20.5 Partition Selection

MySQL 5.7 supports explicit selection of partitions and subpartitions that, when executing a statement, should be checked for rows matching a given `WHERE` condition. Partition selection is similar to partition pruning, in that only specific partitions are checked for matches, but differs in two key respects:

1. The partitions to be checked are specified by the issuer of the statement, unlike partition pruning, which is automatic.

2. Whereas partition pruning applies only to queries, explicit selection of partitions is supported for both queries and a number of DML statements.

SQL statements supporting explicit partition selection are listed here:

- `SELECT`
- `DELETE`
- `INSERT`
- `REPLACE`
- `UPDATE`
- `LOAD DATA`.
- `LOAD XML`.

The remainder of this section discusses explicit partition selection as it applies generally to the statements just listed, and provides some examples.

Explicit partition selection is implemented using a `PARTITION` option. For all supported statements, this option uses the syntax shown here:

```
      PARTITION (partition_names)

      partition_names:
          partition_name, ...
```

This option always follows the name of the table to which the partition or partitions belong. ***`partition_names`*** is a comma-separated list of partitions or subpartitions to be used. Each name in this list must be the name of an existing partition or subpartition of the specified table; if any of the partitions or subpartitions are not found, the statement fails with an error (`partition`

`'partition_name' doesn't exist`). Partitions and subpartitions named in ***`partition_names`*** may be listed in any order, and may overlap.

When the `PARTITION` option is used, only the partitions and subpartitions listed are checked for matching rows. This option can be used in a `SELECT` statement to determine which rows belong to a given partition. Consider a partitioned table named `employees`, created and populated using the statements shown here:

```
SET @@SQL_MODE = '';

CREATE TABLE employees  (
    id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    fname VARCHAR(25) NOT NULL,
    lname VARCHAR(25) NOT NULL,
    store_id INT NOT NULL,
    department_id INT NOT NULL
)
    PARTITION BY RANGE(id)  (
        PARTITION p0 VALUES LESS THAN (5),
        PARTITION p1 VALUES LESS THAN (10),
        PARTITION p2 VALUES LESS THAN (15),
        PARTITION p3 VALUES LESS THAN MAXVALUE
);

INSERT INTO employees VALUES
    ('', 'Bob', 'Taylor', 3, 2), ('', 'Frank', 'Williams', 1, 2),
    ('', 'Ellen', 'Johnson', 3, 4), ('', 'Jim', 'Smith', 2, 4),
    ('', 'Mary', 'Jones', 1, 1), ('', 'Linda', 'Black', 2, 3),
    ('', 'Ed', 'Jones', 2, 1), ('', 'June', 'Wilson', 3, 1),
    ('', 'Andy', 'Smith', 1, 3), ('', 'Lou', 'Waters', 2, 4),
    ('', 'Jill', 'Stone', 1, 4), ('', 'Roger', 'White', 3, 2),
    ('', 'Howard', 'Andrews', 1, 2), ('', 'Fred', 'Goldberg', 3, 3),
    ('', 'Barbara', 'Brown', 2, 3), ('', 'Alice', 'Rogers', 2, 2),
    ('', 'Mark', 'Morgan', 3, 3), ('', 'Karen', 'Cole', 3, 2);
```

You can see which rows are stored in partition `p1` like this:

```
mysql> SELECT * FROM employees PARTITION (p1);
+----+-------+--------+----------+---------------+
| id | fname | lname  | store_id | department_id |
+----+-------+--------+----------+---------------+
|  5 | Mary  | Jones  |        1 |             1 |
|  6 | Linda | Black  |        2 |             3 |
|  7 | Ed    | Jones  |        2 |             1 |
|  8 | June  | Wilson |        3 |             1 |
|  9 | Andy  | Smith  |        1 |             3 |
+----+-------+--------+----------+---------------+
5 rows in set (0.00 sec)
```

The result is the same as obtained by the query `SELECT * FROM employees WHERE id BETWEEN 5 AND 9`.

To obtain rows from multiple partitions, supply their names as a comma-delimited list. For example, `SELECT * FROM employees PARTITION (p1, p2)` returns all rows from partitions `p1` and `p2` while excluding rows from the remaining partitions.

Any valid query against a partitioned table can be rewritten with a `PARTITION` option to restrict the result to one or more desired partitions. You can use `WHERE` conditions, `ORDER BY` and `LIMIT` options, and so on. You can also use aggregate functions with `HAVING` and `GROUP BY` options. Each of the following queries produces a valid result when run on the `employees` table as previously defined:

```
mysql> SELECT * FROM employees PARTITION (p0, p2)
    ->     WHERE lname LIKE 'S%';
+----+-------+-------+----------+---------------+
| id | fname | lname | store_id | department_id |
+----+-------+-------+----------+---------------+
|  4 | Jim   | Smith |        2 |             4 |
| 11 | Jill  | Stone |        1 |             4 |
+----+-------+-------+----------+---------------+
2 rows in set (0.00 sec)

mysql> SELECT id, CONCAT(fname, ' ', lname) AS name
    ->     FROM employees PARTITION (p0) ORDER BY lname;
+----+----------------+
| id | name           |
+----+----------------+
|  3 | Ellen Johnson  |
|  4 | Jim Smith      |
|  1 | Bob Taylor     |
|  2 | Frank Williams |
+----+----------------+
4 rows in set (0.06 sec)

mysql> SELECT store_id, COUNT(department_id) AS c
    ->     FROM employees PARTITION (p1,p2,p3)
    ->     GROUP BY store_id HAVING c > 4;
+---+----------+
| c | store_id |
+---+----------+
| 5 |        2 |
| 5 |        3 |
+---+----------+
2 rows in set (0.00 sec)
```

Statements using partition selection can be employed with tables using any of the partitioning types supported in MySQL 5.7. When a table is created using `[LINEAR] HASH` or `[LINEAR] KEY` partitioning and the names of the partitions are not specified, MySQL automatically names the partitions `p0`, `p1`, `p2`, ..., `pN-1`, where ***N*** is the number of partitions. For subpartitions not explicitly named, MySQL assigns automatically to the subpartitions in each partition `pX` the names `pXsp0`, `pXsp1`, `pXsp2`, ..., `pXspM-1`, where ***M*** is the number of subpartitions. When executing against this table a `SELECT` (or other SQL statement for which explicit partition selection is allowed), you can use these generated names in a `PARTITION` option, as shown here:

```
mysql> CREATE TABLE employees_sub  (
    ->     id INT NOT NULL AUTO_INCREMENT,
    ->     fname VARCHAR(25) NOT NULL,
    ->     lname VARCHAR(25) NOT NULL,
    ->     store_id INT NOT NULL,
    ->     department_id INT NOT NULL,
    ->     PRIMARY KEY pk (id, lname)
    -> )
    ->     PARTITION BY RANGE(id)
    ->     SUBPARTITION BY KEY (lname)
    ->     SUBPARTITIONS 2 (
    ->         PARTITION p0 VALUES LESS THAN (5),
    ->         PARTITION p1 VALUES LESS THAN (10),
    ->         PARTITION p2 VALUES LESS THAN (15),
    ->         PARTITION p3 VALUES LESS THAN MAXVALUE
    -> );
Query OK, 0 rows affected (1.14 sec)

mysql> INSERT INTO employees_sub   # re-use data in employees table
    ->     SELECT * FROM employees;
Query OK, 18 rows affected (0.09 sec)
Records: 18  Duplicates: 0  Warnings: 0

mysql> SELECT id, CONCAT(fname, ' ', lname) AS name
    ->     FROM employees_sub PARTITION (p2sp1);
+----+---------------+
| id | name          |
+----+---------------+
| 10 | Lou Waters    |
| 14 | Fred Goldberg |
+----+---------------+
2 rows in set (0.00 sec)
```

You may also use a `PARTITION` option in the `SELECT` portion of an `INSERT ... SELECT` statement, as shown here:

```
mysql> CREATE TABLE employees_copy LIKE employees;
```

```
Query OK, 0 rows affected (0.28 sec)

mysql> INSERT INTO employees_copy
    ->     SELECT * FROM employees PARTITION (p2);
Query OK, 5 rows affected (0.04 sec)
Records: 5  Duplicates: 0  Warnings: 0

mysql> SELECT * FROM employees_copy;
+----+--------+----------+----------+---------------+
| id | fname  | lname    | store_id | department_id |
+----+--------+----------+----------+---------------+
| 10 | Lou    | Waters   |        2 |             4 |
| 11 | Jill   | Stone    |        1 |             4 |
| 12 | Roger  | White    |        3 |             2 |
| 13 | Howard | Andrews  |        1 |             2 |
| 14 | Fred   | Goldberg |        3 |             3 |
+----+--------+----------+----------+---------------+
5 rows in set (0.00 sec)
```

Partition selection can also be used with joins. Suppose we create and populate two tables using the statements shown here:

```
CREATE TABLE stores (
    id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    city VARCHAR(30) NOT NULL
)
    PARTITION BY HASH(id)
    PARTITIONS 2;

INSERT INTO stores VALUES
    ('', 'Nambucca'), ('', 'Uranga'),
    ('', 'Bellingen'), ('', 'Grafton');

CREATE TABLE departments  (
    id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    name VARCHAR(30) NOT NULL
)
    PARTITION BY KEY(id)
    PARTITIONS 2;

INSERT INTO departments VALUES
    ('', 'Sales'), ('', 'Customer Service'),
    ('', 'Delivery'), ('', 'Accounting');
```

You can explicitly select partitions (or subpartitions, or both) from any or all of the tables in a join. (Note that the `PARTITION` option used to select partitions from a given table immediately follows the name of the table, before all other options, including any table alias.) For example, the following query gets the name, employee ID, department, and city of all employees who work in the Sales or Delivery department (partition `p1` of the `departments` table) at the stores in either of the cities of Nambucca and Bellingen (partition `p0` of the `stores` table):

```
mysql> SELECT
    ->     e.id AS 'Employee ID', CONCAT(e.fname, ' ', e.lname) AS Name,
    ->     s.city AS City, d.name AS department
    -> FROM employees AS e
    ->     JOIN stores PARTITION (p1) AS s ON e.store_id=s.id
    ->     JOIN departments PARTITION (p0) AS d ON e.department_id=d.id
    -> ORDER BY e.lname;
+-------------+---------------+-----------+------------+
| Employee ID | Name          | City      | department |
+-------------+---------------+-----------+------------+
|          14 | Fred Goldberg | Bellingen | Delivery   |
|           5 | Mary Jones    | Nambucca  | Sales      |
|          17 | Mark Morgan   | Bellingen | Delivery   |
|           9 | Andy Smith    | Nambucca  | Delivery   |
|           8 | June Wilson   | Bellingen | Sales      |
+-------------+---------------+-----------+------------+
5 rows in set (0.00 sec)
```

For general information about joins in MySQL, see Section 14.2.9.2, “JOIN Syntax”.

When the `PARTITION` option is used with `DELETE` statements, only those partitions (and subpartitions, if any) listed with the option are checked for rows to be deleted. Any other partitions are ignored, as shown here:

```
mysql> SELECT * FROM employees WHERE fname LIKE 'j%';
+----+-------+--------+----------+---------------+
| id | fname | lname  | store_id | department_id |
+----+-------+--------+----------+---------------+
|  4 | Jim   | Smith  |        2 |             4 |
|  8 | June  | Wilson |        3 |             1 |
| 11 | Jill  | Stone  |        1 |             4 |
+----+-------+--------+----------+---------------+
3 rows in set (0.00 sec)

mysql> DELETE FROM employees PARTITION (p0, p1)
    ->     WHERE fname LIKE 'j%';
Query OK, 2 rows affected (0.09 sec)

mysql> SELECT * FROM employees WHERE fname LIKE 'j%';
+----+-------+-------+----------+---------------+
| id | fname | lname | store_id | department_id |
+----+-------+-------+----------+---------------+
| 11 | Jill  | Stone |        1 |             4 |
+----+-------+-------+----------+---------------+
1 row in set (0.00 sec)
```

Only the two rows in partitions p0 and p1 matching the WHERE condition were deleted. As you can see from the result when the SELECT is run a second time, there remains a row in the table matching the WHERE condition, but residing in a different partition (p2).

UPDATE statements using explicit partition selection behave in the same way; only rows in the partitions referenced by the PARTITION option are considered when determining the rows to be updated, as can be seen by executing the following statements:

```
mysql> UPDATE employees PARTITION (p0)
    ->     SET store_id = 2 WHERE fname = 'Jill';
Query OK, 0 rows affected (0.00 sec)
Rows matched: 0  Changed: 0  Warnings: 0

mysql> SELECT * FROM employees WHERE fname = 'Jill';
+----+-------+-------+----------+---------------+
| id | fname | lname | store_id | department_id |
+----+-------+-------+----------+---------------+
| 11 | Jill  | Stone |        1 |             4 |
+----+-------+-------+----------+---------------+
1 row in set (0.00 sec)

mysql> UPDATE employees PARTITION (p2)
    ->     SET store_id = 2 WHERE fname = 'Jill';
Query OK, 1 row affected (0.09 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql> SELECT * FROM employees WHERE fname = 'Jill';
+----+-------+-------+----------+---------------+
| id | fname | lname | store_id | department_id |
+----+-------+-------+----------+---------------+
| 11 | Jill  | Stone |        2 |             4 |
+----+-------+-------+----------+---------------+
1 row in set (0.00 sec)
```

In the same way, when PARTITION is used with DELETE, only rows in the partition or partitions named in the partition list are checked for deletion.

For statements that insert rows, the behavior differs in that failure to find a suitable partition causes the statement to fail. This is true for both INSERT and REPLACE statements, as shown here:

```
mysql> INSERT INTO employees PARTITION (p2) VALUES (20, 'Jan', 'Jones', 1, 3);
ERROR 1729 (HY000): Found a row not matching the given partition set
mysql> INSERT INTO employees PARTITION (p3) VALUES (20, 'Jan', 'Jones', 1, 3);
```

```
Query OK, 1 row affected (0.07 sec)

mysql> REPLACE INTO employees PARTITION (p0) VALUES (20, 'Jan', 'Jones', 3, 2);
ERROR 1729 (HY000): Found a row not matching the given partition set

mysql> REPLACE INTO employees PARTITION (p3) VALUES (20, 'Jan', 'Jones', 3, 2);
Query OK, 2 rows affected (0.09 sec)
```

For statements that write multiple rows to a partitioned table that uses the `InnoDB` storage engine: If any row in the list following `VALUES` cannot be written to one of the partitions specified in the ***`partition_names`*** list, the entire statement fails and no rows are written. This is shown for `INSERT` statements in the following example, reusing the `employees` table created previously:

```
mysql> ALTER TABLE employees
    ->     REORGANIZE PARTITION p3 INTO (
    ->         PARTITION p3 VALUES LESS THAN (20),
    ->         PARTITION p4 VALUES LESS THAN (25),
    ->         PARTITION p5 VALUES LESS THAN MAXVALUE
    ->     );
Query OK, 6 rows affected (2.09 sec)
Records: 6  Duplicates: 0  Warnings: 0

mysql> SHOW CREATE TABLE employees\G
*************************** 1. row ***************************
       Table: employees
Create Table: CREATE TABLE `employees` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `fname` varchar(25) NOT NULL,
  `lname` varchar(25) NOT NULL,
  `store_id` int(11) NOT NULL,
  `department_id` int(11) NOT NULL,
  PRIMARY KEY (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=27 DEFAULT CHARSET=latin1
/*!50100 PARTITION BY RANGE (id)
(PARTITION p0 VALUES LESS THAN (5) ENGINE = InnoDB,
 PARTITION p1 VALUES LESS THAN (10) ENGINE = InnoDB,
 PARTITION p2 VALUES LESS THAN (15) ENGINE = InnoDB,
 PARTITION p3 VALUES LESS THAN (20) ENGINE = InnoDB,
 PARTITION p4 VALUES LESS THAN (25) ENGINE = InnoDB,
 PARTITION p5 VALUES LESS THAN MAXVALUE ENGINE = InnoDB) */
1 row in set (0.00 sec)

mysql> INSERT INTO employees PARTITION (p3, p4) VALUES
    ->     (24, 'Tim', 'Greene', 3, 1),  (26, 'Linda', 'Mills', 2, 1);
ERROR 1729 (HY000): Found a row not matching the given partition set

mysql> INSERT INTO employees PARTITION (p3, p4. p5) VALUES
    ->     (24, 'Tim', 'Greene', 3, 1),  (26, 'Linda', 'Mills', 2, 1);
```

```
Query OK, 2 rows affected (0.06 sec)
Records: 2  Duplicates: 0  Warnings: 0
```

The preceding is true for both `INSERT` statements and `REPLACE` statements that write multiple rows.

In MySQL 5.7.1 and later, partition selection is disabled for tables employing a storage engine that supplies automatic partitioning, such as `NDB`. (Bug #14827952)