MySQL 8.3 Enterprise Edition & Open Telemetry

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MySQL 8.4 Enterprise Edition Features

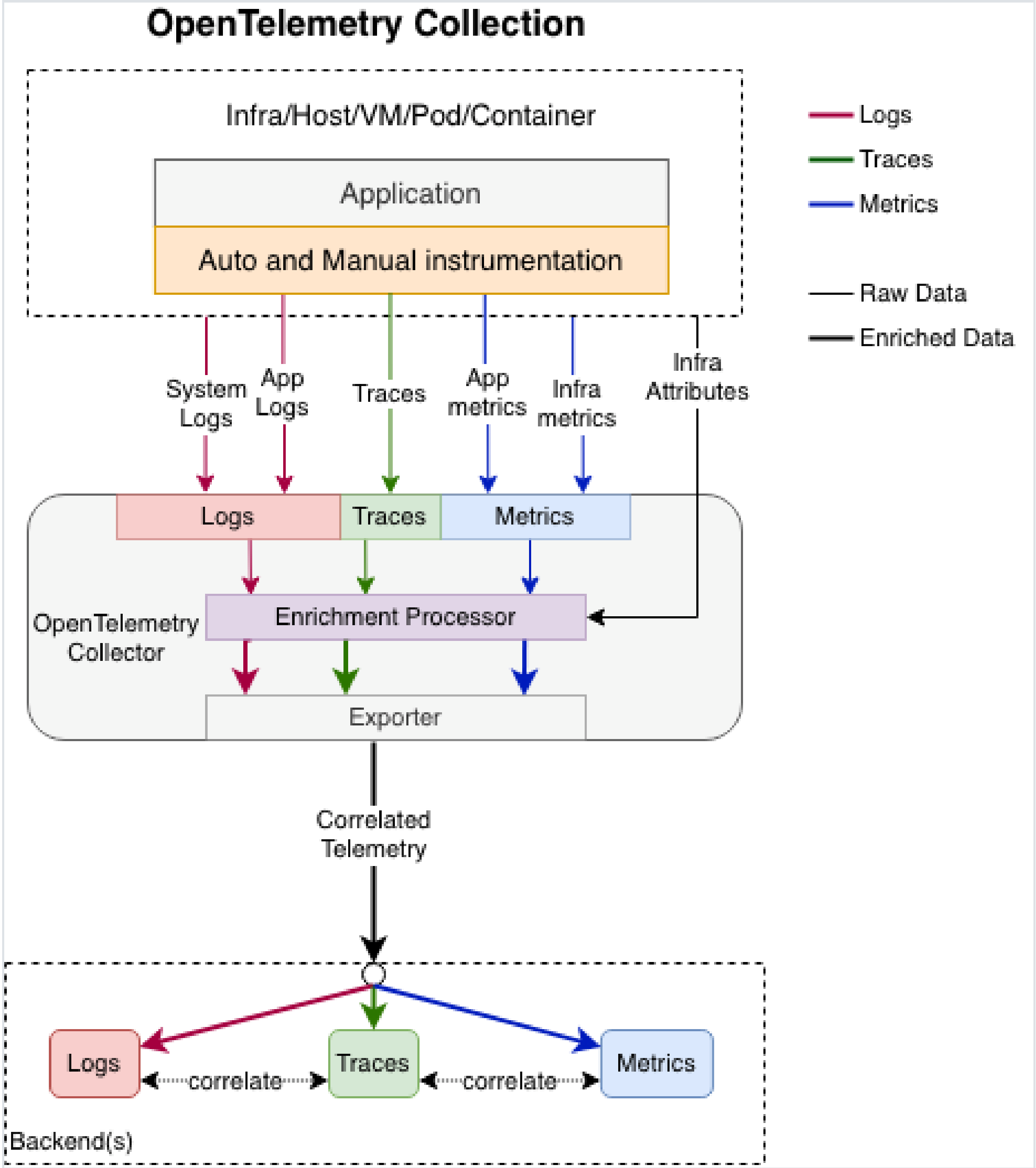
- EE Encryption
- EE Audit
- EE Firewall
- EE Thread Pool
- EE Data Masking
- EE LDAP authentication
- EE Kerberos authentication
- EE PAM authentication
- EE Windows authentication

- EE WebauthN authentication
- EE AWS keyring
- EE Encrypted File keyring
- EE Hashicorp keyring
- EE Oracle Key Vault keyring
- EE OCI Keyring
- EE JavaScript Stored Programs
- EE OpenTelemetry

Introduction to OpenTelemetry

https://opentelemetry.io/

The OpenTelemetry (OTel) project is an open-source, vendor-neutral observability framework, providing a common observability standard. It enables users to instrument their applications in order to export observability data: traces, metrics and logs, enabling increased granularity of debugging and testing.



OpenTelemetry Architecture

Signals flowing from Applications to Backend

Traces , **Metrics** , **Logs**

MySQL plays the role of **application** within in the OpenTelemetry observability framework

OpenTelemetry Infrastructure Components

- Optionally install and start the OpenTelemetry **Collector**

  Adds additional flexibility and options, such as sending signals to many backends

- Install and start vendor specific **Backend**

  Example: Jaeger, Prometheus, …

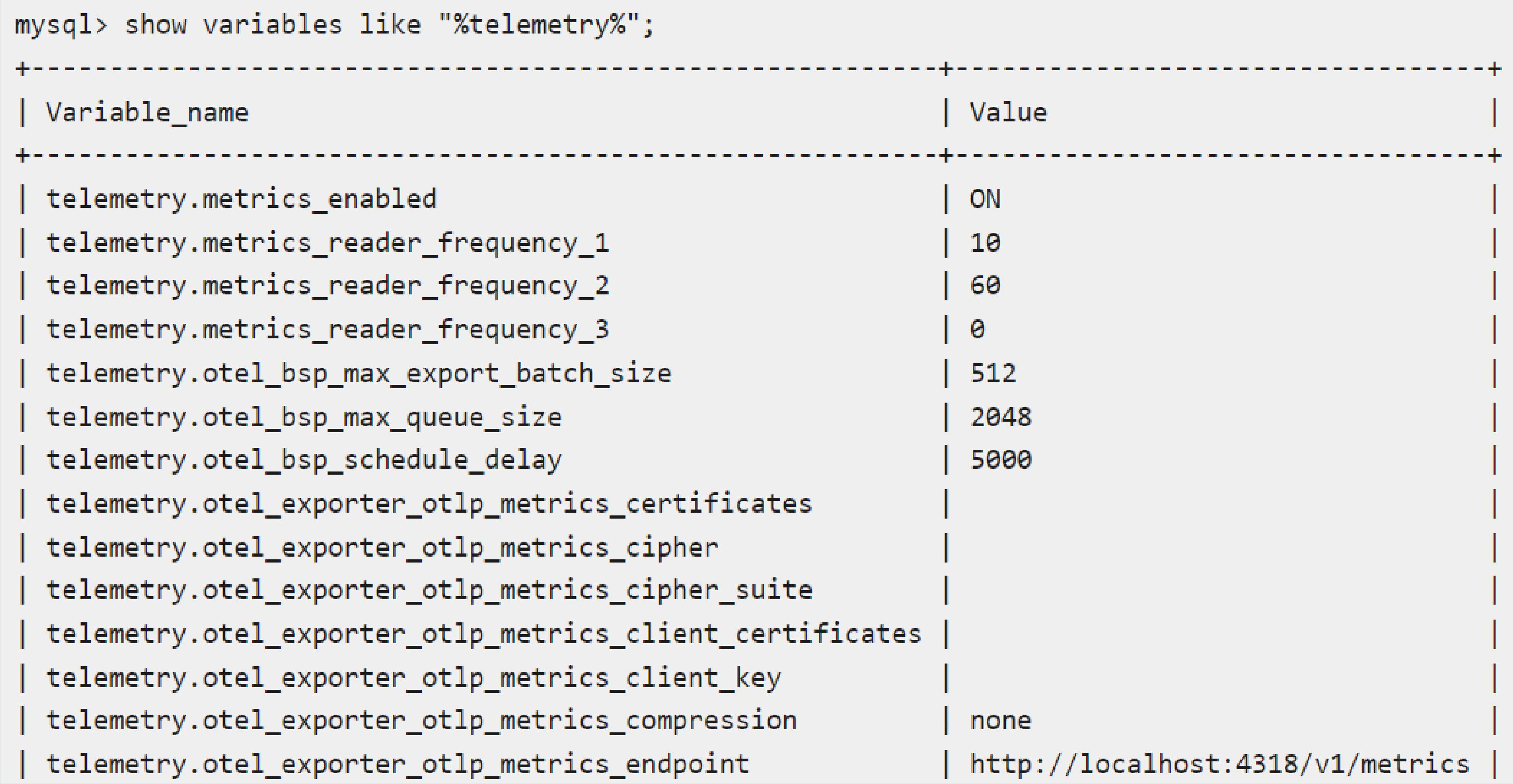
- Use vendor specific **Visualization** tools

  Example: Grafana is a popular choice

MySQL EE – Telemetry Introduction

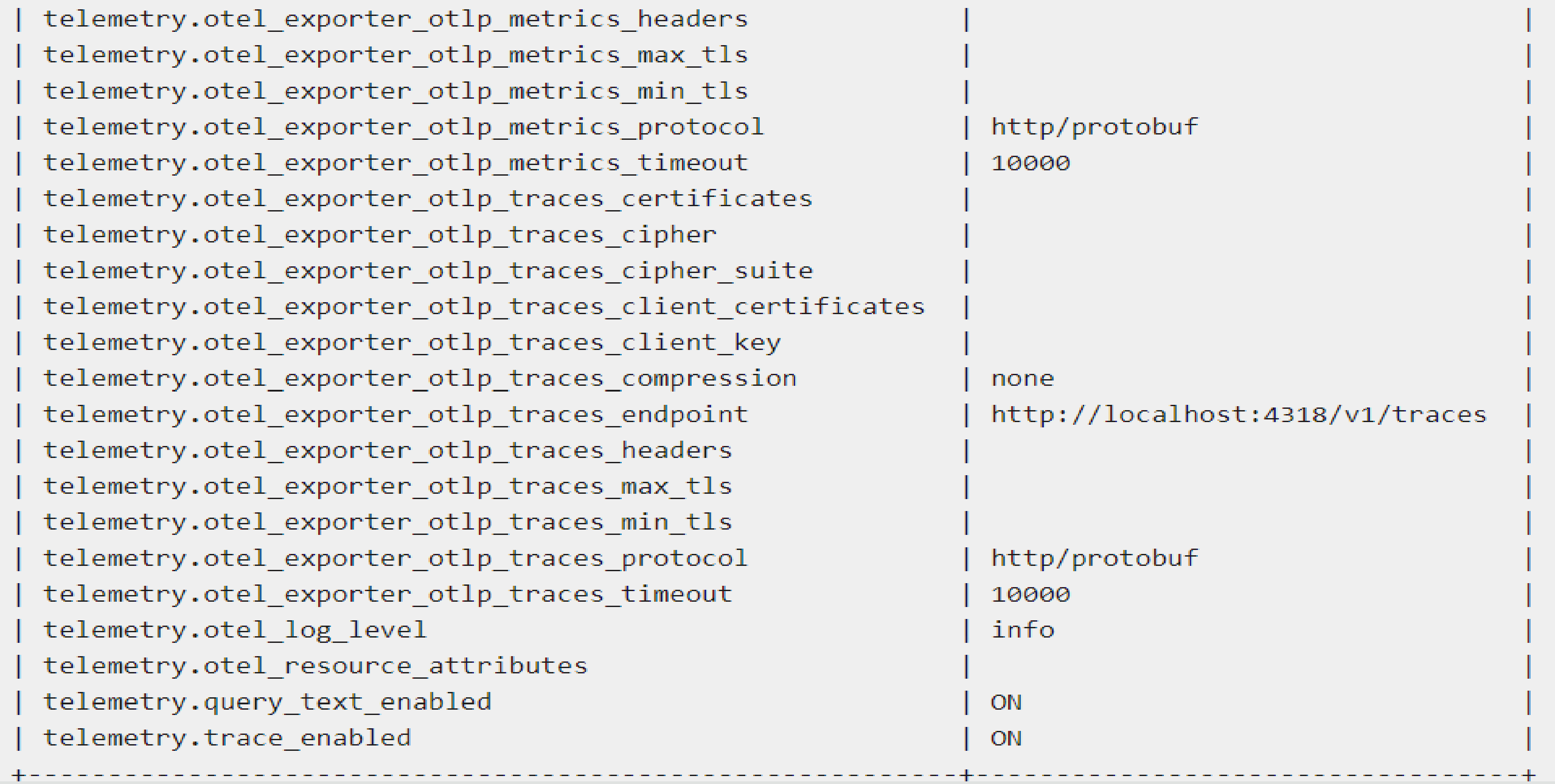
- Supporting Traces and Metrics in 8.3
- Supported on all MySQL EE platforms
- Supported by all MySQL Connectors
- Install component 'file://component_telemetry’;
- Enable/Disable Traces and Metrics
- Can configure different endpoints for Traces and Metrics

Telemetry-specific System variables



```
mysql> show variables like "%telemetry%";
+----------------------------------------------------------+----------------------------------+
| Variable_name                                            | Value                            |
+----------------------------------------------------------+----------------------------------+
| telemetry.metrics_enabled                                | ON                               |
| telemetry.metrics_reader_frequency_1                     | 10                               |
| telemetry.metrics_reader_frequency_2                     | 60                               |
| telemetry.metrics_reader_frequency_3                     | 0                                |
| telemetry.otel_bsp_max_export_batch_size                 | 512                              |
| telemetry.otel_bsp_max_queue_size                        | 2048                             |
| telemetry.otel_bsp_schedule_delay                        | 5000                             |
| telemetry.otel_exporter_otlp_metrics_certificates        |                                  |
| telemetry.otel_exporter_otlp_metrics_cipher              |                                  |
| telemetry.otel_exporter_otlp_metrics_cipher_suite        |                                  |
| telemetry.otel_exporter_otlp_metrics_client_certificates |                                  |
| telemetry.otel_exporter_otlp_metrics_client_key          |                                  |
| telemetry.otel_exporter_otlp_metrics_compression         | none                             |
| telemetry.otel_exporter_otlp_metrics_endpoint            | http://localhost:4318/v1/metrics |
```

Telemetry-specific System variables



```
| telemetry.otel_exporter_otlp_metrics_headers            |                                 |
| telemetry.otel_exporter_otlp_metrics_max_tls            |                                 |
| telemetry.otel_exporter_otlp_metrics_min_tls            |                                 |
| telemetry.otel_exporter_otlp_metrics_protocol           | http/protobuf                   |
| telemetry.otel_exporter_otlp_metrics_timeout            | 10000                           |
| telemetry.otel_exporter_otlp_traces_certificates        |                                 |
| telemetry.otel_exporter_otlp_traces_cipher              |                                 |
| telemetry.otel_exporter_otlp_traces_cipher_suite        |                                 |
| telemetry.otel_exporter_otlp_traces_client_certificates |                                 |
| telemetry.otel_exporter_otlp_traces_client_key          |                                 |
| telemetry.otel_exporter_otlp_traces_compression         | none                            |
| telemetry.otel_exporter_otlp_traces_endpoint            | http://localhost:4318/v1/traces |
| telemetry.otel_exporter_otlp_traces_headers             |                                 |
| telemetry.otel_exporter_otlp_traces_max_tls             |                                 |
| telemetry.otel_exporter_otlp_traces_min_tls             |                                 |
| telemetry.otel_exporter_otlp_traces_protocol            | http/protobuf                   |
| telemetry.otel_exporter_otlp_traces_timeout             | 10000                           |
| telemetry.otel_log_level                                | info                            |
| telemetry.otel_resource_attributes                      |                                 |
| telemetry.query_text_enabled                            | ON                              |
| telemetry.trace_enabled                                 | ON                              |
+---------------------------------------------------------+---------------------------------+
```

Traces

Traces

- Understand the full path through your distributed application
- By passing a **trace context** from one distributed component to the next
- And using this **trace context** as an identifier for reporting information about computing steps taken by individual components within the overall distributed execution path
- The trace context is given by the **trace_id** (the whole tree) and **span_id** (a given node in the tree)

Spans

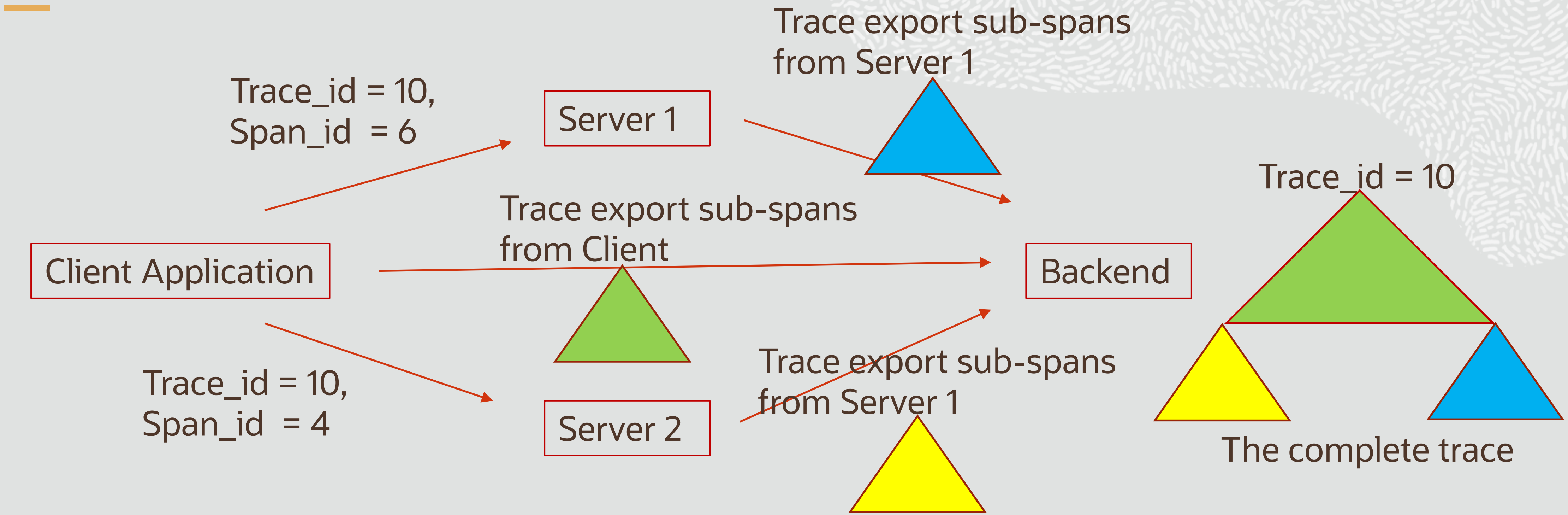
- A span represents a unit of work or operation
- Spans are the building blocks of Traces.
- A span include the information shown here =>

- Name
- Parent span ID (empty for root spans)
- Start and End Timestamps
- Span Context
- Attributes
- Span Events
- Span Links
- Span Status

Nested Spans

- Spans can be nested, as is implied by the presence of a parent span ID
- Child spans represent sub-operations. This allows spans to more accurately capture the work done in an application

Only the Backend sees the full picture



Trace export sub-spans from Server 1

Trace_id = 10,
Span_id = 6

Server 1

Trace_id = 10

Trace export sub-spans from Client

Client Application

Backend

Trace export sub-spans from Server 1

Trace_id = 10,
Span_id = 4

Server 2

The complete trace

MySQL Support for Traces

- MySQL **Connectors** are extended with the ability to pass on the **trace context** to the MySQL Server
- Trace context is passed on as **query attributes** over the MySQL **protocol**
- The MySQL **Server** understands the incoming trace context and reports its own traces in the same context and according to the OpenTelemetry specification
- When no context is provided then a new context is created

MySQL Span Type : Control

Issued when the telemetry configuration changes, notifying downstream system of which signal collection has been enabled or disabled

No parent span_id

Span attributes

- Name: Control
- trace_enabled: Boolean.
- metrics_enabled: Boolean.
- logs_enabled: Boolean
- details:

MySQL Span Type : Session

Issued when a **client session ends**, recording data relevant to that session from initial connection to close of session

No parent span_id

From performance_schema table

session_connect_attrs

Span attributes

- Name: Session
- mysql.processlist_id
- mysql.thread_id
- mysql.user
- mysql.host
- mysql.group
- + session attributes

MySQL Span Type : Statement

Issued when a **statement execution ends** in the server, recording all relevant statement information from the start of the execution to its completion

Parent span_id

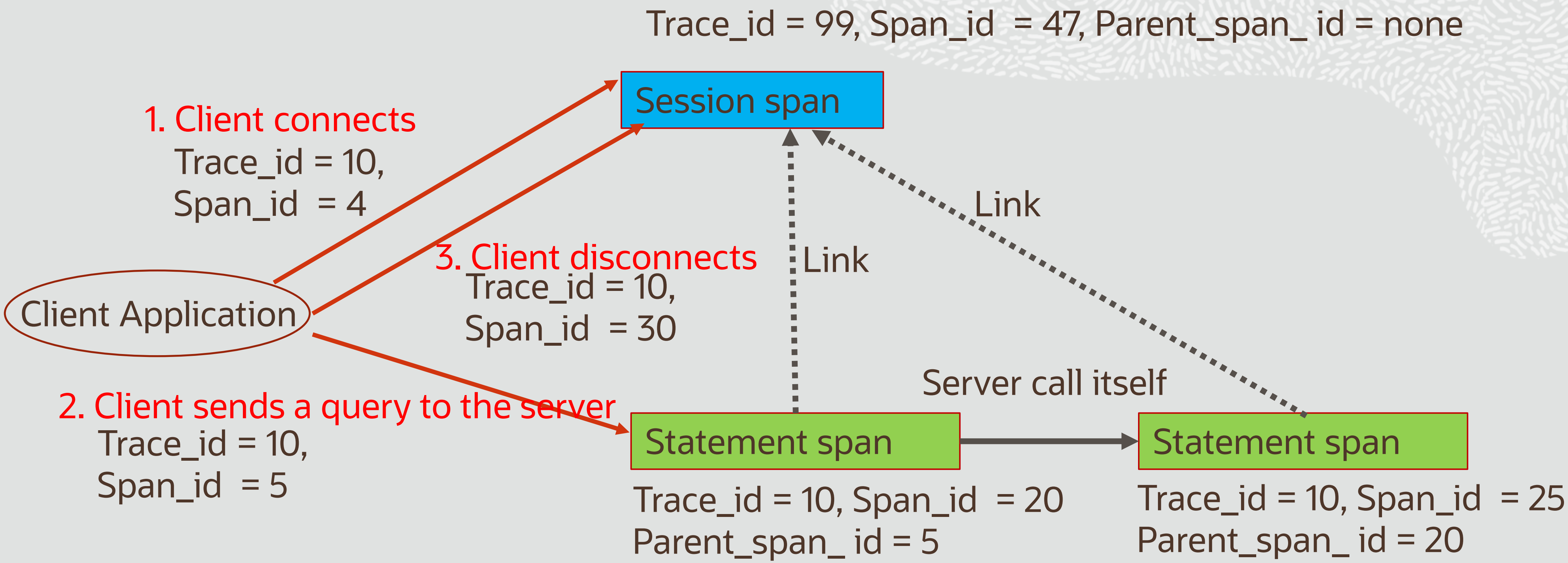
From performance_schema table

events_statements_current

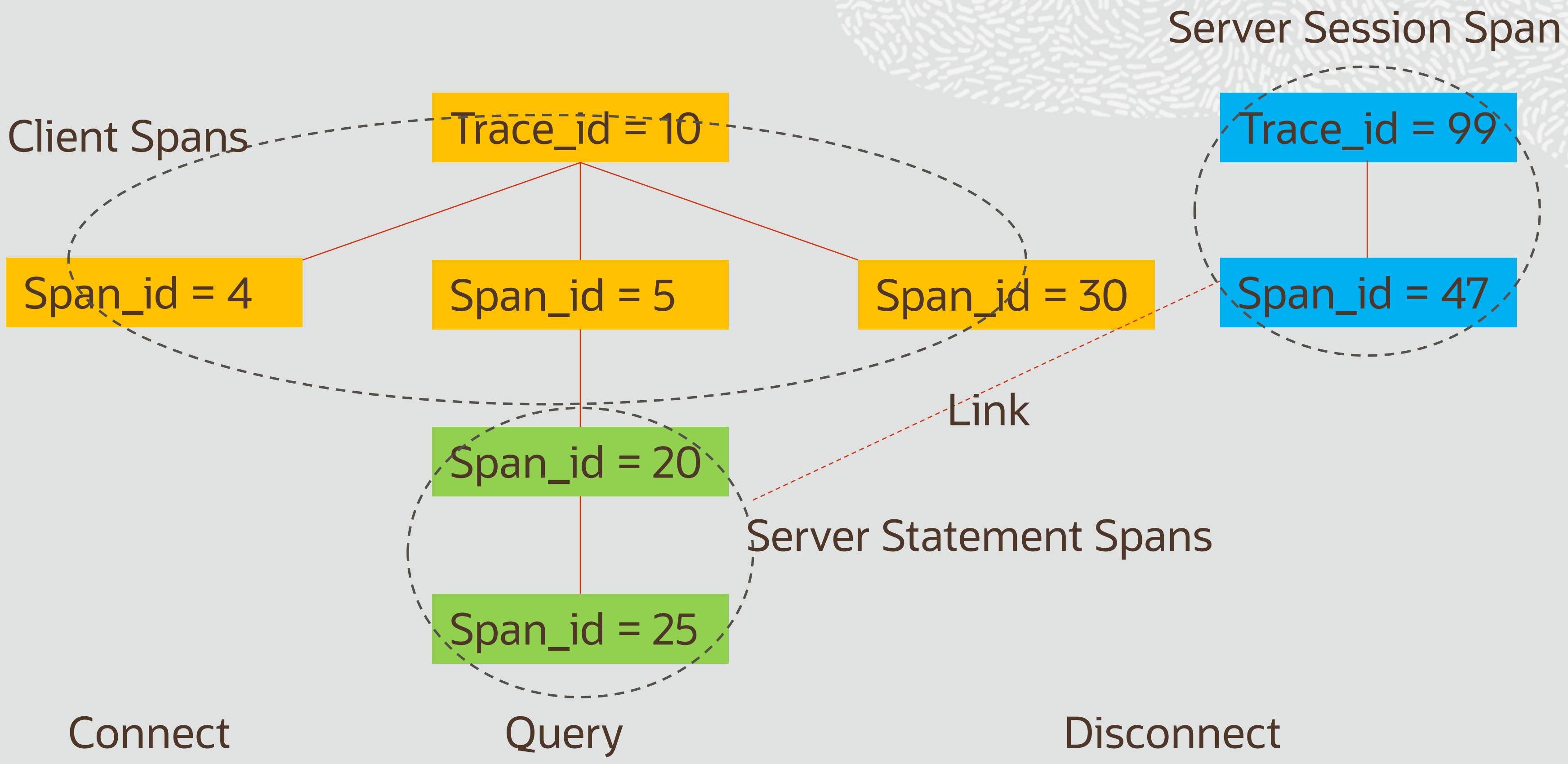
Span attributes

- Name: stmt
- mysql.event_name
- mysql.lock_time
- mysql.sql_text
- mysql.digest_text
- mysql.current_schema
- mysql.object_type
- mysql.object_schema
- mysql.object_name
- mysql.sql_errno
- mysql.sqlstate
- mysql.message_text
- + Many more ….

Example: Session and Statement Spans



Example: Resulting Trace



Metrics

OpenTelemetry Metrics

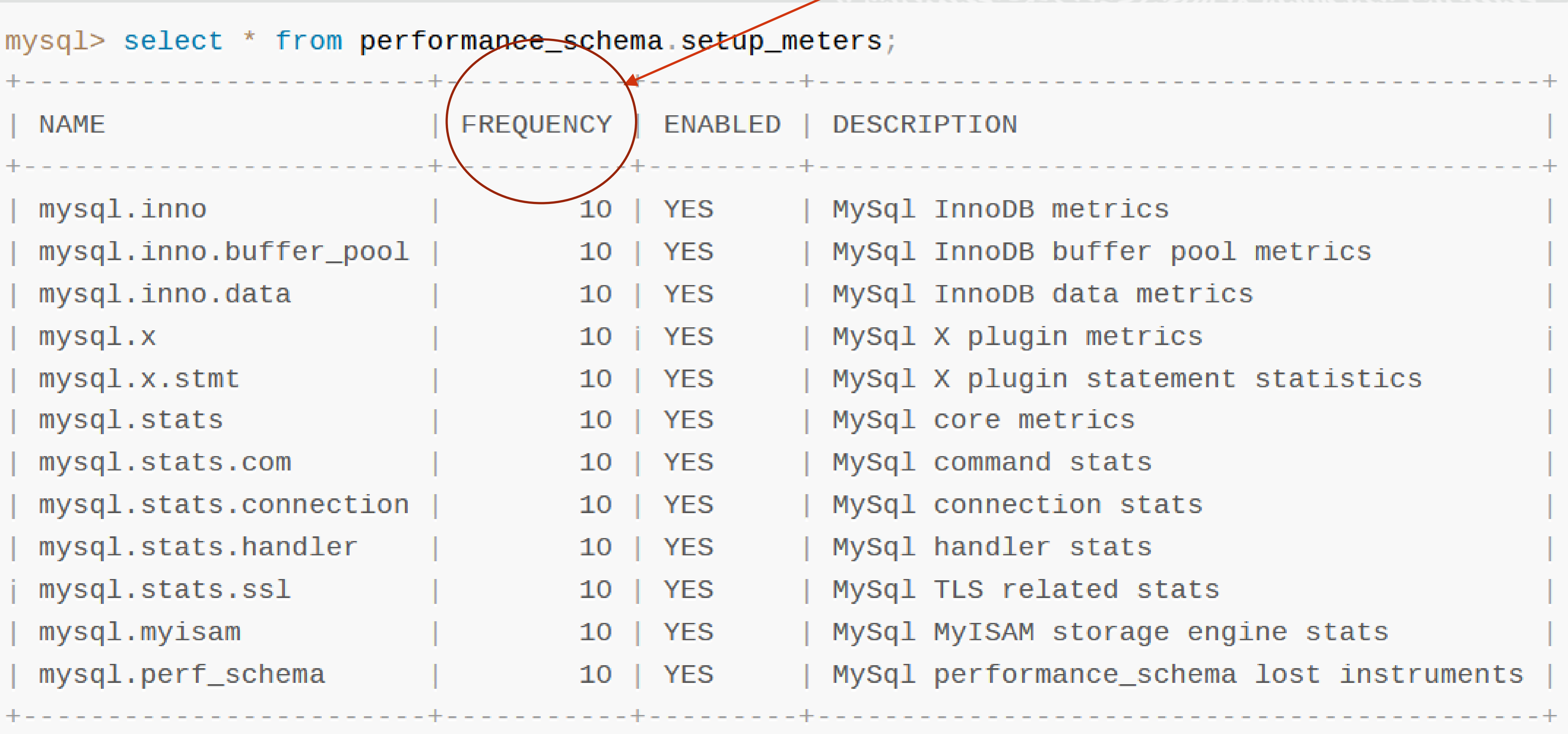
- **Metric**: A measurement captured at runtime
- **Metric Event**: The moment of capturing a measurement (value, timestamp, associated meta-data)
- **Meter**: Group of metrics, created by Meter Providers (e.g. MySQL).
- **Metric instrument**: Name, Kind, Unit (opt), Description (opt)
- Kind: Counter, Async Counter, UpDownCounter, Gauge, …
- **Metric Exporters**: Send metric data to a consumer

MySQL Meters & Metrics instruments

- MySQL 8.3 has defined 474 metrics instruments grouped into 15 meters
- **Meters** are observable: **performance_schema.setup_meters**
- **Metrics instruments** are observable : **performance_schema.setup_metrics**
- Configuration (on/off, export frequency) is defined per Meter
- Everything in SHOW GLOBAL STATUS is exposed as metrics.

MySQL Meters

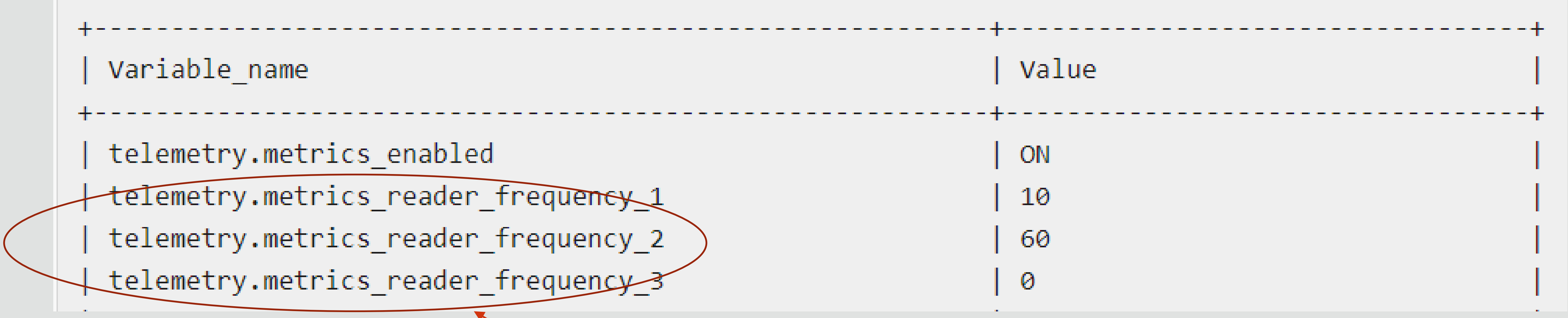
Intention: Actual Frequency rounded up to metrics_reader_frequency_1 , 2, 3 (see next slide)



```
mysql> select * from performance_schema.setup_meters;
+-------------------------+-----------+---------+-------------------------------------------+
| NAME                    | FREQUENCY | ENABLED | DESCRIPTION                               |
+-------------------------+-----------+---------+-------------------------------------------+
| mysql.inno              |        10 | YES     | MySql InnoDB metrics                      |
| mysql.inno.buffer_pool  |        10 | YES     | MySql InnoDB buffer pool metrics          |
| mysql.inno.data         |        10 | YES     | MySql InnoDB data metrics                 |
| mysql.x                 |        10 | YES     | MySql X plugin metrics                    |
| mysql.x.stmt            |        10 | YES     | MySql X plugin statement statistics       |
| mysql.stats             |        10 | YES     | MySql core metrics                        |
| mysql.stats.com         |        10 | YES     | MySql command stats                       |
| mysql.stats.connection  |        10 | YES     | MySql connection stats                    |
| mysql.stats.handler     |        10 | YES     | MySql handler stats                       |
| mysql.stats.ssl         |        10 | YES     | MySql TLS related stats                   |
| mysql.myisam            |        10 | YES     | MySql MyISAM storage engine stats         |
| mysql.perf_schema       |        10 | YES     | MySql performance_schema lost instruments |
+-------------------------+-----------+---------+-------------------------------------------+
```

MySQL Reader frequency

- Reader frequency is configurable but limited to 3 groups (reader threads)

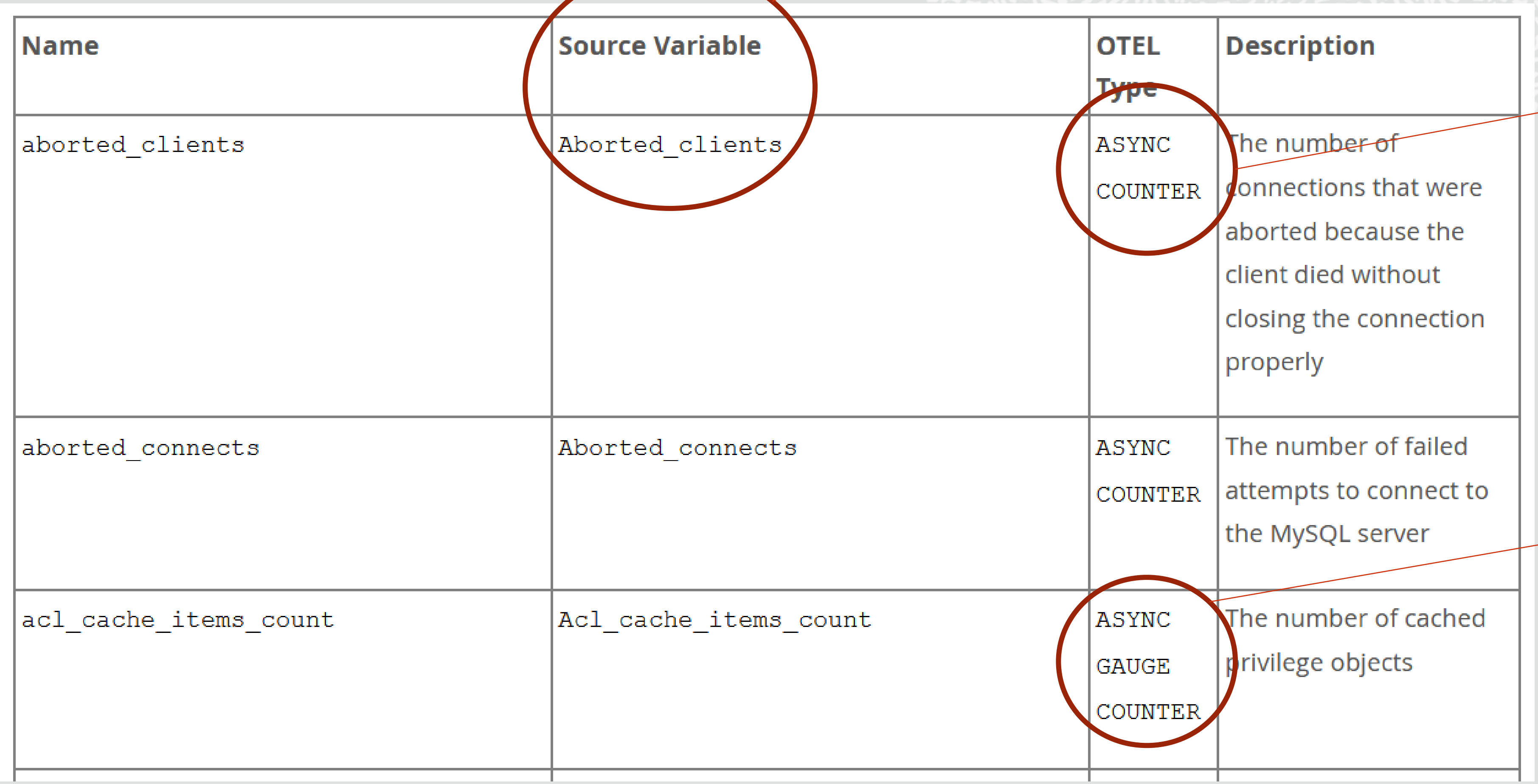


```
+-----------------------------------------------+----------------------------+
| Variable_name                                 | Value                      |
+-----------------------------------------------+----------------------------+
| telemetry.metrics_enabled                     | ON                         |
| telemetry.metrics_reader_frequency_1          | 10                         |
| telemetry.metrics_reader_frequency_2          | 60                         |
| telemetry.metrics_reader_frequency_3          | 0                          |
```

Meter frequency rounded up to metrics_reader_frequency_1 , 2, 3

MySQL Metrics

Source code variable = Metric instrument = GLOBAL STATUS



Name	Source Variable	OTEL Type	Description
aborted_clients	Aborted_clients	ASYNC COUNTER	The number of connections that were aborted because the client died without closing the connection properly
aborted_connects	Aborted_connects	ASYNC COUNTER	The number of failed attempts to connect to the MySQL server
acl_cache_items_count	Acl_cache_items_count	ASYNC GAUGE COUNTER	The number of cached privilege objects

Counter: Always increasing

All Counters are Async

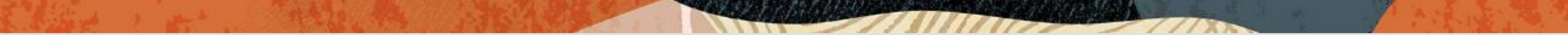
Gauge Counter: Value “as of now”

Final notes

- Background thread reads all metrics with a given frequency and then exported directly to backend (no buffering)
- It is asynchronous since we do not export in real time
- There is only one background thread reding a given metric, thus there is no race conditions.
- Metrics are not protected by mutexes (generally) , thus occasional garbage values may occur

References

- https://opentelemetry.io/
- https://dev.mysql.com/doc/refman/8.3/en/telemetry.html
- https://blogs.oracle.com/observability/post/application-monitoring-with-opentelemetry



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