BNL join algorithm, the BKA join algorithm employs a join buffer to accumulate the interesting columns of the rows produced by the first operand of the join operation. Then the BKA algorithm builds keys to access the table to be joined for all rows in the buffer and submits these keys in a batch to the database engine for index lookups. The keys are submitted to the engine through the Multi-Range Read (MRR) interface (see Section 8.2.1.11, “Multi-Range Read Optimization”). After submission of the keys, the MRR engine functions perform lookups in the index in an optimal way, fetching the rows of the joined table found by these keys, and starts feeding the BKA join algorithm with matching rows. Each matching row is coupled with a reference to a row in the join buffer.

When BKA is used, the value of `join_buffer_size` defines how large the batch of keys is in each request to the storage engine. The larger the buffer, the more sequential access is made to the right hand table of a join operation, which can significantly improve performance.

For BKA to be used, the `batched_key_access` flag of the `optimizer_switch` system variable must be set to `on`. BKA uses MRR, so the `mrr` flag must also be `on`. Currently, the cost estimation for MRR is too pessimistic. Hence, it is also necessary for `mrr_cost_based` to be `off` for BKA to be used. The following setting enables BKA:

```
mysql> SET optimizer_switch='mrr=on,mrr_cost_based=off,batched_key_access=on';
```

There are two scenarios by which MRR functions execute:

- The first scenario is used for conventional disk-based storage engines such as `InnoDB` and `MyISAM`. For these engines, usually the keys for all rows from the join buffer are submitted to the MRR interface at once. Engine-specific MRR functions perform index lookups for the submitted keys, get row IDs (or primary keys) from them, and then fetch rows for all these selected row IDs one by one by request from BKA algorithm. Every row is returned with an association reference that enables access to the matched row in the join buffer. The rows are fetched by the MRR functions in an optimal way: They are fetched in the row ID (primary key) order. This improves performance because reads are in disk order rather than random order.

- The second scenario is used for remote storage engines such as `NDB`. A package of keys for a portion of rows from the join buffer, together with their associations, is sent by a MySQL Server (SQL node) to MySQL Cluster data nodes. In return, the SQL node receives a package (or several packages) of matching rows coupled with corresponding associations. The BKA join algorithm takes these rows and builds new joined rows. Then a new set of keys is sent to the data nodes and the rows from the returned packages are used to build new joined rows. The process continues until the last keys from the join buffer are sent to the data nodes, and the SQL node has received and joined all rows matching these keys. This improves performance because fewer key-bearing packages sent by the SQL node to the data nodes means fewer round trips between it and the data nodes to perform the join operation.

With the first scenario, a portion of the join buffer is reserved to store row IDs (primary keys) selected by index lookups and passed as a parameter to the MRR functions.

There is no special buffer to store keys built for rows from the join buffer. Instead, a function that builds the key for the next row in the buffer is passed as a parameter to the MRR functions.

In `EXPLAIN` output, use of BKA for a table is signified when the `Extra` value contains `Using join buffer (Batched Key Access)` and the `type` value is `ref` or `eq_ref`.

Optimizer Hints for Block Nested-Loop and Batched Key Access Algorithms

In addition to using the `optimizer_switch` system variable to control optimizer use of the BNL and BKA algorithms session-wide, MySQL supports optimizer hints to influence the optimizer on a per-statement basis. See Section 8.9.3, “Optimizer Hints”.