

## Managing Apache Hive

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## ACID operations in Data Hub

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.

## Configuring partitions for transactions

You set a couple of parameters, to prevent or permit dynamic partitioning, that inserts, updates, or deletes data into partitions implicitly created on the table.

### About this task

Configuring partitioning involves changing the following parameters to meet your needs:

- `hive.exec.max.dynamic.partitions`
- `hive.exec.max.dynamic.partitions.pernode`

You set `hive.exec.dynamic.partition.mode` to `strict` to prevent dynamic partitioning or to `nonstrict` (the default) to include `INSERT`, `UPDATE`, and `DELETE` statements in your transaction applications.

### Procedure

1. In Cloudera Manager Clusters select the Hive service. Click Configuration, and search for `hive-site.xml`.
2. In HiveServer2 Advanced Configuration Snippet (Safety Valve) for `hive-site.xml`, click + and add the `hive.exec.dynamic.partition.mode` property.
3. Set the value to `nonstrict`.
4. Save the changes and restart the Hive service.

### Related Information

[Hive Configuration Properties documentation on the Apache wiki](#)

## Options to monitor transactions

As a Hive administrator, you can view the list of all currently open and aborted transactions using the `SHOW TRANSACTIONS` statement or by querying the `TRANSACTIONS` view within the `SYS` database.

The query statements display the following details about transactions:

- `TXN_ID`: Unique internal transaction ID
- `STATE`: Transaction state

- **STARTED:** Timestamp when the transaction was started
- **LAST\_HEARTBEAT:** Timestamp of the latest heartbeat
- **USER:** Hive user who initiated the transaction
- **HOST:** Host machine or virtual machine where the transaction was initiated
- **HEARTBEAT\_COUNT:** Total number of heartbeats
- **TYPE:** Transaction type
  - **DEFAULT**
  - **REPL\_CREATED**
  - **READ\_ONLY**
  - **COMPACTION**
- **TC\_DATABASE:** Hive database name
- **TC\_TABLE:** Table name
- **TC\_PARTITION:** Partition name (if the table is partitioned)
- **TC\_OPERATION\_TYPE:**
  - **SELECT**
  - **INSERT**
  - **UPDATE**
  - **COMPACT**
- **TC\_WRITEID:** Unique internal write ID

The following sections describe the various options that you can use to monitor transactions.

## SHOW TRANSACTIONS

You can run the **SHOW TRANSACTIONS** statement to view details about all open and aborted transactions.

**SHOW TRANSACTIONS;**

This statement lists all the transactions and you cannot filter or limit the results as required. Alternatively, you can use the **SYS** database to query and filter specific transactions.

## Querying the SYS database

You can query the **TRANSACTIONS** view within the **SYS** database to filter and view specific transactions.

For example, you can run the following query to view transactions in a particular state:

```
SELECT *
FROM SYS.TRANSACTIONS
WHERE STATE='aborted';
```



**Important:** Currently, you cannot retrieve information about old or aborted transactions from the **SYS** database that is preventing the Cleanup phase. This is because the **MIN\_HISTORY\_LEVEL** table is not exposed in the **SYS** database. As a workaround, you can run the following query directly on the backend database:

```
SELECT * from TXNS where txn_id = (
  SELECT MIN(res.id) FROM (
    SELECT ntxn_next id from next_txn_id
    UNION ALL
    SELECT MIN(mhl_min_open_txn_id) id FROM min_history_level
    UNION ALL
    SELECT MIN(txn_id) id FROM txns WHERE txn_state = 'a'
  ) res);
```



**Note:** Similarly, you can also query the INFORMATION\_SCHEMA database for details about transactions. You must use the Ranger service and set up access policies for Hive users on this database to make it accessible.

## Options to monitor transaction locks

As a Hive administrator, you can view information about locks on a table, partition, or schema that are created as a result of transactions. You can either use the SHOW LOCKS statement or query the LOCKS view within the SYS database to view transaction locks.

Hive transactions, enabled by default, disable 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.

The query statements display the following details about transaction locks unless ZooKeeper or in-memory lock managers are used:

- LOCK\_EXT\_ID: Unique internal ID of a lock request that might be requesting multiple lock entries on several resources (tables or partitions).
- LOCK\_INT\_ID: Unique internal ID of a lock entry that has been requested by a LOCK\_EXT\_ID
- TXNID: Transaction ID associated with the lock, if one exists
- DB: Hive database name
- TABLE: Table name
- PARTITION: Partition name (if the table is partitioned)
- LOCK\_STATE:
  - acquired: transaction initiator holds 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: lock cannot be shared. No one else can hold the lock at the same time.
  - shared\_read: any number of other shared\_read locks can lock the same resource at the same time
  - shared\_write: any number of shared\_read locks can lock the same resource at the same time, but no other shared\_write locks are allowed
- LAST\_HEARTBEAT: Last time the holder of this lock sent a heartbeat
- ACQUIRED\_AT: Time when the lock was acquired, if it has been acquired
- USER: Hive user who requested the lock
- HOST: Host machine or virtual machine on which the Hive user is running a Hive client
- HEARTBEAT\_COUNT: Total number of heartbeats
- BLOCKEDBY\_EXT\_ID: ID of the lock (LOCK\_EXT\_ID) causing current lock to be in “waiting” mode, if the lock is in this mode
- BLOCKEDBY\_INT\_ID: ID of the lock (LOCK\_INT\_ID) causing current lock to be in “waiting” mode, if the lock is in this mode

The following sections describe the various options that you can use to monitor transaction locks.

### SHOW LOCKS

You can run the SHOW LOCKS statement to view details about all transaction locks. Ensure that transactions are enabled

SHOW LOCKS;

The following examples illustrate some sample queries that you can run:

**Query to check table locks**

```
SHOW LOCKS mytable EXTENDED;
```

**Query to check partition locks**

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

**Query to check schema locks**

```
SHOW LOCKS SCHEMA mydatabase;
```

The SHOW LOCKS SCHEMA cannot be used with ZooKeeper or in-memory lock managers.

The SHOW LOCKS statement lists all the transaction locks and you cannot filter or limit the results as required. Alternatively, you can use the SYS database to query and filter specific locks.

**Querying the SYS database**

You can query the LOCKS view within the SYS database to filter and view specific locks.

The following examples illustrate how you can run queries on the SYS.LOCKS view to monitor transaction locks:

**Query to view locks requested on a particular resource (table or partition)**

```
SELECT *
FROM SYS.LOCKS
WHERE db='default'
AND table='tab_acid';
```

**Query to view list of acquired locks**

```
SELECT *
FROM SYS.LOCKS
WHERE lock_state='acquired';
```

**Query to view blocking transactions that are preventing locks requested by a user- defined transaction, from being acquired**

```
SELECT *
FROM SYS.TRANSACTIONS
WHERE txn_id IN (
  SELECT txnid
  FROM SYS.LOCKS
  INNER JOIN (
    SELECT blockedby_ext_id, blockedby_int_id
    FROM SYS.LOCKS
    WHERE txnid=4534) b
  ON lock_ext_id = b.blockedby_ext_id
  AND lock_int_id = b.blockedby_int_id
);
```



**Note:** Similarly, you can also query the INFORMATION\_SCHEMA database for details about transaction locks. You must use the Ranger service and set up access policies for Hive users on this database to make it accessible.

**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.

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.

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

### 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.

Policy ID	Policy Name	Policy Labels	Status	Audit Logging	Roles	Groups	Users
7	all - hiveservice	--	Enabled	Enabled	--	--	hive rangerlookup impala

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. Consider disabling compaction by

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.

## 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.

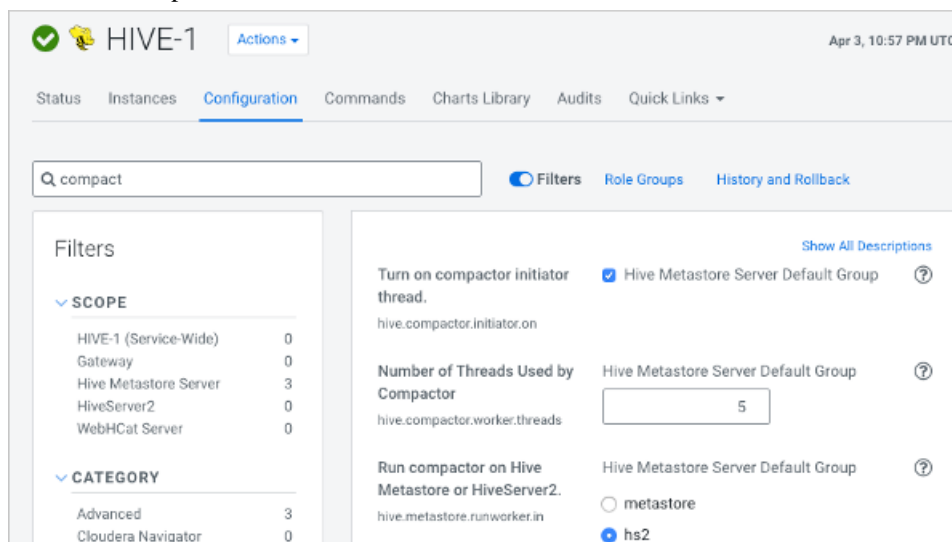
### Before you begin

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.



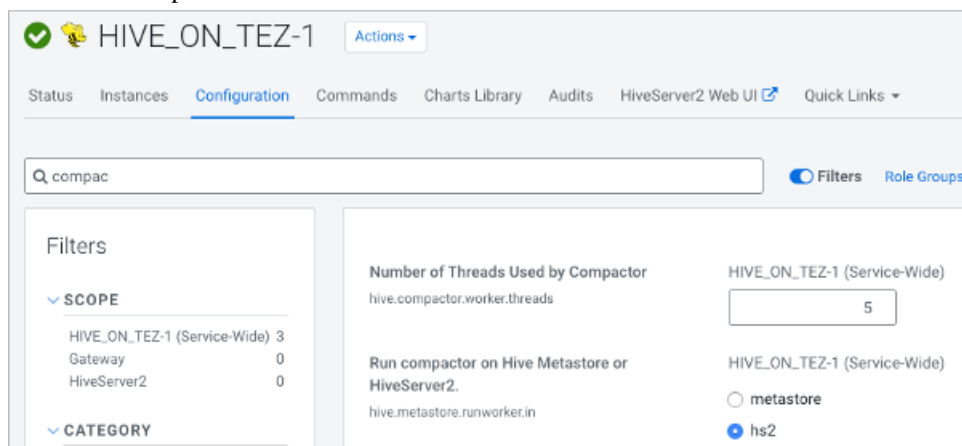
Configuration page for HIVE-1. Search results for 'compact' are shown. The left sidebar lists filters for SCOPE and CATEGORY. The main area displays configuration items for the compactor.

Filter	Count
HIVE-1 (Service-Wide)	0
Gateway	0
Hive Metastore Server	3
HiveServer2	0
WebHCat Server	0

Category	Count
Advanced	3
Cloudera Navigator	0

Configuration Item	Value
Turn on compactor initiator thread.	<input checked="" type="checkbox"/> Hive Metastore Server Default Group
Number of Threads Used by Compactor	5
Run compactor on Hive Metastore or HiveServer2.	<input checked="" type="radio"/> hs2

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 on Tez service: Clusters HIVE\_ON\_TEZ-1 Configuration .
6. Search for compact.



Configuration page for HIVE\_ON\_TEZ-1. Search results for 'compact' are shown. The left sidebar lists filters for SCOPE and CATEGORY. The main area displays configuration items for the compactor.

Filter	Count
HIVE_ON_TEZ-1 (Service-Wide)	3
Gateway	0
HiveServer2	0

Category	Count
Advanced	3
Cloudera Navigator	0

Configuration Item	Value
Number of Threads Used by Compactor	5
Run compactor on Hive Metastore or HiveServer2.	<input checked="" type="radio"/> hs2
Run compactor on Hive Metastore or HiveServer2.	<input checked="" type="radio"/> hs2

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\_COMPACT table property is set.

2. Start compaction in a pseudo-synchronous way.

```
ALTER TABLE mydb.mytable PARTITION (mypart='myval') COMPACT 'MAJOR' AND
WAIT;
```

## Options to monitor compactons

You can view the progress of compactons using the SHOW COMPACTIONS statement or by querying the COMPACTIONS view within the SYS database.

The query statement displays the following details about compactons:

- C\_ID: Unique internal compaction ID
- C\_DATABASE: Hive database name
- C\_TABLE: Table name
- C\_PARTITION: Partition name (if the table is partitioned)
- C\_TYPE: Major or minor compaction
- C\_STATE: Compaction state
  - initiated: waiting in queue to be compacted
  - working: currently being compacted
  - ready for cleaning: compaction completed and old files scheduled for removal
  - failed: compaction job failed. Details are printed to the metastore log.
  - succeeded: compaction job completed successfully
  - attempted: initiator attempted to schedule a compaction but failed or `hive.compactor.initiator.failed.compacts.threshold` is breached and compaction is skipped. Details are printed to the metastore log.
- C\_WORKER\_HOST: Thread ID of the worker thread performing the compaction
- C\_WORKER\_ID: Unique internal worker ID
- C\_WORKER\_VERSION: Version of distribution with running worker
- C\_ENQUEUE\_TIME: Time when compaction request was placed
- C\_START: Start time of the compaction job
- C\_DURATION: Duration (in ms) of the compaction job
- C\_HADOOP\_JOB\_ID: ID of the submitted MapReduce job for MR compaction. 'None' for query-based compaction.

- C\_INITIATOR\_HOST: Host where initiator is configured
- C\_INITIATOR\_ID: Unique internal initiator ID
- C\_INITIATOR\_VERSION: Version of distribution with active initiator



**Note:** Details about "initiators" and "workers" are new additions that you can use to investigate the compaction setup in an environment. If you are unable to retrieve these details using the options listed here, you can run the following query on the backend database:

```
SELECT activity.pid,
       activity.username,
       activity.client_addr,
       activity.client_hostname,
       activity.query,
       blocking.pid AS blocking_pid,
       blocking.query AS blocking_query,
       blocking.client_addr AS blocking_client_addr,
       blocking.client_hostname AS blocking_client_hostname
FROM pg_stat_activity AS activity
JOIN pg_stat_activity AS blocking
  ON blocking.pid = ANY(pg_blocking_pids(activity.pid))
WHERE blocking.query like '%AUX_TABLE%';
```

The following sections describe the various options that you can use to monitor compactons.

## SHOW COMPACTIONS

You can run the SHOW COMPACTIONS statement to view details about all the compaction jobs.

SHOW COMPACTIONS;

Authorization is not required to use the SHOW COMPACTIONS statement. Therefore, every user can view compactons and their current state.

Since the statement lists all the compaction jobs, you cannot filter or limit the results as required. Alternatively, you can use the SYS database to query and filter specific compactons.

## Querying the SYS database

The SYS database in the Hive metastore contains the following sources that you can use to monitor compactons:

- COMPACTION\_QUEUE: Stores information about compaction requests - both explicit user submitted and compactons discovered by the initiator and enqueued.
- COMPLETED\_COMPACTIONS: Stores the same information present in COMPACTION\_QUEUE along with the compaction's end time. Records are moved to the completed table when the cleaner finishes the job on the compaction request.
- COMPACTIONS: A view over the COMPACTION\_QUEUE and COMPLETED\_COMPACTIONS tables that resolves the column values to human readable format.

The SYS database tables and views are treated as normal Hive external tables or views, and therefore, standard access policies can be configured against these sources.

The following examples illustrate how you can run queries on the SYS.COMPACTIONS view to monitor compactons:

### Query to display the last 10 failed compactons

```
SELECT *
FROM SYS.COMPACTIONS
WHERE C_STATE='failed'
ORDERBY C_ID DESC
LIMIT 10;
```

### Query to check the status of a specific compaction using the compaction ID

```
SELECT *  
FROM SYS.COMPACTIONS  
WHERE C_ID='1234';
```

### Query to view the total number of compactions in a particular state

```
SELECT COUNT(*)  
FROM SYS.COMPACTIONS  
WHERE C_STATE='ready for cleaning';
```



**Note:** Similarly, you can also query the INFORMATION\_SCHEMA database for details about compactions. You must use the Ranger service and set up access policies for Hive users on this database to make it accessible.

## 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

At the Hive JDBC client prompt, 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

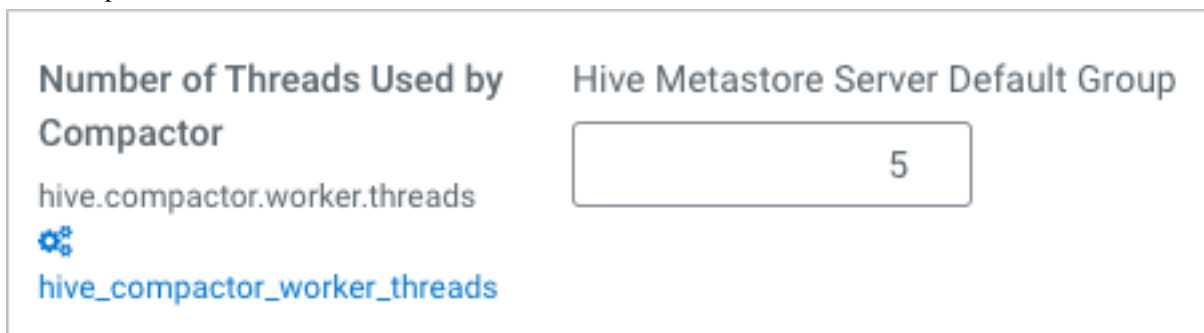
You see how to configure compaction properties exposed in Cloudera Manager. You rarely need to configure other compaction properties, but need to know how to do this.

### 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`.



The screenshot shows a configuration page in Cloudera Manager. The title is "Number of Threads Used by Compactor". Below the title, the property name "hive.compactor.worker.threads" is displayed next to a gear icon. Below that, the property name "hive\_compactor\_worker\_threads" is shown in blue. To the right, under the heading "Hive Metastore Server Default Group", there is a text input field containing the value "5".

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.

## Compaction observability in Cloudera Manager

Compaction observability is a notification and information system based on metrics about the health of the compaction process. A healthy compaction process is critical to query performance, availability, and uptime of your data warehouse. You learn how to use compaction observability to prevent serious problems from developing.

Compaction runs in the background. At regular intervals, Hive accesses the health of the compaction process, and logs an error in the event of a problem. The assessment is based on metrics, such as the number of rows in the metadata table `TXN_TO_WRITE_ID` and the age of the longest running transaction (`oldest_open_txn_age_in_sec`). For example, if compaction is not running, the `TXN_TO_WRITE_ID` table in the HMS backend database becomes bloated and queries slow down.

Compaction health monitoring provides the following information to help you proactively address the problems before the problems become an emergency:

- Warnings and errors indicating problems in compaction processes
- Charts of various metrics that provide information about compaction health
- Recommended actions to address suboptimal configurations

Compaction observability does not attempt to do root cause analysis (RCA) and does not attempt to fix the underlying problem. Compaction observability helps you quickly respond to symptoms of compaction problems.

Using Cloudera Manager, you can view compaction health checks for the Hive Metastore and Hive on Tez services, view actions and advice related to configurations and thresholds, and use the Compaction tab from the Hive Metastore service to view compaction-related charts based on the collected metrics.

## Configuring compaction health monitoring

As an administrator, you can use Cloudera Manager to enable or disable compaction health tests for the Hive Metastore (HMS) and HiveServer (HS2) services, configure how those health tests factor into the overall health of the service, and modify thresholds for the status of certain health tests.

### About this task

You can configure HMS and HS2 compaction properties that are exposed in Cloudera Manager by searching for the property. Occasionally, you might add a property to `hive-site.xml` or `core-site.xml` using the Hive Service Advanced Configuration Snippet (Safety Valve).

### Procedure

1. In Cloudera Manager, click **Clusters Hive Configuration** to navigate to the configuration page for HMS.
2. Search for **Hive Compaction Health Test**, enable the property, and save the changes.
3. Enable the **Hive Compaction Health Test** property for the HS2 service by going to **Clusters Hive on Tez Configuration**.
4. To configure the Health Check thresholds, go to **Clusters Hive Configuration**.
5. Select the **Category Monitoring** filter.
6. Modify the warning and critical (error) threshold values for the required compaction-related thresholds and save the changes.

### Results

The **Health Tests** panel of HMS and HS2 service displays the compaction health test results, typically with specific metrics that the test returned.



**Note:** For the HS2 service, if there is no delta metric data (metric values are too low to be collected), then the health check displays a "Disabled" status.

## Monitoring compaction health in Cloudera Manager

Using Cloudera Manager, you can view compaction health checks for the Hive Metastore (HMS) and Hive on Tez services, view actions and advice related to configurations and thresholds, and use the **Compaction** tab from the Hive Metastore service to view compaction-related charts based on the collected metrics.

### Before you begin

- You must have enabled compaction health checks.
- You must have enabled the Hive ACID metrics service to collect ACID-related metrics.

### Procedure

1. Sign in to Cloudera Manager as an Administrator.
2. Go to the HMS service by clicking **Clusters Hive**.  
The **Health Tests** panel in the **Status** tab displays the compaction health test results, typically with the specific metrics that the test returned.

Similarly, you can view the compaction health test results for the HiveServer (HS2) service by going to **Clusters Hive on Tez**.

3. From the HMS service page, click the **Compactions** tab to view dashboards of compaction-related charts of various metrics.

You can create triggers for the charts that allow you to define actions to be taken when a specified condition is met.

## Hive ACID metric properties for compaction observability

As an administrator, you must configure certain properties related to the Hive ACID metrics service to enable the collection of Hive ACID metrics that are required to display compaction-related alerts and charts in Cloudera Manager.

## Basic properties

You must configure the following metrics to enable Hive ACID metrics collection:

### **hive.metastore.metrics.enabled**

Default value: True

Enables or disables Hive metrics subsystem for the Hive Metastore (HMS) role.

### **hive.server2.metrics.enabled**

Default value: True

Enables or disables Hive metrics subsystem for the HiveServer (HS2) role.

### **hive.metastore.acidmetrics.ext.on**

Default value: True

Set this to property to True to collect additional acid related metrics outside of the Hive ACID metrics service. Enable this property for both HMS and HS2 roles.



**Note:** Ensure that you have also enabled the `hive.metastore.metrics.enabled` property for HMS and the `hive.server2.metrics.enabled` property for HS2.

### **metastore.acidmetrics.thread.on**

Default value: True

Specifies whether to run Hive ACID related metrics collection on this metastore instance. Enable this property in only one HMS instance and disable the property in all other instances.

## Advanced properties

Set these additional properties to configure how Hive ACID metrics service collects metric data:

The following properties have to be configured in the HMS instance where `metastore.acidmetrics.thread.on` is enabled:

### **metastore.acidmetrics.check.interval**

Default value: 300 seconds

Specifies the time (in seconds) between Hive ACID metric collection jobs.

### **metastore.acidmetrics.table.aborted.txns.threshold**

Default value: 1500

Hive metrics subsystem collects the number of tables that have a large number of aborted transactions. This property specifies the minimum number of aborted transactions required to consider a table.

### **metastore.compactor.acid.metrics.logger.frequency**

Default value: 360m

Specifies the logging frequency (in minutes) of Hive ACID metrics. Set this property in only one HMS instance and set the property to 0 in all other HMS instances to disable logging.

The following properties have to be configured in the HS2 (Hive on Tez) service:

### **hive.txn.acid.metrics.cache.size**

Default value: 100

Specifies the size of the ACID metrics cache, which is the maximum number of partitioned and unpartitioned tables with the most deltas that is included in the list of active, obsolete, and small deltas. Valid values are between 0 to 500.

### **hive.txn.acid.metrics.cache.duration**

Default value: 7200 seconds

Specifies the maximum lifetime (in seconds) for an entry in the ACID metrics cache.

**hive.txn.acid.metrics.reporting.interval**

Default value: 30 seconds

Specifies the reporting period (in seconds) for ACID metrics.

**hive.txn.acid.metrics.delta.num.threshold**

Default value: 100

Specifies the minimum number of active delta files that a table or partition must have to be included in the ACID metrics report.

**hive.txn.acid.metrics.obsolete.delta.num.threshold**

Default value: 100

Specifies the minimum number of obsolete delta files that a table or partition must have to be included in the ACID metrics report.

**hive.txn.acid.metrics.delta.check.threshold**

Default value: 300 seconds

Specifies the minimum age (in seconds) for delta files to be included in the ACID metrics report. Delta files less than this age are not included in the report.

**hive.txn.acid.metrics.delta.pct.threshold**

Default value: 0.01

Specifies the percentage size of the delta files relative to the base directory. Delta files whose size is smaller than this threshold value are considered as small deltas and are not included in the ACID metrics report. (1 = 100%, so the default 0.01 = 1%)

## Query vectorization

You can use vectorization to improve instruction pipelines for certain data and queries and to optimize how Hive uses the cache. Vectorization processes 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.