Automatic Locks in DML Operations

The purpose of a DML lock, also called a **data lock**, is to guarantee the integrity of data being accessed concurrently by multiple users. For example, a DML lock can prevent multiple customers from buying the last copy of a book available from an online bookseller. DML locks prevent destructive interference of simultaneous conflicting DML or DDL operations.

DML statements automatically acquire locks at both the table level and the row level. In the sections that follow, the acronym in parentheses after each type of lock or lock mode is the abbreviation used in the Locks Monitor of Oracle Enterprise Manager. Enterprise Manager might display "TM" for any table lock, rather than indicate the mode of table lock (such as RS or SRX).

The types of row and table locks are summarized here. For a more complete discussion of the types of row and table locks, see *Oracle Database Concepts*.

Row Locks (TX) A **row lock**, also called a **TX lock**, is a lock on a single row of a table. A transaction acquires a row lock for each row modified by one of the following statements: `INSERT`, `UPDATE`, `DELETE`, `MERGE`, and `SELECT ... FOR UPDATE`. The row lock exists until the transaction commits or rolls back.

When a transaction obtains a row lock for a row, the transaction also acquires a table lock for the table in which the row resides. The table lock prevents conflicting DDL operations that would override data changes in a current transaction.

Table Locks (TM) A transaction automatically acquires a table lock (**TM lock**) when a table is modified with the following statements: `INSERT`, `UPDATE`, `DELETE`, `MERGE`, and `SELECT ... FOR UPDATE`. These DML operations require table locks to reserve DML access to the table on behalf of a transaction and to prevent DDL operations that would conflict with the transaction. You can explicitly obtain a table lock using the `LOCK TABLE` statement, as described in "Manual Data Locking".

A table lock can be held in any of the following modes:

- A **row share lock (RS)**, also called a **subshare table lock (SS)**, indicates that the transaction holding the lock on the table has locked rows in the table and intends to update them. An SS lock is the least restrictive mode of table lock, offering the highest degree of concurrency for a table.
- A **row exclusive lock (RX)**, also called a **subexclusive table lock (SX)**, indicates that the transaction holding the lock has updated table rows or issued `SELECT ... FOR UPDATE`. An SX lock allows other transactions to query, insert, update, delete, or lock rows concurrently in the same table. Therefore, SX locks allow multiple transactions to obtain simultaneous SX and SS locks for the same table.
- A **share table lock (S)** held by one transaction allows other transactions to query the table (without using `SELECT ... FOR UPDATE`) but allows updates only if a single transaction holds the share table lock. Multiple transactions may hold a share table lock concurrently, so holding this lock is not sufficient to ensure that a transaction can modify the table.
- A **share row exclusive table lock (SRX)**, also called a **share-subexclusive table lock (SSX)**, is more restrictive than a share table lock. Only one transaction at a time can acquire an SSX lock on a given table. An SSX lock held by a transaction allows other transactions to query the table (except for `SELECT ... FOR UPDATE`) but not to update the table.
- An **exclusive table lock (X)** is the most restrictive mode of table lock, allowing the transaction that holds the lock exclusive write access to the table. Only one transaction can obtain an X lock for a table.

Locks in DML Operations

Oracle Database automatically obtains row-level and table-level locks on behalf of DML operations. The type of operation determines the locking behavior. Table B-1 summarizes the information in this section.

Table B-1 Summary of Locks Obtained by DML Statements

SQL Statement	Row Locks	Table Lock Mode	RS	RX	S	SRX	X
SELECT ... FROM *table*...	—	none	Y	Y	Y	Y	Y
INSERT INTO *table* ...	Yes	SX	Y	Y	N	N	N
UPDATE *table* ...	Yes	SX	Y[Foot 1]	Y[Footref 1]	N	N	N
MERGE INTO *table* ...	Yes	SX	Y	Y	N	N	N
DELETE FROM *table* ...	Yes	SX	Y[Footref 1]	Y[Footref 1]	N	N	N
SELECT ... FROM *table* FOR UPDATE OF ...	Yes	SX	Y[Footref 1]	Y[Footref 1]	N	N	N
LOCK TABLE *table* IN...	—						
ROW SHARE MODE		SS	Y	Y	Y	Y	N
ROW EXCLUSIVE MODE		SX	Y	Y	N	N	N
SHARE MODE		S	Y	N	Y	N	N
SHARE ROW EXCLUSIVE MODE		SSX	Y	N	N	N	N
EXCLUSIVE MODE		X	N	N	N	N	N

The characteristics of `INSERT`, `UPDATE`, `DELETE`, and `SELECT ... FOR UPDATE` statements are as follows:

- A transaction containing a DML statement acquires exclusive row locks on the rows modified by the statement. Therefore, other transactions cannot update or delete the locked rows until the locking transaction either commits or rolls back.
- In addition to these row locks, a transaction containing a DML statement that modifies data also requires at least a subexclusive table lock (SX) on the table that contains the affected rows. If the transaction already holds an S, SRX, or X table lock for the table, which are more restrictive than an SX lock, then the SX lock is not needed and is not acquired. If the containing transaction already holds only an SS lock, however, then Oracle Database automatically converts the SS lock to an SX lock.
- A transaction that contains a DML statement does not require row locks on any rows selected by a subquery or an implicit query.

  In the following sample `UPDATE` statement, the `SELECT` statement in parentheses is a subquery, whereas the `WHERE a > 5` clause is an implicit query:

  ```
  UPDATE t SET x = ( SELECT y FROM t2 WHERE t2.z = t.z ) WHERE a > 5;
  ```

  A subquery or implicit query inside a DML statement is guaranteed to be consistent as of the start of the query and does not see the effects of the DML statement of which it forms a part.

- A query in a transaction can see the changes made by previous DML statements in the same transaction, but not the uncommitted changes of other transactions.