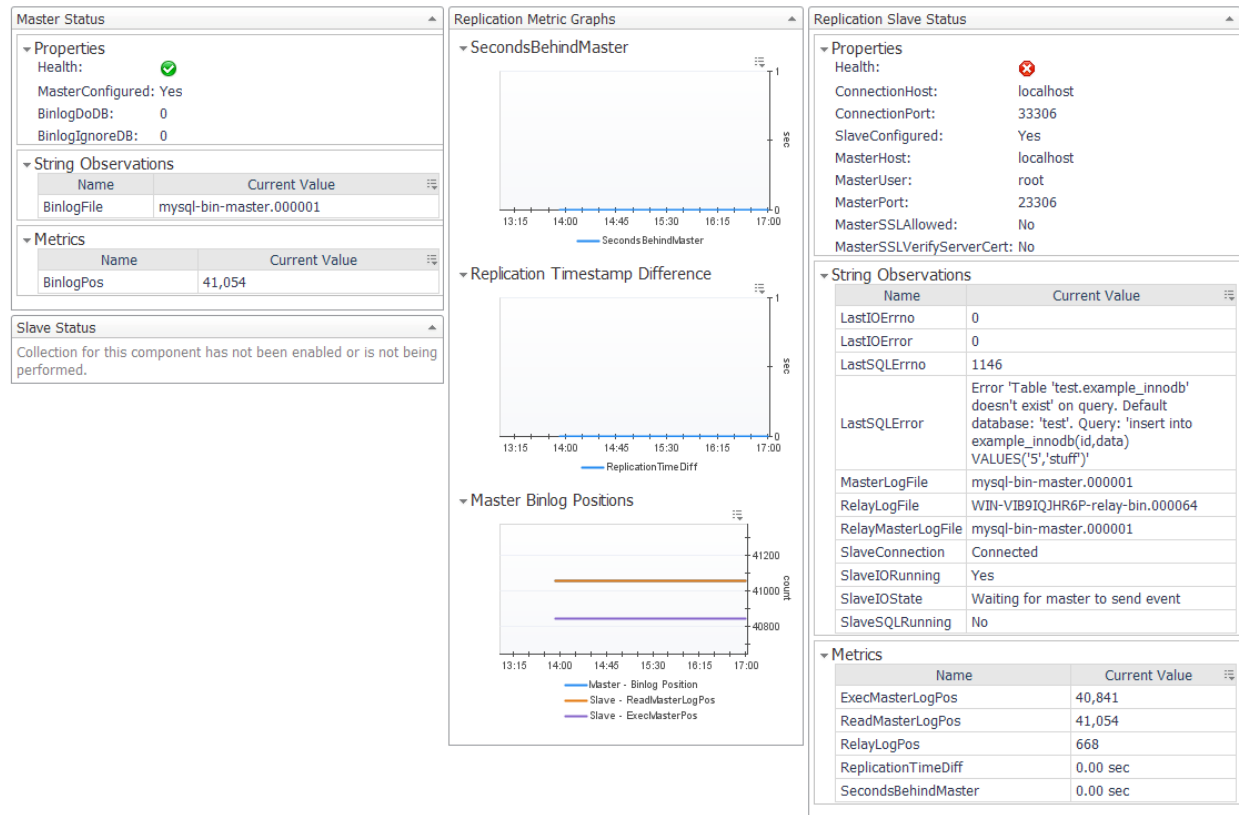
The Administration Log below records actions performed in the specified time range for auditing purposes. Information includes a timestamp, the Foglight user who performed the action, the database user employed, the actual statement text, execution time, result (if any) and any resulting SQLExceptions or warnings from the statement.

Prerequisites to use Administrative Actions

- 1) In the Agent Properties of the agent monitoring the MySQL server, Enable Administration must be set to true.
- 2) Also in the Agent Properties, a DB user and password must be provided. This user must have the necessary privileges to perform actions taken through the Administration Panel or the action will fail. This user will be solely employed to perform actions on request, not for data collection or other purposes.
- 3) A Foglight user must have the MySQL Administrator role granted to them in the Administration>Users & Security dashboard in order to access and use the Administration Panel.

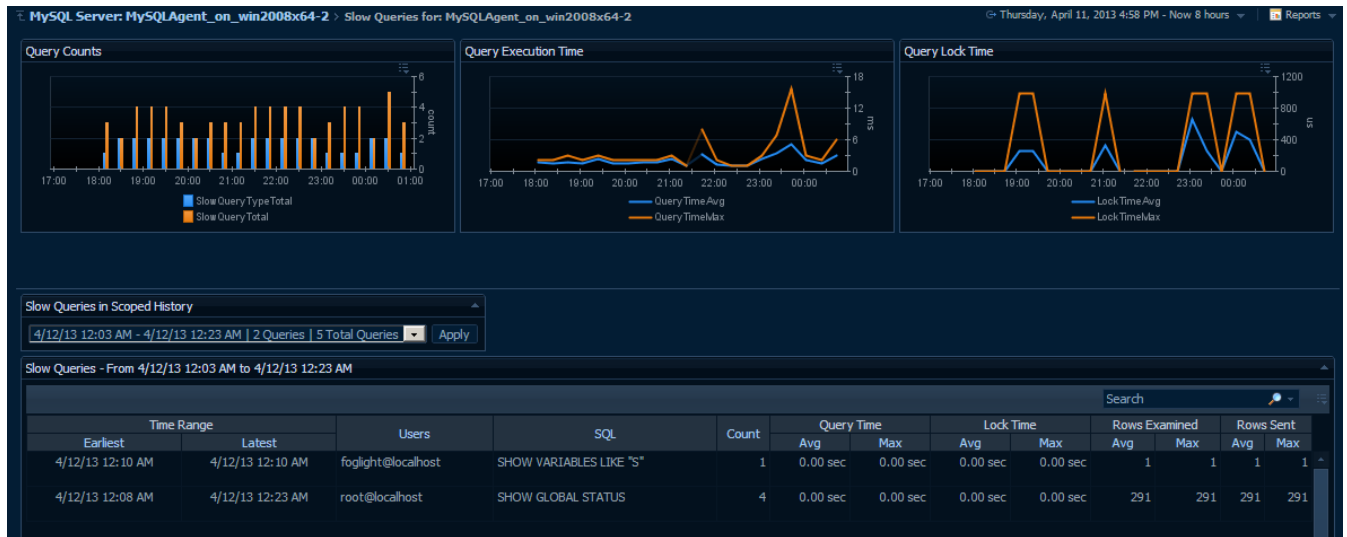
Replication Data

MySQL Replication Data - MySQLMaster_on_WIN2008x64



This page shows complete data on MySQL Replication collected by a single MySQL agent and will change depending on which collections have been enabled. This page is primarily meant to serve as a demonstration of data collected by the agent, but can be used for simple Master-Slave replication configurations. More complex configurations can use elements of this page in another dashboard.

Slow Queries (deprecated)



The Slow Queries dashboard has been deprecated. For MySQL versions 5.6.5+, the Statements dashboard features more data gathered from the Performance Schema database.

The Slow Queries dashboard displays collected queries and their aggregated metrics as well as several derived metrics to show slow query activity overall. At the top of the page, 3 time plots graph these derived metrics. The first graph shows the number of unique queries and the number of total queries found during each collection period. The second graph shows the average and maximum execution time for all collected queries across time. The third graph shows the average and maximum lock times.

Below that, a dropdown list shows all available data snapshots that took place within the scoped time range of the page. By manipulating the Zonar or the calendar feature at the top right, you can change the data snapshots available in the dropdown as well as the scoped time range of the graphs. In the table displaying the unique queries for that snapshot, the following data is shown, in order from left to right:

- **Time Range (Earliest)** – The first appearance of this unique query in the current collection.
- **Time Range (Latest)** – The last appearance of this unique query in the current collection.
- **Users** – A list of the user(s) who have executed this query.
- **SQL** – A generalized version of the SQL string for this unique query.
- **Count** – The number of instances of this query.
- **Query Time (Avg)** – The average execution time for this query.
- **Query Time (Max)** – The maximum execution time for this query.
- **Lock Time (Avg)** – The average lock time for this query.
- **Lock Time (Max)** – The maximum lock time for this query.
- **Rows Examined Time (Avg)** – The average number of rows examined for this query.
- **Rows Examined (Max)** – The maximum number of rows examined for this query.
- **Rows Sent (Avg)** – The average number of rows sent for this query.
- **Rows Sent (Max)** – The maximum number of rows sent for this query.

In addition to these columns, minimum values for these unique query metrics are available, though hidden. To make these columns visible or hide others, use the customizer at the top-right of the table. You can also use the search bar to filter the list of available queries.

Appendix A – Rules

Bug #24432 May Break Replication

Rule Definition:

Condition	State
<pre>String x=scope.MySQL_Version; x=x.replaceAll(/(\.)/, ""); int y = x.toInteger(); if((y>=5024 && y<=5034) (y>=5112 && y<=5117)){return true;}else{return false;}</pre>	Warning

Problem Description

For INSERT ... ON DUPLICATE KEY UPDATE statements where some AUTO_INCREMENT values were generated automatically for inserts and some rows were updated, one auto-generated value was lost per updated row, leading to faster exhaustion of the range of the AUTO_INCREMENT column. Affected versions of MySQL include 5.0.24 to 5.0.34, and 5.1.12 to 5.1.17 (inclusive).

Because the original problem can affect replication (different values on master and slave), it is recommended that the master and its slaves be upgraded to the current version.

Advice

Upgrade to the latest release of the MySQL server.

Concurrent_Queries_Running

Purpose:

The Concurrent Queries Running rule will fire when the number of threads currently running exceeds normal usage.

Rule Definition:

Condition	State
<pre>#ThreadsRunning#>25</pre>	Critical

Problem Description

Too many active queries indicates there is a severe load on the server, and may be a sign of lock contention or unoptimized SQL queries.

Advice

Issue a SHOW FULL PROCESSLIST and examine the SQL output for locked or unoptimized queries. You can also enable the slow query log to log queries that are running too long or are not using an index.

Database_Connectivity Rule

Purpose:

The Database_Connectivity rule will fire when a new connection cannot be made to the database.

Rule Definition:

Condition	State
MySQLAgent_Connection_Status.ConnectivityPct = 0	Fatal
MySQLAgent_Connection_Status.ConnectivityPct =100	Normal

Inefficient_Sort Rule

Purpose:

The Inefficient Sort rule will help determine if the sort buffer is too small. If that is the case then a sort may have to do a number of merge passes using temporary disk files.

Rule Definition:

Condition	State
((MySQLAgent_Sort_Buffer.MergePassesSortedPerSec) / (MySQLAgent_Sort_Buffer.SortRangePerSec + MySQLAgent_Sort_Buffer.SortScanPerSec)) >= registry("InefficientSortCritical")	Critical
((MySQLAgent_Sort_Buffer.MergePassesSortedPerSec) / (MySQLAgent_Sort_Buffer.SortRangePerSec + MySQLAgent_Sort_Buffer.SortScanPerSec)) >= registry("InefficientSortWarning")	Warning

Note

registry("InefficientSortCritical ") is a Foglight Registry Variable with a default value of 2.
registry("InefficientSortWarning") is a Foglight Registry Variable with a default value of 1.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

InnoDB_Buffer_Pool_HitRate Rule

Purpose:

The InnoDB_Buffer_Pool_HitRate rule will fire when the buffer pool hit rate falls below a user defined percentage. This rule applies only to InnoDB.

Rule Definition:

Condition	State
MySQLAgent_Innodb_Buffer_Pool.HitRatePct <= registry("InnoDBBufferPoolHitRateCritical")	Critical
MySQLAgent_Innodb_Buffer_Pool.HitRatePct <= registry("InnoDBBufferPoolHitRateWarning")	Warning

Note

registry("InnoDBBufferPoolHitRateCritical") is a Foglight Registry Variable with a default value of 90.

registry("InnoDBBufferPoolHitRateWarning") is a Foglight Registry Variable with a default value of 95.

Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

Logical I/O is many times faster than physical I/O, and therefore a DBA should strive to keep physical I/O to a minimum. It is true that logical I/O is not free, and that the DBA should work to keep all I/O to a minimum, but it is best if most data access is performed in memory. When using InnoDB, most data access should occur in RAM, and therefore the InnoDB buffer cache hit rate should be high.

Advice

Increase the size of the InnoDB buffer pool: Set innodb_buffer_pool_size to a larger value in your my.cnf/my.ini file and restart your server. Continue to monitor the cache to be sure there is an improvement.

Key_Buffer_HitRate Rule

Purpose:

The Key_Buffer_HitRate rule will fire when the Key Buffer hit rate falls below a user defined percentage.

Rule Definition:

Condition	State
MySQLAgent_Key_Buffer_KeyHitRate <= registry("KeyBufferHitRateCritical")	Critical
MySQLAgent_Key_Buffer_KeyHitRate <= registry("KeyBufferHitRateWarning")	Warning

Note

registry("KeyBufferHitRateCritical") is a Foglight Registry Variable with a default value of 90.
 registry("KeyBufferHitRateWarning") is a Foglight Registry Variable with a default value of 95.
 Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

The key cache hit ratio represents the proportion of keys that are being read from the key cache in memory instead of from disk. This should normally be greater than 99% for optimum efficiency.

Advice

Increase the key_buffer_size variable and monitor the key cache hit ratio. When it reaches an acceptable level, put the corresponding value of key_buffer_size in your my.cnf/my.ini file so the variable is set properly when the server is restarted.

Query_Cache_Hit_Rate Rule

Purpose:

The Query_Cache_HitRate rule will fire when the query cache hit rate falls below a user defined percentage. A low hit rate is not necessarily indicative of a problem; it may just be due to the types of SQL statements being run.

Rule Definition:

Condition	State
MySQLAgent_Query_Cache.HitRatePct <= registry("QueryCacheHitRateCritical")	Critical
MySQLAgent_Query_Cache.HitRatePct <= registry("QueryCacheHitRateWarning")	Warning

Note

registry("QueryCacheHitRateCritical") is a Foglight Registry Variable with a default value of 92.
 registry("QueryCacheHitRateWarning") is a Foglight Registry Variable with a default value of 96.
 Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

When enabled, the query cache should experience a high degree of "hits", meaning that queries in the cache are being reused by other user connections. A low hit rate may mean that not enough memory is allocated to the cache, identical queries are not being issued repeatedly to the server, or that the statements in the query cache are invalidated too frequently by INSERT, UPDATE or DELETE statements.

Advice

Evaluate whether the query cache is suitable for your application. If you have a high rate of INSERT / UPDATE / DELETE statements compared to SELECT statements, then there may be little benefit to enabling the query cache. Also check whether there is a high value of Qcache_lowmem_prunes, and if so consider increasing the query_cache_size.

Query_Cache_Undersized

Purpose:

This rule is designed to help the DBA determine the optimal size for the Query Cache.

Rule Definition:

Condition	State
#QueryCacheSize# > 0 && #NumLowMemPrunes# > 0	Warning

Problem Description

When the Query Cache is full, and needs to add more queries to the cache, it will make more room in the cache by freeing the least recently used queries from the cache, and then inserting the new queries. If this is happening often then you should increase the size of the cache to avoid this constant "swapping".

Increase the size of the query cache dynamically, then monitor the cache hit rate for improvements. Once you reach an acceptable hit ratio, and NumLowMemPrunes stops increasing, set that value within your my.cnf/my.ini file so the variable is set properly when the server is restarted.

Replication Slave Connection Unavailable

Purpose:

The agent was unable to connect to the replication slave during the last sample collection.

Rule Definition:

Condition	State
#SlaveConnection#!="Connected"	Fatal

Message:

@AgentName failed to connect to the replication slave server during the last sample collection.

Replication Server Times Out of Sync

Purpose:

Checks if the time difference between servers is greater than thresholds set in registry variables.
Not enabled by default.

Rule Definition:

Condition	State
#ReplicationTimeDiff#>registry("replicationTimeFATAL")	Fatal
#ReplicationTimeDiff#>registry("replicationTimeCRIT")	Critical
#ReplicationTimeDiff#>registry("replicationTimeWARN")	Warning

Note

registry("replicationTimeFATAL ") is a Foglight Registry Variable with a default value of 60.
registry("replicationTimeCRIT ") is a Foglight Registry Variable with a default value of 30.
registry("replicationTimeWARN ") is a Foglight Registry Variable with a default value of 5.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Message:

The replication servers monitored by @AgentName are out of sync. The difference between the UNIX Timestamp of these servers is ____ second(s), which exceeds ____, the current registry value.

Replication Slave Behind Master

Purpose:

Checks if the SecondsBehindMaster value is greater than thresholds set in registry variables. This rule is not enabled by default.

Rule Definition:

Condition	State
#SecondsBehindMaster#>registry("slaveBehindFATAL")	Fatal
#SecondsBehindMaster#>registry("slaveBehindCRIT")	Critical
#SecondsBehindMaster#>registry("slaveBehindWARN")	Warning

Note

registry("slaveBehindFATAL ") is a Foglight Registry Variable with a default value of 30.
registry("slaveBehindCRIT ") is a Foglight Registry Variable with a default value of 15.
registry("slaveBehindWARN ") is a Foglight Registry Variable with a default value of 5.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Message:

The Seconds_Behind_Master value for the replication server monitored by @AgentName is ____ second(s), which is higher than ____, the current registry value.

Seconds_Behind_Master effectively calculates how far behind the Replication Slave's SQL thread is from its I/O thread. On a fast network where I/O delay is close to 0, this will be approximately the delay currently experienced between the Master and Slave SQL executions.

Replication Slave I/O In Failed State

Purpose:

Triggers if the message in SlavelIOState contains the string "failed" during two consecutive samples, meaning that the I/O thread has been unable to connect or maintain a connection to the master server.

Rule Definition:

Condition	State
def matcher = (#SlavelIOState# =~ ".*failed.*") matcher.matches()	Critical

Message:

The SlaveIOState for the replication server monitored by @AgentName is either reconnecting or waiting to reconnect after a disconnection event. This has occurred during the past two samples. The current state is: ____.

Replication Slave SQL Thread Not Running

Purpose:

Checks whether SQL thread is running.

Rule Definition:

Condition	State
getPropertyObject("SlaveConfigured")==="Yes" && #SlaveSQLRunning#=="No"	Fatal

Message:

The Slave SQL Thread for the Replication Slave server monitored by @AgentName is not running.

Replication Slave I/O Thread Not Running

Purpose:

Checks whether I/O thread is running and connected to master.

Rule Definition:

Condition	State
getPropertyObject("SlaveConfigured")==="Yes" && (#SlaveIORunning#=="No" #SlaveIORunning#=="Connecting")	Fatal

Message:

The Slave IO Thread for the Replication Slave server monitored by @AgentName is either not running or not connected to a replication master. The current value for Slave_IO_Running is: ____.

Not all MySQL versions are capable of making the distinction between these two states. Please refer to MySQL documentation for more information.

Slave Behind Master

Purpose:

Checks if the SecondsBehindMaster value is greater than thresholds set in registry variables. This rule is not enabled by default.

Rule Definition:

Condition	State
#SecondsBehindMaster#>registry("slaveBehindFATAL")	Fatal
#SecondsBehindMaster#>registry("slaveBehindCRIT")	Critical
#SecondsBehindMaster#>registry("slaveBehindWARN")	Warning

Note

registry("slaveBehindFATAL ") is a Foglight Registry Variable with a default value of 30.
registry("slaveBehindCRIT ") is a Foglight Registry Variable with a default value of 15.
registry("slaveBehindWARN ") is a Foglight Registry Variable with a default value of 5.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Message:

The Seconds_Behind_Master value for the server monitored by @AgentName is ____ second(s), which is higher than ____, the current registry value.

Seconds_Behind_Master effectively calculates how far behind the Slave's SQL thread is from its I/O thread. On a fast network where I/O delay is close to 0, this will be approximately the delay currently experienced between the Master and Slave SQL executions.

Slave I/O In Failed State

Purpose:

Triggers if the message in SlavelIOState contains the string "failed" during two consecutive samples, meaning that the I/O thread has been unable to connect or maintain a connection to the master server.

Rule Definition:

Condition	State
def matcher = (#SlavelIOState# =~ ".*failed.*") matcher.matches()	Critical

Message:

The SlaveIOState for the server monitored by @AgentName is either reconnecting or waiting to reconnect after a disconnection event. This has occurred during the past two samples. The current state is: ____.

Slave SQL Thread Not Running

Purpose:

Checks whether SQL thread is running.

Rule Definition:

Condition	State
getPropertyObject("SlaveConfigured")==="Yes" && #SlaveSQLRunning#=="No"	Fatal

Message:

The Slave SQL Thread for the Slave server monitored by @AgentName is not running.

Slave I/O Thread Not Running

Purpose:

Checks whether I/O thread is running and connected to master.

Rule Definition:

Condition	State
getPropertyObject("SlaveConfigured")==="Yes" && (#SlaveIORunning#=="No" #SlaveIORunning#=="Connecting")	Fatal

Message:

The Slave IO Thread for the Slave server monitored by @AgentName is either not running or not connected to a replication master. The current value for Slave_IO_Running is: _____. Not all MySQL versions are capable of making the distinction between these two states. Please refer to MySQL documentation for more information.

Slow_Connections Rule

Purpose:

The Slow_Connections rule will fire when the time to establish a connection falls below a user defined time. Under some circumstances MySQL does a DNS lookup of the host name that the user is connecting from and this can delay establishing the connection.

Rule Definition:

Condition	State
MySQLAgent_Connection_Status.SecondsConnect >= registry("SlowConnectionFatal")	Fatal
MySQLAgent_Connection_Status.SecondsConnect >= registry("SlowConnectionCritical")	Critical
MySQLAgent_Connection_Status.SecondsConnect >= registry("SlowConnectionWarning")	Warning

Note

registry("SlowConnectionFatal") is a Foglight Registry Variable with a default value of 10.
registry("SlowConnectionCritical") is a Foglight Registry Variable with a default value of 2.
registry("SlowConnectionWarning") is a Foglight Registry Variable with a default value of 1.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Slow Query Average Execution Time Rule

Purpose:

The Slow Query Average Execution Time rule fires when the average execution time for all queries written to the slow query log in the latest collection exceeds the defined threshold.

Rule Definition:

Condition	State
#SlowQueryAvgTime#>registry("SlowQueryAvgTimeFatal")	Fatal
#SlowQueryAvgTime#>registry("SlowQueryAvgTimeCrit")	Critical
#SlowQueryAvgTime#>registry("SlowQueryAvgTimeWarn")	Warning

Note

registry("SlowQueryAvgTimeFatal ") is a Foglight Registry Variable with a default value of 2.5.
registry("SlowQueryAvgTimeCrit ") is a Foglight Registry Variable with a default value of 5.
registry("SlowQueryAvgTimeWarn ") is a Foglight Registry Variable with a default value of 7.5.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Slow Query Max Execution Time Rule

Purpose:

The Slow Query Max Execution Time rule fires when the maximum execution time for all queries written to the slow query log in the latest collection exceeds the defined threshold.

Rule Definition:

Condition	State
#SlowQueryMaxTime#>registry("SlowQueryMaxTimeFatal")	Fatal
#SlowQueryMaxTime#>registry("SlowQueryMaxTimeCrit")	Critical
#SlowQueryMaxTime#>registry("SlowQueryMaxTimeWarn")	Warning

Note

registry("SlowQueryMaxTimeFatal ") is a Foglight Registry Variable with a default value of 5.
 registry("SlowQueryMaxTimeCrit ") is a Foglight Registry Variable with a default value of 7.5.
 registry("SlowQueryMaxTimeWarn ") is a Foglight Registry Variable with a default value of 10.
 Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Table Scans Excessive

Purpose:

This rule indicates that the server may not be using indexes efficiently to read from the database tables.

Rule Definition:

Condition	State
(#numReqReadRndNext# > 100000) && ((100-(((#numReqReadRndNext# + #numReqReadFixedPos#) / (#numReqReadRndNext# + #numReqReadFixedPos# + #numEntryReadFirst# + #numReqReadNext# + #numReqReadKey# + #numReqReadPrev#))*100)) < registry("TableScansExcessiveFatal"))	Fatal
(#numReqReadRndNext# > 100000) && ((100-(((#numReqReadRndNext# + #numReqReadFixedPos#) / (#numReqReadRndNext# + #numReqReadFixedPos# + #numEntryReadFirst# + #numReqReadNext# + #numReqReadKey# + #numReqReadPrev#))*100)) < registry("TableScansExcessiveCritical"))	Critical
(#numReqReadRndNext# > 100000) && ((100-(((#numReqReadRndNext# + #numReqReadFixedPos#) / (#numReqReadRndNext# + #numReqReadFixedPos# + #numEntryReadFirst# + #numReqReadNext# + #numReqReadKey# + #numReqReadPrev#))*100)) < registry("TableScansExcessiveWarning"))	Warning

Note

registry("TableScansExcessiveFatal ") is a Foglight Registry Variable with a default value of 60.
registry("TableScansExcessiveCritical ") is a Foglight Registry Variable with a default value of 80.
registry("TableScansExcessiveWarning ") is a Foglight Registry Variable with a default value of 90.

Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

The target server does not appear to be using indexes efficiently. The values of Handler_read_rnd_next and Handler_read_rnd together - which reflect the number of rows read via full table scans - are high compared to the sum of Handler variables which denote all row accesses - such as Handler_read_key, Handler_read_next etc. You should examine your tables and queries for proper use of indexes.

Advice

Look for long-running queries issued shortly before the time of this alert, queries where avg or max execution time has increased significantly from one interval to another, or queries where max execution time is much greater than avg execution time. Also, look for queries flagged as requiring a table scan.

Another option is to turn on the Slow Query Log (if it is not already turned on) and monitor what goes into it. Statements that are logged there are candidates for tuning. Note, however, that statements will only be logged there if they take longer than your long_query_time parameter to run, so statements triggering full scans of small tables that execute very quickly may not show up. Once you have found tuning candidates, use the EXPLAIN statement on the queries to see which tables should have indexes added to them.

If you are using MySQL 4.1 or later you can use the --log-queries-not-using-indexes option to log all statements that do a full table scan, even if they would not otherwise qualify for the slow query log.

Note that full table scans are not necessarily bad, as long as they are confined to very small tables, so be sure to take table size into account as you review your queries and their EXPLAIN plans.

Tablespace_Utilization Rule

Purpose:

The Tablespace_Utilization rule will fire when there is less than a user defined amount of tablespace left in an InnoDB database for those databases that do not have auto extend enabled. This rule applies only to InnoDB.

Rule Definition:

Condition	State
#TablespaceFreeMB#<=registry("TablespaceFatal") && #TableSpaceAutoExtend#<1	Fatal
#TablespaceFreeMB#<=registry("TablespaceCritical") && #TableSpaceAutoExtend#<1	Critical
#TablespaceFreeMB#<=registry("TablespaceWarning") && #TableSpaceAutoExtend#<1	Warning

Note

registry("TablespaceFatal") is a Foglight Registry Variable with a default value of 0.
registry("TablespaceCritical") is a Foglight Registry Variable with a default value of 4.
registry("TablespaceWarning") is a Foglight Registry Variable with a default value of 8.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Thread Cache Not Enabled Rule

Purpose:

This rule will fire if the Thread Cache is not enabled.

Rule Definition:

Condition	State
#ThreadCacheSize#<1	Fire

Problem Description

Each connection to the MySQL database server runs in its own thread. Thread creation takes time, so rather than killing the thread when a connection is closed, the server can keep the thread in its thread cache and use it for a new connection later.

Advice

Set your thread_cache_size variable high enough that the Threads_created value in SHOW STATUS stops increasing dynamically, then set this value for thread_cache_size within your my.cnf/my.ini file.

Thread_Pool_HitRate Rule

Purpose:

The Thread_Pool_HitRate rule will fire when the Thread Pool hit rate falls below a user defined percentage.

Rule Definition:

Condition	State
MySQLAgent_Thread_Pool_KeyHitRate <= registry("ThreadPoolHitRateCritical")	Critical
MySQLAgent_Thread_Pool_KeyHitRate <= registry("ThreadPoolHitRateWarning")	Warning

Note

registry("ThreadPoolHitRateCritical") is a Foglight Registry Variable with a default value of 90.
registry("ThreadPoolHitRateWarning") is a Foglight Registry Variable with a default value of 95.
Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

Each connection to the MySQL database server runs in its own thread. Thread creation takes time, so rather than killing the thread when a connection is closed, the server can keep the thread in its thread cache and use it for a new connection later.

Advice

Increase the thread_cache_size variable dynamically and monitor the thread cache hit ratio. When it reaches an acceptable level, put the corresponding value of thread_cache_size in your my.cnf/my.ini file so the variable is set properly when the server is restarted. The ideal situation is to get Threads_created as close as possible to thread_cache_size - no new connections having to wait for new thread allocation - staying as close to around a 99% thread cache hit ratio as you can.

Transaction_Purge_lag Rule

Purpose:

The Transaction_Purge_Lag rule will fire when the number of transactions waiting to be purged exceeds a user defined limit. The user can control the lag by adjusting the MySQL innodb_max_purge_lag startup parameter.

InnoDB keeps information about old versions of rows in the tablespace in an area called the rollback segment so that it can support transaction rollback and consistent reads. When a transaction completes the old versions of the rows affected by the transaction can be purged. This purging is done as a background task and can be delayed by active transactions. If the purging lags too far behind then the rollback segments grow and can fill up the tablespace.

Rule Definition:

Condition	State
MySQLAgent_Innodb_Storage_Engine.TransactionPurgeLag >= registry("TransactionPurgeLagCritical")	Critical
MySQLAgent_Innodb_Storage_Engine.TransactionPurgeLag >= registry("TransactionPurgeLagWarning")	Warning

Note

registry("TransactionPurgeLagCritical") is a Foglight Registry Variable with a default value of 1500000.
registry("TransactionPurgeLagWarning") is a Foglight Registry Variable with a default value of 1000000. Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

The TransactionPurgeLag is the difference between the current transaction number and the last transaction number to have its row history purged. This variable indicates how far behind purging is lagging. The user can alter innodb_max_purge_lag to control the lag.

Advice

Check your innodb_max_purge_lag to ensure that it is set to a reasonable number for your needs and that the TransactionPurgeLag does not exceed the innodb_max_purge_lag setting. If it does, it may be caused by an old consistent read view that can see rows marked for purging.

Unflushed_Log_Buffer Rule

Purpose:

The Unflushed_Log_Buffer rule will fire when the percentage of log entries in the log buffer waiting to be flushed to disk exceeds a user defined percentage.

Rule Definition:

Condition	State
MySQLAgent_Innodb_Transaction_Log.UnflushedPct >= registry("UnflushedLogCritical")	Critical
MySQLAgent_Innodb_Transaction_Log.UnflushedPct >= registry("UnflushedLogWarning")	Warning

Note

registry("UnflushedLogCritical") is a Foglight Registry Variable with a default value of 50.

registry("UnflushedLogWarning") is a Foglight Registry Variable with a default value of 30. Use the Foglight Registry to change thresholds for rules by modifying registry entries.

Problem Description

The percentage of entries in the log buffer has exceeded your user-defined threshold.

Advice

If your environment has large or frequent transactions, you may want to increase `innodb_log_buffer_size` to deal with this. A large log buffer allows large transactions to run without a need to write the log to disk before the transactions commit. Thus, if you have big transactions, making the log buffer larger saves disk I/O.

Appendix B – Reports

Executive Summary – Executive summary of MySQL instance with high-level information including connection, workload, availability, and performance metrics, as well as top 10 alarms by severity.

Failed Logins Report - Shows failed login attempts to MySQL server in selected timeRange and generated error counts.

Health Check – Report showing health indicators for the MySQL instance, including connections, workload, system, and performance metrics, top 10 statement digests by wait and lock times and error counts, and top 10 alarms by severity.

MySQL Server Configuration – Displays variables for the MySQL instance with values at the start and end of the selected time range and when they were modified.

MySQL Server Configuration Comparison – Compares current variable values for all MySQL instances contained in a Service against a selected MySQL instance (template server) to ensure configuration compliance. The report will optionally return all variables or just the variables with at least one difference in values.

Storage Report – Shows information on MySQL server storage capacity, growth rate, etc.

Top MySQL Servers by Connections – Displays top X MySQL instances by the selected connection metric: successful connects, aborted connects, success percentage, or aborted clients.

Top MySQL Tables – Displays top X tables in a MySQL instance by the selected table metric: total size, row count, used space percentage, or growth rate.

Top Statement Digests – Displays top X statement digests for a MySQL instance by the selected metric: count, average/sum/max wait time, average lock time, errors, or warnings.

Users Report – Shows information on MySQL users, connections, and privileges.

Appendix C – Table and Field Description

MySQL Agent Data Tables

This section includes data tables for the MySQL agent:

Connection_Status Table

Purpose

This table contains information about whether new connections can be made to the database or not.

Table Description

Field	Description
ConnectionDetails	The connection details; host, port, database and user name.
ConnectionPort	The connection port of the database
ErrorMessage	The error message if a connection could not be made or blank if the connection was successful
ConnectivityPct	Shows if a new connection can be made (value is 100) or not (0)
secondsConnect	Number of seconds MySQL took to fully establish the connection
Connections	The number of connection attempts (successful or not) to the MySQL server.
MaxUsedConnections	The maximum number of connections that have been in use simultaneously since the server started.

Database_Information Table

Purpose

This table contains information about the MySQL database being monitored.

Table Description

Field	Description
MySQL_Version	Will contain the numeric portion of the version. E.g. 5.0.22-community-max-nt-log becomes 5.0.22
MajorVersion	The digits to the left of the first point in the database version number. E.g. if the version number is 5.0.22-community-max-nt-log the this value will be 5

MinorVersion	The digits to the right of the first point in the database version number. E.g. if the version number is 5.0.22-community-max-nt-log the this value will be 0
uptime	The time in seconds that this database has been up

Handler Table

Purpose

This table contains handler information within MySQL.

Table Description

Field	Description
internalCommit	The number of internal COMMIT statements.
numDeleteRows	The number of times that rows have been deleted from tables.
commitCountPrepare	A counter for the prepare phase of two-phase commit operations.
numEntryReadFirst	The number of times the first entry was read from an index.
numReqReadKey	The number of requests to read a row based on a key.
numReqReadNext	The number of requests to read the next row in key order.
numReqReadPrev	The number of requests to read the previous row in key order.
numReqReadFixedPos	The number of requests to read a row based on a fixed position.
numReqReadRndNext	The number of requests to read the next row in the data file.
numReqRollback	The number of requests for a storage engine to perform a rollback operation.
numReqRollback	The number of requests for a storage engine to place a savepoint.
numReqRollback	The number of requests for a storage engine to roll back to a savepoint.
numReqUpdate	The number of requests to update a row in a table.
numReqWrite	The number of requests to insert a row in a table.

InnoDB_Buffer_Pool Table

Purpose

This table contains information about the InnoDB buffer. The buffer pool size is tunable and should be made as large as possible to increase the buffer hit rate.

Table Description

Field	Description
BufferMemAllocated	Memory allocated for the InnoDB buffer pool.
BufferPoolAdditionalSize	Memory allocated for additional InnoDB buffer pool
BufferPoolSize	Total number of pages in InnoDB buffer
DatabasePages	Number of database pages in buffer
CleanPages	Number of clean pages in buffer
DirtyPages	Number of dirty pages in buffer
MiscPages	Number of miscellaneous pages in buffer
BufferFree	Number of free pages in buffer
ModifiedPages	Number of modified pages in buffer
FreePagesPct	Percent of free pages in buffer. If this is consistently high then the buffer is too big.
HitRatePct	Percent buffer hit rate
MissRate	Percent buffer miss rate
BufferPoolWriteReq	The number of logical write requests done to the InnoDB buffer pool.
BufferPoolReadReq	The number of logical read requests done to the InnoDB buffer pool.
LogBufferSize	Size of the InnoDB Log Buffer

InnoDB Storage Engine Table

Purpose

This table contains information about the state of the InnoDB storage engine.

Table Description

Field	Description
MutexOsWaitsPerSec	The number of times InnoDB waited on the OS for a mutex.
MutexSpinWaitsPerSec	The number of times InnoDB spun waiting for a mutex to become free.
MutexSpinRoundsPerSec	The number of times InnoDB spun round waiting for a mutex to become free.
RWlockOsWaitsPerSec	The number of times InnoDB waited on the OS for a read/write lock.
RWlockSpinWaitsPerSec	The number of times InnoDB spun waiting for a shared read/write to become free.

TransactionsPerSec	The number of transactions being processed per second
QueriesInsideInnodb	The number of queries active inside InnoDB
QueriesInQueue	The number of queries waiting to enter InnoDB
TransactionPurgeLag	The difference between the current transaction number and the last transaction number to have its row history purged. Indicates how far behind purging is lagging. The user can alter innodb_max_purge_lag to control the lag.
PendingNormalAsyncIOReadsPerSec	Number of pending normal asynchronous I/O reads per second
PendingNormalAsyncIOWritesPerSec	Number of pending normal asynchronous I/O writes per second
InsertBufferAsyncIOReadsPerSec	Number of insert buffer asynchronous I/O reads per second
InsertBufferAsyncIOWritesPerSec	Number of insert buffer asynchronous I/O writes per second
InnoDBIOThreads	The number of helper threads performing InnoDB I/O.
OSFileReadsPerSec	Number of Operating System reads per second
OSFileWritesPerSec	Number of Operating System writes per second
OSFsyncsPerSec	Number of Operating System fsync calls per second
DataWritesPerSec	Number of physical data writes per second
DataReadsPerSec	Number of physical data reads per second
RowsInsertedPerSec	Number of rows inserted per second
RowsReadPerSec	Number of rows read per second
RowsUpdatesPerSec	Number of rows updated per second
RowsDeletedPerSec	Number of rows deleted per second

Innodb_Transaction_Log Table

Purpose

This table contains information about the state of the InnoDB transaction log. The transaction log buffer size is tunable and affects the speed of large transactions.

Table Description

Field	Description
WaitsPerSec	Number of times InnoDB has to wait for log to be flushed to disk per second
WritesPerSec	Number of times InnoDB has written the log to disk per second

UnflushedPct	Percent of InnoDB log buffer that has yet to be flushed to disk. If this is too high then buffer needs to be tuned.
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Joins Table

Purpose

This table contains information on joins within MySQL.

Table Description

Field	Description
fullJoin	The number of joins that perform table scans because they do not use indexes.
fullRangeJoin	The number of joins that used a range search on a reference table.
rangeJoins	The number of joins that used ranges on the first table.
rangeCheckKeys	The number of joins without keys that check for key usage after each row.
fullScanJoins	The number of joins that did a full scan of the first table.

Key_Buffer Table

Purpose

This table contains information on key blocks within MySQL.

Table Description

Field	Description
KeyBlocksNotFlushed	The number of key blocks in the key cache that have changed but have not yet been flushed to disk.
KeyBlocksUnUsed	The number of unused blocks in the key cache.
KeyBlocksUsed	The number of used blocks in the key cache.
KeyReadRequests	The number of requests to read a key block from the cache.
KeyReads	The number of physical reads of a key block from disk.
KeyWriteRequests	The number of requests to write a key block to the cache.
KeyWrites	The number of physical writes of a key block to disk.
KeyHitRate	The rate of physical reads from a disk to requests to read from the cache.

Master_Status Table

Purpose

This table stores information about the slave status of the host server.

Table Description

Field	Description
MasterConfigured	The server is set up for master replication
BinlogFile	The name of the current master binary log file
BinlogPos	The position in the current master binary log file
BinlogDoDB	The databases included in replication, if this option is set
BinlogIgnoreDB	The databases not included in replication, if this option is set

Mutex Table

Purpose

This table contains information to the internal Mutexes within MySQL.

Table Description

Field	Description
MutexName	The mutex name
MutexCount	The number of accesses to this mutex
MutexRate	The number of accesses to the mutex per second
SpinWaits	The number of spin waits made while waiting for the mutex to become free
SpinWaitRate	The number of spin waits per second while waiting for the mutex to become free
SpinRounds	The number of spin rounds made while waiting for the mutex to become free
OSWaits	The number of OS waits made while waiting for the mutex to become free
OSWaitsTimeSec	The time spent in OS waits while waiting for the mutex to become free
OSWaitsTimeRateSec	The time per second spent in OS waits while waiting for the mutex to become free
MutexModule	The source module that defines the mutex

Network_Interface Table

Purpose

This table contains information about network I/O.

Table Description

Field	Description
BytesReceivedPerSec	The number of bytes received per second
BytesSentPerSec	The number of bytes sent per second

Query_Cache Table

Purpose

This table caches the SQL of a query and provides its results. It provides information about the cache hit rate.

Table Description

Field	Description
HitRatePct	% of SQL queries that were in the query cache
StatementsExec	The number of SQL statements that are currently being executed
StatementsExecPerSec	The number of SQL statements per second that are currently being executed.
QueryCacheSize	Query Cache Size in megabytes of memory
UsedMemoryMB	The megabytes of memory in the query cache that are used
FreeMemoryMB	The megabytes of memory in the query cache that are free
NumCachedStatements	The number of SQL statements that are in the cache
NumCachedInserts	The number of queries added to the query cache
NumLowMemPrunes	The number of queries that were deleted from the query cache because of low memory.
NumQueriesNotCached	The number of non-cached queries.
NumCachedTotalBlocks	The total number of blocks in the query cache.
NumCachedUsedBlocks	The number of used memory blocks in the query cache.
NumCachedFreeBlocks	The number of free memory blocks in the query cache.

Replication_Slave_Status Table

Purpose

This table stores information about the slave status of the replication slave server used by the master host server. It also stores connection-related and timestamp information.

Table Description

Field	Description
SlaveConnection	Whether the agent is able to connect to the replication slave server
SlaveConfigured	Whether the server is set up for slave replication
ReplicationTimeDiff	The difference in seconds between the time on the master server and replication slave server
ConnectionHost	The hostname or IP that the agent is using to connect to the replication slave server
ConnectionPort	The port that the agent is using to connect to the replication slave server
SlaveIOState	The current state of the replication slave's I/O thread
MasterHost	The master host that the slave is connected to
MasterUser	The user name of the account used to connect to the master
MasterPort	The port used to connect to the master
MasterLogFile	The name of the master binary log file from which the I/O thread is currently reading
ReadMasterLogPos	The position in the current master binary log file up to which the I/O thread has read
ExecMasterLogPos	The position in the current master binary file up to which the SQL thread has read and executed
RelayLogFile	The name of the relay log file from which the SQL thread is currently reading and executing.
RelayLogPos	The position in the current relay log file up to which the SQL thread has read and executed
RelayMasterLogFile	The name of the master binary log file containing the most recent event executed by the SQL thread
SlaveIORunning	Whether the I/O thread is running and has connected successfully to the master
SlaveSQLRunning	Whether the SQL thread is running
MasterSSLAllowed	Whether an SSL connection to the master is permitted and if the replication slave server has SSL enabled
MasterSSLVerifyServerCert	Whether this security feature is enabled
SecondsBehindMaster	The time difference in seconds between the slave SQL thread and the slave I/O thread.
LastIOErrno	The error number of the last error that caused the I/O thread to stop
LastIOError	The error message of the last error that caused the I/O thread to stop
LastSQLErrno	The error number of the last error that caused the SQL thread to stop
LastSQLError	The error message of the last error that caused the SQL thread to stop

Slave_Status Table

Purpose

This table stores information about the slave status of the host server.

Table Description

Field	Description
SlaveConfigured	Whether the server is set up for slave replication
SlaveIOState	The current state of the slave I/O thread
MasterHost	The master host that the slave is connected to
MasterUser	The user name of the account used to connect to the master
MasterPort	The port used to connect to the master
MasterLogFile	The name of the master binary log file from which the I/O thread is currently reading
ReadMasterLogPos	The position in the current master binary log file up to which the I/O thread has read
ExecMasterLogPos	The position in the current master binary file up to which the SQL thread has read and executed
RelayLogFile	The name of the relay log file from which the SQL thread is currently reading and executing.
RelayLogPos	The position in the current relay log file up to which the SQL thread has read and executed
RelayMasterLogFile	The name of the master binary log file containing the most recent event executed by the SQL thread
SlaveIORunning	Whether the I/O thread is running and has connected successfully to the master
SlaveSQLRunning	Whether the SQL thread is running
MasterSSLAllowed	Whether an SSL connection to the master is permitted and if the slave server has SSL enabled
MasterSSLVerifyServerCert	Whether this security feature is enabled
SecondsBehindMaster	The time difference in seconds between the slave SQL thread and the slave I/O thread.
LastIOErrno	The error number of the last error that caused the I/O thread to stop
LastIOError	The error message of the last error that caused the I/O thread to stop
LastSQLErrno	The error number of the last error that caused the SQL thread to stop
LastSQLError	The error message of the last error that caused the SQL thread to stop

Slow Query Entry

Purpose

This table stores information about a unique query collected from the Slow Query Log. When the queries are gathered, they are genericized and standardized in order to aggregate them with other similar queries. This is done by removing column values and other values that are of limited or no importance to the way a query operates. For instance, “SELECT * FROM customers WHERE name=‘Jones’ LIMIT 2;” and “SELECT * FROM customers WHERE name=‘Smith’ LIMIT 5;” would be considered instances of one unique query type. If the second query were instead to select data from a table named “pets”, they would be considered different.

SQL	A genericized instance of this SQL query string.
EarliestTime	The earliest time this query appeared in the collection period.
LatestTime	The latest time this query appeared in the collection period.
Users	The DB users who executed this query, separated by " ".
Count	The number of times this query was executed.
QueryTimeMin	The minimum execution time for this query.
QueryTimeMax	The maximum execution time for this query.
QueryTimeAvg	The average execution time for this query.
LockTimeMin	The minimum lock time for this query.
LockTimeMax	The maximum lock time for this query.
LockTimeAvg	The average lock time for this query.
RowsSentMin	The minimum number of rows returned from this query.
RowsSentMax	The maximum number of rows returned from this query.
RowsSentAvg	The average number of rows returned from this query.
RowsExaminedMin	The minimum number of rows examined during the execution of this query.
RowsExaminedMax	The maximum number of rows examined during the execution of this query.
RowsExaminedAvg	The average number of rows examined during the execution of this query.

Sort_Buffer Table

Purpose

This table contains information about the MySQL sort buffer.

Table Description

Field	Description
SortBufferSize	Buffer size that each thread needs to allocate to do a sort
RowsSortedPerSec	The number of rows sorted per second
SortRangePerSec	The number of sorts per second that used a range (i.e. used an index)
SortScanPerSec	The number of sorts per second that used a full table scan (i.e. read the entire table). High values generally indicate poor use of indexing.
MergePassesSortedPerSec	The number of merge passes that the sort algorithm has had to do per second

Tables Table

Purpose

This table contains information about tables within the database.

Table Description

Field	Description
DatabaseName	The database that the tablespace is in
TablespaceName	The tablespace name.
TableSpaceAutoExtend	The increment size for extending the size of an auto-extending tablespace when it becomes full.
TablespaceFreeMB	Megabytes of free space in the tablespace
TablespaceFreePct	Percentage of free space in the tablespace
TablespaceUsedMB	Megabytes of used space in the tablespace
TablespaceUsedPct	Percentage of used space in the tablespace
TablespaceTotalSizeMB	Megabytes of total size in the tablespace
NumRows	The number of rows in the tablespace

Thread_Pool Table

Purpose

This table contains information about how the thread cache is operating.

Table Description

Field	Description
ThreadCacheSize	The maximum number of threads that can be cached
ThreadsCached	The number of threads in the thread cache
ThreadsConnected	The number of currently open connections
ThreadsCreatedPerSec	The number of new threads created per second. A high creation rate is indicative that the cache is too small.
ThreadsRunning	The number of active (non sleeping) threads
ThreadPoolHitRatePct	The number of threads that were used from the pool in comparison to the total number of connections made

Top_Sessions Table

Purpose

This table contains information about sessions that have the longest running commands, excluding the master and slave replication, idle sessions and the session that the agent is connected to.

Table Description

Field	Description
SessionsId	The MYSQL id for the session
SessionsUser	The user ID that the session is connected as.
SessionsDatabase	The database that the session is using
SessionsSeconds	The number of seconds that the command has been executing.
SessionsCommand	A portion of the command that is currently executing.
SessionsState	The state of the session
SessionsSQL	A portion of the SQL that is currently executing