Cloudera Runtime 7.2.11

Managing Apache Hive

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ACID operations

Apache Hive supports ACID (atomicity, consistency, isolation, and durability) v2 transactions at the row level without any configuration. Knowing what this support entails helps you determine the table type you create.

By default, managed tables are ACID tables. You cannot disable ACID transactions on managed tables, but you can change the Hive default behavior to create external tables by default to mimic legacy releases. Application development and operations are simplified with strong transactional guarantees and simple semantics for SQL commands. You do not need to bucket ACID v2 tables, so maintenance is easier. With improvements in transactional semantics, advanced optimizations, such as materialized view rewrites and automatic query cache, are available. With these optimizations, you can deploy new Hive application types.

A Hive operation is atomic. The operation either succeeds completely or fails; it does not result in partial data. A Hive operation is also consistent: After an application performs an operation, the results are visible to the application in every subsequent operation. Hive operations are isolated. Your operations do not cause unexpected side effects for other users. Finally, a Hive operation is durable. A completed operation is preserved in the event of a failure.

Hive operations are atomic at the row level instead of the table or partition level. A Hive client can read from a partition at the same time another client adds rows to the partition. Transaction streaming rapidly inserts data into Hive tables and partitions.

Viewing transactions

As Administrator, you can view a list of open and aborted transactions.

Procedure

Enter a query to view transactions.
SHOW TRANSACTIONS
The following information appears in the output:

- Transaction ID
- Transaction state
- Hive user who initiated the transaction
- Host machine or virtual machine where transaction was initiated

Viewing transaction locks

As a Hive administrator, you can get troubleshooting information about locks on a table, partition, or schema.

About this task

Hive transactions, enabled by default, disables Zookeeper locking. DbLockManager stores and manages all transaction lock information in the Hive Metastore. Heartbeats are sent regularly from lock holders and transaction initiators to the Hive Metastore to prevent stale locks and transactions. The lock or transaction is aborted if the metastore does not receive a heartbeat within the amount of time specified by the hive.txn.timeout configuration property.

Before you begin

Check that transactions are enabled (the default).

Procedure

1. Enter a Hive query to check table locks.

```
SHOW LOCKS mytable EXTENDED;
```

2. Check partition locks.

```
SHOW LOCKS mytable PARTITION(ds='2018-05-01', hr='12') EXTENDED;
```

3. Check schema locks.

```
SHOW LOCKS SCHEMA mydatabase;
```

The following information appears in the output unless ZooKeeper or in-memory lock managers are used.

- Database name
- Table name
- Partition, if the table is partitioned
- Lock state:
  - Acquired - transaction initiator hold the lock
  - Waiting - transaction initiator is waiting for the lock
  - Aborted - the lock has timed out but has not yet been cleaned
- Lock type:
  - Exclusive - the lock cannot be shared
  - Shared_read - the lock cannot be shared with any number of other shared_read locks
  - Shared_write - the lock may be shared by any number of other shared_read locks but not with other shared_write locks
- Transaction ID associated with the lock, if one exists
- Last time lock holder sent a heartbeat
- Time the lock was acquired, if it has been acquired
- Hive user who requested the lock
- Host machine or virtual machine on which the Hive user is running a Hive client
- Blocked By ID - ID of the lock causing current lock to be in Waiting mode, if the lock is in this mode

Related Information

Apache wiki transaction configuration documentation

Data compaction

As administrator, you need to manage compaction of delta files that accumulate during data ingestion. Compaction is a process that performs critical cleanup of files.

Hive creates a set of delta files for each transaction that alters a table or partition. By default, compaction of delta and base files occurs at regular intervals. Compactions occur in the background without affecting concurrent reads and writes.

There are two types of compaction:

- Minor

  Rewrites a set of delta files to a single delta file for a bucket.

- Major

  Rewrites one or more delta files and the base file as a new base file for a bucket. A major compaction runs if there are multiple deltas and no base file.

  Carefully consider the need for a major compaction as this process can consume significant system resources and take a long time. Base and delta files for a table or partition are compacted.

  You can configure automatic compactions or do manual compactions. Start a major compaction during periods of low traffic. You use an ALTER TABLE statement to start compaction manually. A manual compaction either returns the accepted compaction request ID or shows the ID (and current state) of a compaction request for the very same target. The request is stored in the COMPACTION_QUEUE table.

You can configure automatic compactions or do manual compactions.

Related Information

Apache Wiki transactions and compaction documentation

Compaction prerequisites

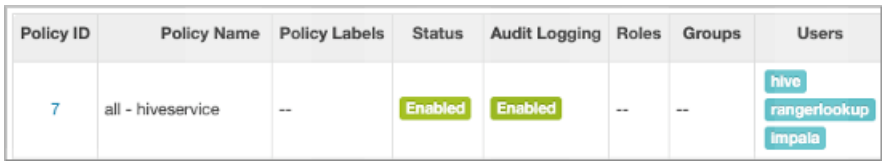
To prevent data loss or an unsuccessful compaction, you must meet the prerequisites before compaction occurs.

Exclude compaction users from Ranger policies

Compaction causes data loss if Apache Ranger policies for masking or row filtering are enabled and the user hive or any other compaction user is included in the Ranger policies.

1. Set up Ranger masking or row filtering policies to exclude the user hive from the policies.

   The user (named hive) appears in the Users list in the Ranger Admin UI.



2. Identify any other compaction users from the masking or row filtering policies for tables as follows:
   - If the hive.compaction.run.as.user property is configured, the user runs compaction.
   - If a user is configured as owner of the directory on which the compaction will run, the user runs compaction.
   - If a user is configured as the table owner, the user runs compaction
3. Exclude compaction users from the masking or row filtering policies for tables.

Failure to perform these critical steps can cause data loss. For example, if a compaction user is included in an enabled Ranger masking policy, the user sees only the masked data, just like other users who are subject to the Ranger masking policy. The unmasked data is overwritten during compaction, which leads to data loss of unmasked content as only the underlying tables will contain masked data. Similarly, if Ranger row filtering is enabled, you do not see, or have access to, the filtered rows, and data is lost after compaction from the underlying tables.

The worker process executes queries to perform compaction, making Hive data subject to data loss (HIVE-27643). MapReduce-based compactions are not subject to the data loss described above as these compactions directly use the MapReduce framework.

Related Information

Row-level filtering and column masking in Hive with Ranger policies

Compaction tasks

Compaction in Hive goes hand-in-hand with Hive ACID. Compaction is not, however, necessarily required for Hive ACID. You need to understand when you want, or do not want, compaction to occur.

If you confine your ACID operations tables to full reloads and some delta merges, the performance is steady. As tables are always rewritten (dropped and recreated), there is no need for compaction. In this case, consider disabling automatic compaction.

Compaction occurs for the following reasons:

- You explicitly trigger compaction on a table or partition.
- Automatic compaction finds something to compact.

You run an ALTER TABLE statement to start explicit compaction. Automatic compaction happens without your intervention when Hive periodically crawls through the transaction information, finds tables/partitions affected and those fit for the pre-defined conditions, and marks them for compaction. Conditions are based on the number of deltas, amount of change, and so on.

Compaction of sorted tables is not supported.

In a data pipeline, creating staging or temporary tables can significantly increase the compaction throughput. Avoid compaction of these tables.

Related Information

Initiating automatic compaction

Starting compaction manually

Disabling automatic compaction

Initiating automatic compaction in Cloudera Manager

Several properties in the Hive and Hive metastore service configurations must be set to enable automatic compaction. You need to check that the property settings are correct and to add one of the properties to the Hive on Tez service. Automatic compaction will then occur at regular intervals, but only if necessary.

About this task

Initiator threads should run in only one Hive metastore server (even in high-availability / HA configurations) in a public cloud environment. Disable Initiator threads in the other Hive Metastore servers in the DataLake cluster, and in all the Datahub clusters' Hive service, the compaction initiator thread can be run by a single Hive metastore in the DataLake cluster. The following properties must be set in Hive metastore (Hive-1) and Hive on Tez services as follows:

- hive.compactor.initiator.on = true (default)
- hive.compactor.worker.threads = <a value greater than 0> (default and recommended value = 5)
- hive.metastore.runworker.in = hs2 (default)

You must run the compactor initiator on only one HMS instance at a time.

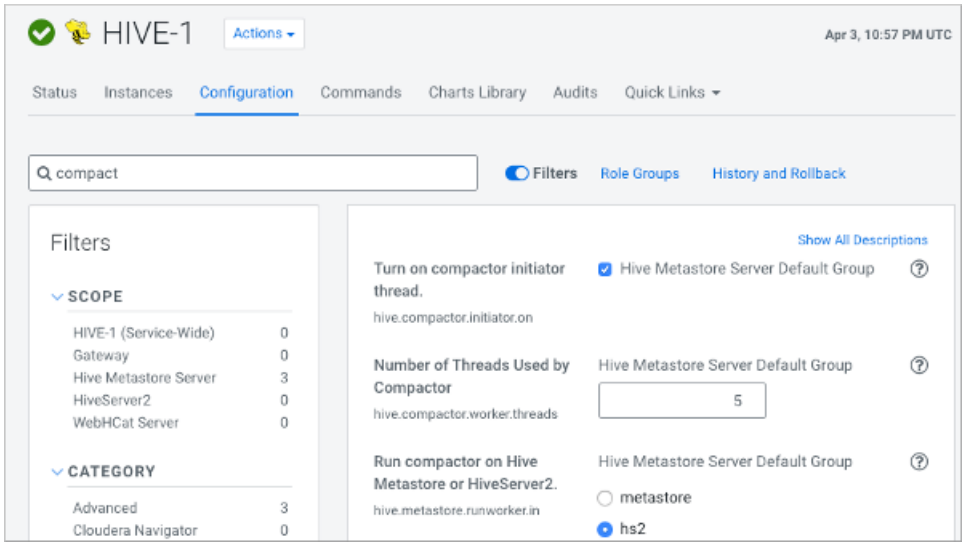
Before you begin

Tables or partitions you are compacting must be full ACID or insert-only ACID tables.

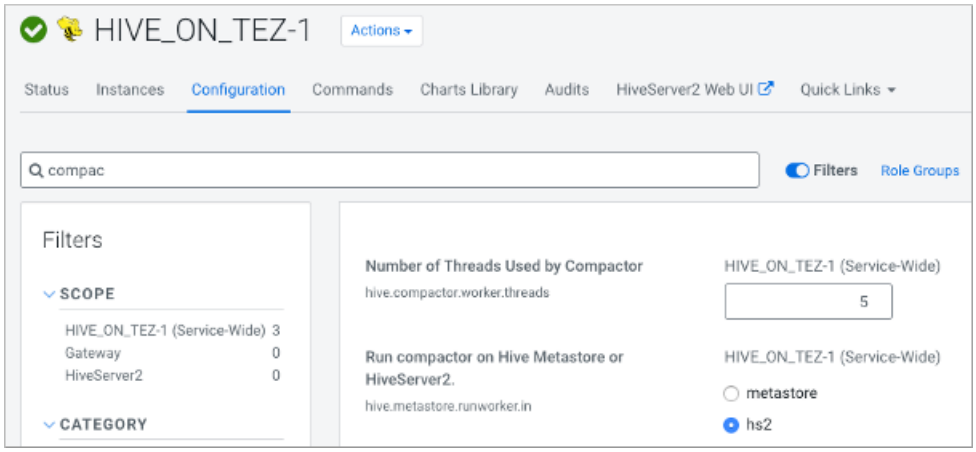
Procedure

1. In Cloudera Manager, select the Hive metastore service: Clusters Hive-1 Configuration .

2. Search for compact.



3. Check that Turn on Compactor Initiator Thread (hive.compactor.initiator.on), Number of Threads Used by Compactor (hive.compactor.worker.threads), and Run Compactor on Hive Metastore or HiveServer2 (hive.metastore.runworker.in) are set to the values shown above.
4. Save the changes.
5. In Cloudera Manager, select the Hive metastore service: Clusters HIVE_ON_TEZ-1 Configuration .
6. Search for compact.



7. Check that the Number of Threads Used by Compactor (hive.compactor.worker.threads), and Run compactor on Hive Metastore or HiveServer2 (hive.metastore.runworker.in) is set to hs2.
8. Save the changes and restart the Hive on Tez and Hive (HIVE-1) metastore services at an appropriate time.

Starting compaction manually

You manually start compaction when automatic compaction fails for some reason. You can start compaction by running a Hive statement.

About this task

You can run compaction pseudo-synchronously using the AND WAIT clause. Compaction actually occurs asynchronously, but seems synchronous. The compaction request is recorded and queued, and remains in a waiting cycle, querying the status of the compaction in the background until a failure, success, or timeout occurs. The hive.compactor.wait.timeout (default: 300s) property sets the timeout.

Start compaction using a query

You use the following syntax to issue a query that starts compaction:

```
 ALTER TABLE tablename [PARTITION (partition_key='partition_value' [,...])]
COMPACT 'compaction_type'
```

Before you begin

- Tables or partitions you are compacting must be full ACID or insert-only ACID tables.
- Compaction must be enabled (initiator hive.compactor.initiator.on=true)

Procedure

1. Run a query to start a major compaction of a table.

   ```
   ALTER TABLE mytable COMPACT 'major'
   ```

   Use the COMPACT 'minor' clause to run a minor compaction. ALTER TABLE compacts tables even if the NO_AUTO_COMPACTION table property is set.
2. Start compaction in a pseudo-synchronous way.
   ALTER TABLE mydb.mytable PARTITION (mypart='myval') COMPACT 'MAJOR' AND WAIT;

Viewing compaction progress

You view the progress of compactions by running Hive queries.

About this task

Authorization is not required to use the SHOW COMPACTIONS statement. Every user can view compactions and can see the current state of compactions.

Procedure

Enter the query to view the progress of compactions.
SHOW COMPACTIONS;

- Unique internal ID
- Database name
- Table name
- Partition name
- Major or minor compaction
- Compaction state:
  - Initiated - waiting in queue
  - Working - currently compacting
  - Ready for cleaning - compaction completed and old files scheduled for removal
  - Failed - the job failed. Details are printed to the metastore log.
  - Succeeded
  - Attempted - initiator attempted to schedule a compaction but failed. Details are printed to the metastore log.
- Thread ID
- Start time of compaction
- Duration
- Job ID - ID of the submitted MapReduce job

Disabling automatic compaction

You can disable automatic compaction of a particular Hive ACID table by setting a Hive table property. By default, compaction is enabled, so you must enter an ALTER TABLE command to disable it.

About this task

Compaction of a full ACID table is skipped under the following conditions:

- Another compaction is either running or already initiated for the target.
- The compaction target table is already dropped.
- Table is explicitly configured to be skipped by the auto-compaction

Compaction of an insert-only, ACID table is skipped if hive.compactor.compact.insert.only is set to false (turned off). The default is true. Although you can disable automatic compaction, tables still can be compacted if you explicitly request compaction.Disabling automatic compaction does not prevent you from performing manual compaction.

The compaction auto-initiator can be disabled on service instance level (disabled by default). You can independently enable or disable compaction workers on service instance level. Compaction merges only the bucket files with the same index and keeps the same number of bucket files in base. Compaction does not rebalance the rows between the buckets.

Procedure

Start the Hive shell, and in the database of the target table, alter the TBLPROPERTIES.

```
ALTER TABLE my_t SET TBLPROPERTIES ('NO_AUTO_COMPACTION'='true');
```

Configuring compaction using table properties

You see how to configure compaction using table properties and learn about the advantage of using this method of configuration.

About this task

You can configure compaction using table properties. Using table properties, you can group all table and partition compactions into a specific queue to match your use case. You can also size the compactor job based on the tables parameters like size and compression.

Procedure

Set table properties to adjust the compaction initiator properties.

```
ALTER TABLE mydb.mytable
SET TBLPROPERTIES (
'compactorthreshold.hive.compactor.delta.pct.threshold'='0.2f',
'compactorthreshold.hive.compactor.delta.num.threshold'='20');
```

These properties change thresholds, as the names imply: the deltas/base size percentage override threshold and the number of deltas threshold.

Configuring compaction in Cloudera Manager

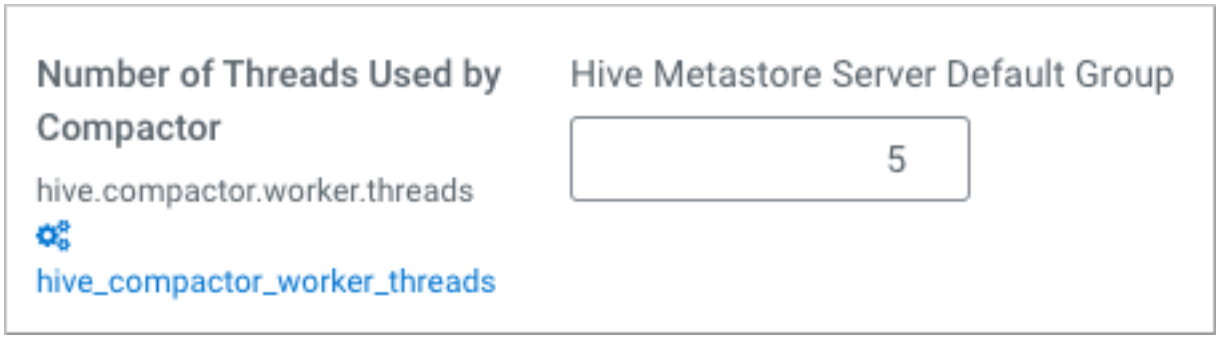
You see how to configure compaction properties exposed in Cloudera Manager. You rarely need to configure other compaction properties, but need to know how to do this.

About this task

You can configure Hive metastore (HMS) and HiveServer (HS2) properties. Compaction properties you typically configure appear in Cloudera Manager. You search for a property to change it. Occasionally, you might add a property to hive-site or core-site using the Cloudera Manager Safety Valve.

Procedure

1. In Cloudera Manager, click Clusters Hive Configuration , and search for a property, such as hive.compactor.worker.threads.



2. Change the value, and save.
3. Restart the Hive cluster.

Configuring the compaction check interval

You need to know when and how to control the compaction process checking, performed in the background, of the file system for changes that require compaction.

When you turn on the compaction initiator, consider setting the hive.compactor.check.interval property. This property determines how often the initiator should search for possible tables, partitions, or compaction. By default, the value for this property is set to 300 seconds. Decreasing hive.compactor.check.interval has the following effect:

- Reduces the time it takes for compaction to be started for a table or partition that requires compaction.
- Requires several calls to the file system for each table or partition that has undergone a transaction since the last major compaction, resulting in increases to the load on the filesystem.

The compaction initiator first checks the completed transactions (COMPLETED_TXN_COMPONENTS), excluding those that already have completed compactions, searching for potential compaction targets. The search of the first iteration includes all transactions. Further searching of iterations are limited to the time-frame since the last iteration.

To configure the compaction check interval, set the hive.compactor.check.interval. For example:

From Cloudera Manager, go to Clusters Hive Metastore Configuration and set the value for the hive.compactor.check.interval parameter in the Hive Metastore Server Advanced Configuration Snippet (Safety Valve) for hive-site.xml file.

Compactor properties

You check and change a number of Apache Hive properties to configure the compaction of delta files that accumulate during data ingestion. You need to know the defaults and valid values.

Basic compactor properties

hive.compactor.initiator.on

Default=false

Whether to run the initiator and cleaner threads on this metastore instance or not. Set in only one instance.

hive.compactor.worker.threads

Default=0

Set this to a positive number to enable Hive transactions, which are required to trigger transactions. Worker threads spawn jobs to perform compactions, but do not perform the compactions themselves. Increasing the number of worker threads decreases the time that it takes tables or partitions to be compacted. However, increasing the number of worker threads also increases the background load on the CDP cluster because they cause more jobs to run in the background.

hive.metastore.runworker.in

Default=HS2

Specifies where to run the Worker threads that spawn jobs to perform compactions. Valid values are HiveServer (HS2) or Hive metastore (HMS).

hive.compactor.abortedtxn.threshold

Default=1000 aborts

The number of aborted transactions that triggers compaction on a table/partition.

hive.compactor.aborted.txn.time.threshold

Default=12 hours

The hours of aborted transactions that trigger compaction on a table/partition.

Advanced compactor properties

hive.compactor.worker.timeout

Default=86400s

Expects a time value using d/day, h/hour, m/min, s/sec, ms/msec, us/usec, or ns/nsec (default is sec). Time in seconds after which a compaction job will be declared failed and the compaction re-queued.

hive.compactor.check.interval

Default=300s

A valid value is a time with unit (d/day, h/hour, m/min, s/sec, ms/msec, us/usec, ns/nsec), which is sec if not specified.

Time in seconds between checks to see if any tables or partitions need to be compacted. This value should be kept high because each check for compaction requires many calls against the NameNode. Decreasing this value reduces the time it takes to start compaction for a table or partition that requires it. However, checking if compaction is needed requires several calls to the NameNode for each table or partition involved in a transaction done since the last major compaction. Consequently, decreasing this value increases the load on the NameNode.

hive.compactor.delta.num.threshold

Default=10

Number of delta directories in a table or partition that triggers a minor compaction.

hive.compactor.delta.pct.threshold

Default=0.1

Percentage (fractional) size of the delta files relative to the base that triggers a major compaction. (1.0 = 100%, so the default 0.1 = 10%.)

hive.compactor.max.num.delta

Default=500

Maximum number of delta files that the compactor attempts to handle in a single job.

hive.compactor.wait.timeout

Default=300000

The value must be greater than 2000 milliseconds.

Time out in milliseconds for blocking compaction.

hive.compactor.initiator.failed.compacts.threshold

Default=2

A valid value is between 1 and 20, and must be less than hive.compactor.history.retention.failed.

The number of consecutive compaction failures (per table/partition) after which automatic compactions are not scheduled any longer.

hive.compactor.cleaner.run.interval

Default=5000ms

A valid value is a time with unit (d/day, h/hour, m/min, s/sec, ms/msec, us/usec, ns/nsec), which is msec if not specified.

The time between runs of the cleaner thread.

hive.compactor.job.queue

Specifies the Hadoop queue name to which compaction jobs are submitted. If the value is an empty string, Hadoop chooses the queue.

hive.compactor.compact.insert.only

Default=true

The compactor compacts insert-only tables, or not (false). A safety switch.

hive.compactor.crud.query.based

Default=false

Performs major compaction on full CRUD tables as a query, and disables minor compaction.

hive.split.grouping.mode

Default=query

A valid value is either query or compactor.

This property is set to compactor from within the query-based compactor. This setting enables the Tez SplitGrouper to group splits based on their bucket number, so that all rows from different bucket files for the same bucket number can end up in the same bucket file after the compaction.

hive.compactor.history.retention.succeeded

Default=3

A valid value is between 0 and 100.

Determines how many successful compaction records are retained in compaction history for a given table/partition.

hive.compactor.history.retention.failed

Default=3

A valid value is between 0 and 100.

Determines how many failed compaction records are retained in compaction history for a given table/partition.

hive.compactor.history.retention.attempted

Default=2

A valid value is between 0 and 100.

Determines how many attempted compaction records are retained in compaction history for a given table/partition.

hive.compactor.history.reaper.interval

Default=2m

A valid value is a time with unit (d/day, h/hour, m/min, s/sec, ms/msec, us/usec, ns/nsec), which is msec if not specified.

Determines how often the compaction history reaper runs.

Query vectorization

You can use vectorization to improve instruction pipelines and cache use. Vectorization enables certain data and queries to process batches of primitive types on the entire column rather than one row at a time.

Unsupported functionality on vectorized data

Some functionality is not supported on vectorized data:

- DDL queries
- DML queries other than single table, read-only queries
- Formats other than Optimized Row Columnar (ORC)

Supported functionality on vectorized data

The following functionality is supported on vectorized data:

- Single table, read-only queries

  Selecting, filtering, and grouping data is supported.
- Partitioned tables
- The following expressions:
  - Comparison: >, >=, <, <=, =, !=
  - Arithmetic plus, minus, multiply, divide, and modulo
  - Logical AND and OR
  - Aggregates sum, avg, count, min, and max

Supported data types

You can query data of the following types using vectorized queries:

- tinyint
- smallint
- int
- bigint
- date
- boolean
- float
- double
- timestamp
- stringchar
- varchar
- binary

Vectorization default

Vectorized query execution can affect performance. You need to be aware of the Boolean default value of hive.vectorized.execution.enabled.

Vectorized query execution is enabled by default (true). Vectorized query execution processes Hive data in batch, channeling a large number of rows of data into columns, foregoing intermediate results. This technique is more efficient than the MapReduce execution process that stores temporary files.