17.1.3.1 GTID Concepts

A global transaction identifier (GTID) is a unique identifier created and associated with each transaction committed on the server of origin (master). This identifier is unique not only to the server on which it originated, but is unique across all servers in a given replication setup. There is a 1-to-1 mapping between all transactions and all GTIDs.

A GTID is represented as a pair of coordinates, separated by a colon character (`:`), as shown here:

```
GTID = source_id:transaction_id
```

The ***`source_id`*** identifies the originating server. Normally, the server's `server_uuid` is used for this purpose. The ***`transaction_id`*** is a sequence number determined by the order in which the transaction was committed on this server; for example, the first transaction to be committed has `1` as its ***`transaction_id`***, and the tenth transaction to be committed on the same originating server is assigned a ***`transaction_id`*** of `10`. It is not possible for a transaction to have `0` as a sequence number in a GTID. For example, the twenty-third transaction to be committed originally on the server with the UUID `3E11FA47-71CA-11E1-9E33-C80AA9429562` has this GTID:

```
3E11FA47-71CA-11E1-9E33-C80AA9429562:23
```

This format is used to represent GTIDs in the output of statements such as `SHOW SLAVE STATUS` as well as in the binary log. They can also be seen when viewing the log file with **mysqlbinlog** `--base64-output=DECODE-ROWS` or in the output from `SHOW BINLOG EVENTS`.

As written in the output of statements such as `SHOW MASTER STATUS` or `SHOW SLAVE STATUS`, a sequence of GTIDs originating from the same server may be collapsed into a single expression, as shown here.

```
3E11FA47-71CA-11E1-9E33-C80AA9429562:1-5
```

The example just shown represents the first through fifth transactions originating on the MySQL Server whose `server_uuid` is `3E11FA47-71CA-11E1-9E33-C80AA9429562`.

In MySQL 5.6.6 and later, this format is also used to supply the argument required by the `START SLAVE` options `SQL_BEFORE_GTIDS` and `SQL_AFTER_GTIDS`.

GTID Sets

A GTID set is a set of global transaction identifiers which is represented as shown here:

```
gtid_set:
    uuid_set [, uuid_set] ...
    | ''

uuid_set:
    uuid:interval[:interval]...

uuid:
    hhhhhhhh-hhhh-hhhh-hhhh-hhhhhhhhhhhh

h:
    [0-9|A-F]

interval:
    n[-n]

    (n >= 1)
```

GTID sets are used in the MySQL Server in several ways. For example, the values stored by the `gtid_executed` and `gtid_purged` system variables are represented as GTID sets. In addition, the functions `GTID_SUBSET()` and `GTID_SUBTRACT()` require GTID sets as input.

GTIDs are always preserved between master and slave. This means that you can always determine the source for any transaction applied on any slave by examining its binary log. In addition, once a transaction with a given GTID is committed on a given server, any subsequent transaction having the same GTID is ignored by that server. Thus, a transaction committed on the master can be applied no more than once on the slave, which helps to guarantee consistency.

When GTIDs are in use, the slave has no need for any nonlocal data, such as the name of a file on the master and a position within that file. All necessary information for synchronizing with the master is obtained directly from the replication data stream. From the perspective of the database administrator or developer, GTIDs entirely take the place of the file-offset pairs previously required to determine points for starting, stopping, or resuming the flow of data between master and slave. This means that, when you are using GTIDs for replication, you do not need (or want) to include `MASTER_LOG_FILE` or `MASTER_LOG_POS` options in the `CHANGE MASTER TO` statement used to direct a slave to replicate from a given master; in place of these options, it is necessary only to enable the `MASTER_AUTO_POSITION` option introduced in MySQL 5.6.5. For the exact steps needed to configure and start masters and slaves using GTID-based replication, see Section 17.1.3.2, “Setting Up Replication Using GTIDs”.

The generation and lifecycle of a GTID consists of the following steps:

1. A transaction is executed and committed on the master.

   This transaction is assigned a GTID using the master's UUID and the smallest nonzero transaction sequence number not yet used on this server; the GTID is written to the master's binary log (immediately preceding the transaction itself in the log).

2. After the binary log data is transmitted to the slave and stored in the slave's relay log (using established mechanisms for this process—see Section 17.2, “Replication Implementation”, for details), the slave reads the GTID and sets the value of its `gtid_next` system variable as this GTID. This tells the slave that the next transaction must be logged using this GTID.

   The slave sets `gtid_next` in a session context.

3. The slave checks to make sure that this GTID has not already been used to log a transaction in its own binary log. If and only if this GTID has not been used, the slave then writes the GTID and applies the transaction (and writes the transaction to its binary log). By reading and checking the transaction's GTID first, before processing the transaction itself, the slave guarantees not only that no previous transaction having this GTID has been applied on the slave, but also that no other session has already read this GTID but has not yet committed the associated transaction. In other words, multiple clients are not permitted to apply the same transaction concurrently.

4. Because `gtid_next` is not empty, the slave does not attempt to generate a GTID for this transaction but instead writes the GTID stored in this variable—that is, the GTID obtained from the master—immediately preceding the transaction in its binary log.