Red Hat Directory Server 11

Performance Tuning Guide

Tuning the performance of Directory Server

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Abstract

This guide provides tips for improving server and database performance.

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CHAPTER 1. INTRODUCTION TO DIRECTORY SERVER PERFORMANCE TUNING

This article provides some procedures and options that administrators can use to optimize the performance of their Red Hat Directory Server deployments. Performance tuning a Directory Server instance is unique to each server because of differences for every server in its machine environment, directory size and data type, load and network use, even the types of operations that users and clients perform.

The purpose of this guide is to highlight the features that Red Hat Directory Server provides for tracking and assessing server and database performance. There are also some procedures given to help tune server performance. For more in-depth planning information, however, check out the *Red Hat Directory Server Deployment Guide*, and for for command-line and UI-based administrative instructions, see the *Red Hat Directory Server Administration Guide*.

1.1. SETTING GOALS FOR DIRECTORY SERVER PERFORMANCE

Performance tuning is simply a way to identify potential (or real) bottlenecks in the normal operating environment of the server and then taking steps to mitigate those bottlenecks.

The general plan for performance tuning is:

1. Assess the environment. Look at everything around the Directory Server: its usage, the load, the network connection and reliability, most common operations, the physical machine its on, along with any services competing for its resources.
2. Measure the current Directory Server performance and establish baselines.
3. Identify the server areas which can be improved.
4. Make any changes to the Directory Server settings and, potentially, to the host machine.
5. Measure the Directory Server performance again to see how the changes affected the performance.

Directory Server provides some sort of monitoring in three areas:

- The server process (counters and logs)
- The databases (counters)
- Any database links (counters)

In the Directory Server, most performance measurements are going to be how well the Directory Server retrieves and delivers information to clients. With that in mind, these are the server areas that can be tuned for the best Directory Server performance (and these are the areas covered in this article):

- Search operations
- Indexing performance (which affects both search and write operations)
- Database transactions
- Database and entry cache settings
- Database links

Other changes can be made to the host machine's settings or hardware which can also affect Directory Server performance:

- Available memory (based on directory size)
- Other servers running on the same machine (which could compete for resources)
- Distributing user databases across other Directory Server instances on other machines
- Balancing server loads due to network performance

These changes relate much more to planning an effective Directory Server deployment than changes that can be made to an instance. Reviewing the *Deployment Guide* can provide more detail about how to plan an optimal enterprise deployment.

CHAPTER 2. TRACKING SERVER AND DATABASE PERFORMANCE

Red Hat Directory Server has two methods of recording and tracking performance data: performance counters and logs. Counters are used to determine how well the Directory Server performing, particularly in database performance; logs are used to diagnose any problem areas with server and LDAP operations and configuration.

Performance counters focus on the operations and information of the Directory Server for the server, all configured databases, and database links (chaining databases).

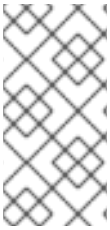
There are three types of logs: access (for client connections), errors (for errors, warnings, and details of events), and audit (changes to Directory Server configuration). The access and error logs run by default (and the errors log is required for the server to run). Audit logging, because of the overhead, must be enabled manually.

NOTE

The access log is buffered. This allows full access logging even with highly loaded servers, but there is a time lag between when the event occurs in the server and when the event is written to the log.

2.1. MONITORING SERVER ACTIVITY

The Directory Server's current activities can be monitored from either the Web Console or the command line. It is also possible to monitor the activity of the caches for all of the database.



NOTE

Some of the counters for Directory Server database attributes monitored by server use 64-bit integers, even on 32-bit systems (total connections, operations initiated, operations completed, entries sent, and bytes sent). On high-volume systems, this keeps the counters from rolling too quickly and skewing monitoring data.

2.1.1. Monitoring the Directory Server Using the Command Line

To monitor the server using the command line: **ldapsearch**,

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com monitor server
```

The following table describes the attributes the command returns:

Table 2.1. Server Monitoring Attributes

Attribute	Description
version	Identifies the directory's current version number.
threads	The current number of active threads used for handling requests. Additional threads may be created by internal server tasks, such as replication or chaining.

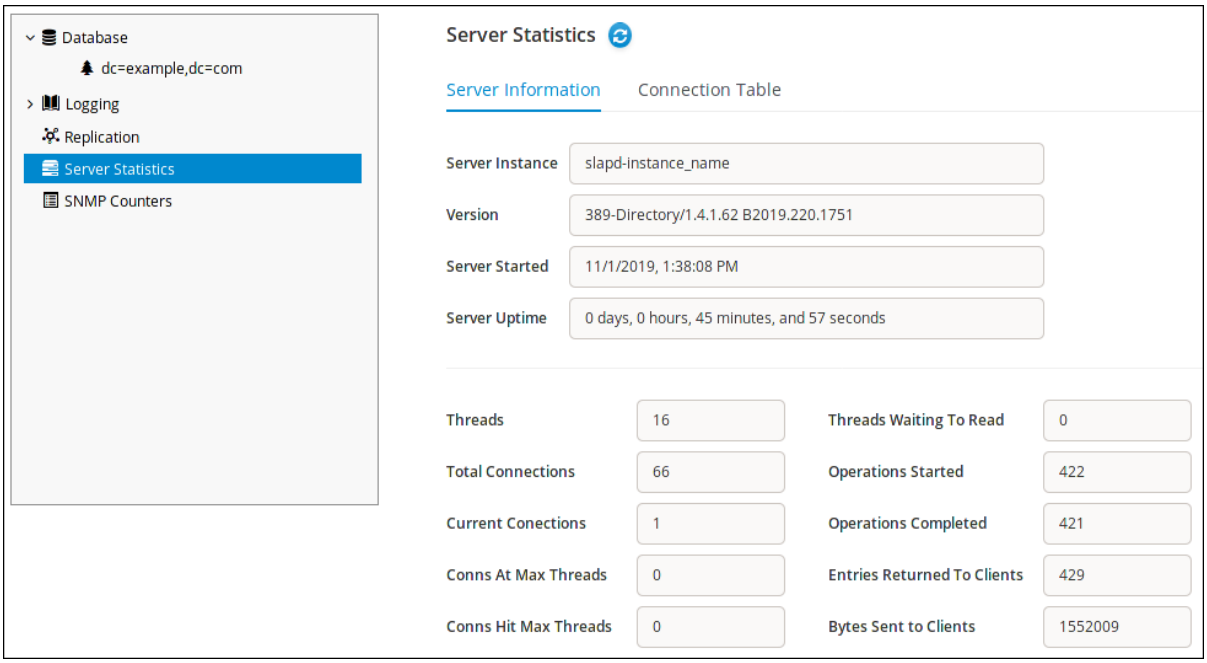
Attribute	Description
connection	Provides the following summary information for each open connection (only available if you bind to the directory as Directory Manager): *fd* – The file descriptor used for this connection. *opentime* – The time this connection was opened. *opsinitiated* – The number of operations initiated by this connection. *opscompleted* – The number of operations completed. *binddn* – The distinguished name used by this connection to connect to the directory. *rw* – The field shown if the connection is blocked for read or write. By default, this information is available to Directory Manager. However, the ACI associated with this information can be edited to allow others to access the information.
currentconnections	Identifies the number of connections currently in service by the directory.
totalconnections	Identifies the number of connections handled by the directory since it started.
currentconnectionsatmaxthreads	Displays all connections that are currently in a **max thread** state.
maxthreadsperconnhits	Displays how many times a connection hit **max thread**.
dtablesize	Shows the number of file descriptors available to the directory. Each connection requires one file descriptor: one for every open index, one for log file management, and one for **ns-slapd** itself. Essentially, this value shows how many additional concurrent connections can be serviced by the directory. For more information on file descriptors, see the operating system documentation.
readwaiters	Identifies the number of threads waiting to read data from a client.
opsinitiated	Identifies the number of operations the server has initiated since it started.
opscompleted	Identifies the number of operations the server has completed since it started.
entriessent	Identifies the number of entries sent to clients since the server started.
bytessent	Identifies the number of bytes sent to clients since the server started.

Attribute	Description
currenttime	Identifies the time when this snapshot of the server was taken. The time is displayed in Greenwich Mean Time (GMT) in UTC format.
starttime	Identifies the time when the server started. The time is displayed in Greenwich Mean Time (GMT) in UTC format.
nbackends	Identifies the number of back ends (databases) the server services.

2.1.2. Monitoring the Server Using the Web Console

To monitor the server using the web console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Monitoring** tab, select **Server Statistics**.



The following table describes the fields visible in this menu:

Table 2.2. General Information (Server)

Field	Description
Server Instance	Displays the name of the Directory Server instance.
Version	Identifies the current server version.

Field	Description
Server Started	The date and time the server was started.
Server Uptime	The time the instance is running.
Threads	The current number of active threads used for handling requests. Additional threads may be created by internal server tasks, such as replication or chaining.
Current Connections	The total number of open connections. Each connection can account for multiple operations, and therefore multiple threads.
Conns At Max Threads	Displays all connections that are currently in a **max thread** state.
Conns Hit Max Threads	Displays how many times a connection hit **max thread**.
Threads Waiting To Read	The total number of threads waiting to read from the client. Threads may not be immediately read if the server starts to receive a request from the client, and then the transmission of that request is halted for some reason. Generally, threads waiting to read are an indication of a slow network or client.
Operations Started	The number of operations initiated by this connection.
Operations Completed	The number of operations completed by the server for this connection.
Entries Returned to Clients	The number of entries sent to clients since the server started.
Bytes Sent to Clients	The number of bytes sent to clients since the server started.

2.2. MONITORING DATABASE ACTIVITY

NOTE

Some of the counters for Directory Server database attributes monitored by server use 64-bit integers, even on 32-bit systems (entry cache hits, entry cache tries, the current cache size, and the maximum cache size). On high-volume systems, this keeps the counters from rolling too quickly and skewing monitoring data.

2.2.1. Monitoring Database Activity Using the Command Line

To monitor the current activity of a database:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com monitor backend
```

The following table describes the attributes the command returns:

Table 2.3. Database Monitoring Attributes

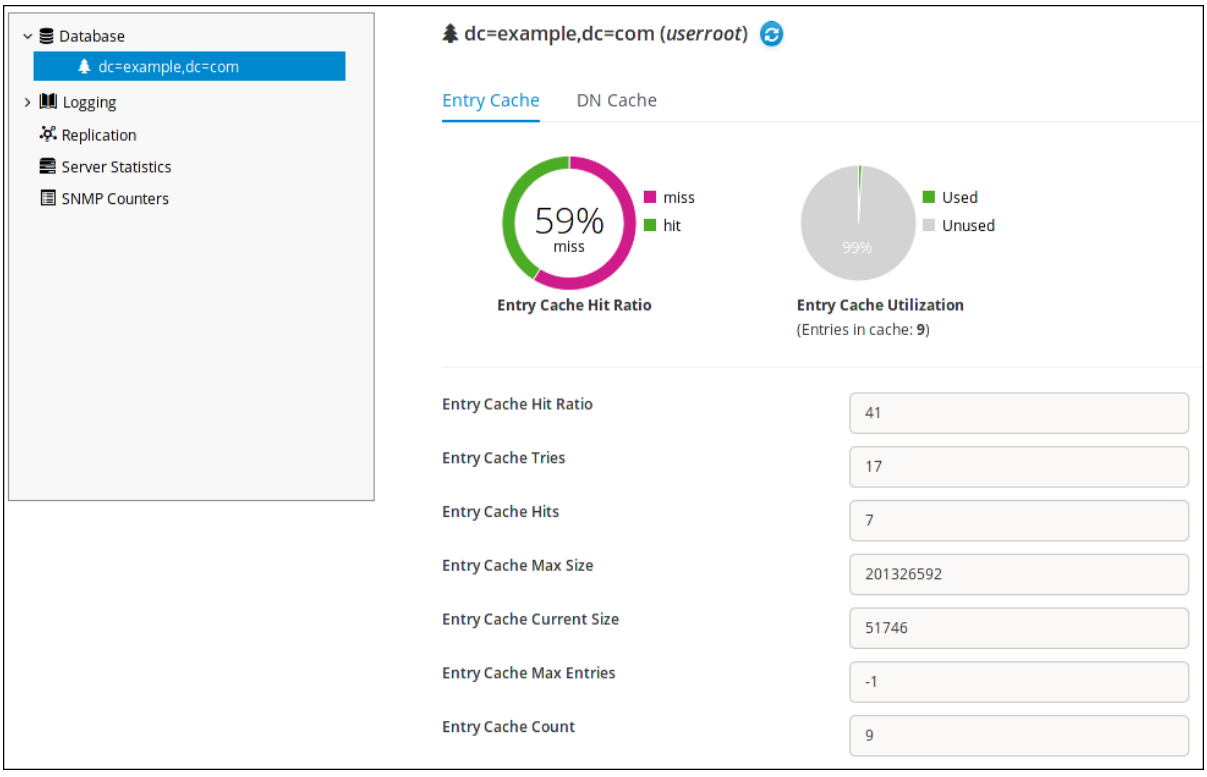
Attribute	Description
readonly	Indicates whether the database is in read-only mode; **0** means that the server is not in read-only mode, **1** means that it is in read-only mode.
entrycachehits	The total number of successful entry cache lookups. That is, the total number of times the server could process a search request by obtaining data from the cache rather than by going to disk.
entrycachetries	The total number of entry cache lookups since the directory was last started. That is, the total number of search operations performed against the server since server startup.
entrycachehitratio	Ratio that indicates the number of entry cache tries to successful entry cache lookups. This number is based on the total lookups and hits since the directory was last started. The closer this value is to 100%, the better. Whenever a search operation attempts to find an entry that is not present in the entry cache, the directory has to perform a disk access to obtain the entry. Thus, as this ratio drops towards zero, the number of disk accesses increases, and directory search performance drops. To improve this ratio, increase the size of the entry cache by increasing the value of the ***nsslapd-cachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.
currententrycachesize	The total size, in bytes, of directory entries currently present in the entry cache. To increase the size of the entries which can be present in the cache, increase the value of the ***nsslapd-cachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.
maxentrycachesize	The maximum size, in bytes, of directory entries that can be maintained in the entry cache. To increase the size of the entries which can be present in the cache, increase the value of the ***nsslapd-cachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.
dncachehits	The number of times the server could process a request by obtaining data from the cache rather than by going to the disk.
dncachetries	The total number of database accesses since server startup.
dncachehitratio	The ratio of cache tries to successful cache hits. The closer this number is to 100%, the better.
currentdncachesize	The total size, in bytes, of DNs currently present in the DN cache. To increase the size of the entries which can be present in the DN cache, increase the value of the ***nsslapd-dncachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.

Attribute	Description
maxdncachesize	The maximum size, in bytes, of DNs that can be maintained in the DN cache. To increase the size of the entries which can be present in the cache, increase the value of the ***nsslapd-dncachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.
currentdncachecount	The number of DNs currently present in the DN cache.
maxdncachecount	The maximum number of DNs allowed in the DN cache.

2.2.2. Monitoring Database Activity Using the Web Console

To monitor the database activity using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Monitoring** tab, select the database entry to display.
4. Select **Entry Cache** to display the performance values of the entry cache:

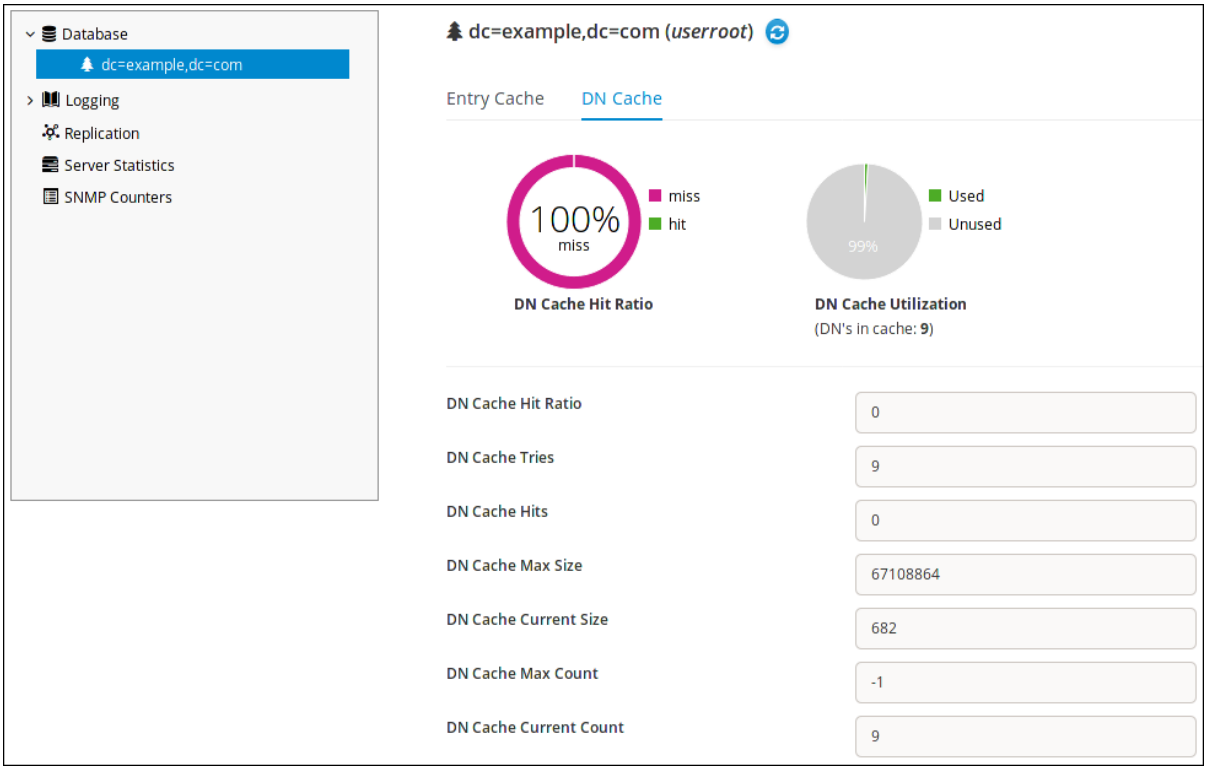


The following table describes the fields visible on this tab:

Table 2.4. Fields on the Entry Cache Tab

Field Name	Description
Entry Cache Hit Ratio	Ratio that indicates the number of entry cache tries to successful entry cache lookups. This number is based on the total lookups and hits since the directory was last started. The closer this value is to 100%, the better. Whenever an operation attempts to find an entry that is not present in the entry cache, the directory has to perform a disk access to obtain the entry. Thus, as this ratio drops towards zero, the number of disk accesses increases, and directory search performance drops. To improve this ratio, increase the size of the entry cache by increasing the value of the ***nsslapd-cachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.
Entry Cache Tries	The total number of entry cache lookups since the directory was last started. That is, the total number of entries requested since server startup.
Entry Cache Hits	The total number of successful entry cache lookups. That is, the total number of times the server could process a search request by obtaining data from the cache rather than by going to disk.
Entry Cache Max Size	The size of the entry cache in bytes maintained by the directory. This value is managed by the ***nsslapd-cachememsize*** attribute in the **cn=***database_name*, **cn=ldbm database,cn=plugins,cn=config** entry for the database.
Entry Cache Current Size	The number of directory entries currently present in the entry cache.
Entry Cache Max Entries	*DEPRECATED.* The maximum number of directory entries that can be maintained in the entry cache. Do not attempt to manage the cache size by setting a maximum number of allowed entries. This can make it difficult for the host to allocate RAM effectively. Manage the cache size by setting the amount of RAM available to the cache, using the ***nsslapd-cachememsize*** attribute.
Entry Cache Count	The number of directory entries currently present in the entry cache.

5. Select **DN Cache** for performance values on the DN cache.



2.3. MONITORING DATABASE LINK ACTIVITY

The activity for database links (chained databases) can also be displayed, however, only using the command line:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com monitor chaining
```

The following table describes the attributes the command returns:

Table 2.5. Database Link Monitoring Attributes

Attribute Name	Description
nsAddCount	The number of add operations received.
nsDeleteCount	The number of delete operations received.
nsModifyCount	The number of modify operations received.
nsRenameCount	The number of rename operations received.
nsSearchBaseCount	The number of base-level searches received.
nsSearchOneLevelCount	The number of one-level searches received.
nsSearchSubtreeCount	The number of subtree searches received.
nsAbandonCount	The number of abandon operations received.

Attribute Name	Description
nsBindCount	The number of bind request received.
nsUnbindCount	The number of unbinds received.
nsCompareCount	The number of compare operations received.
nsOperationConnectionCount	The number of open connections for normal operations.
nsBindConnectionCount	The number of open connections for bind operations.

2.4. MONITORING THE LOCAL DISK FOR GRACEFUL SHUTDOWN

When the disk space available on a system becomes too small, the Directory Server process terminates. As a consequence, there is a risk of corrupting the database or loosing data.

To prevent this problem, you can configure Directory Server to monitor the free disk space. The monitoring thread checks the free space on the file systems that contain the configuration, transaction log, and database directories.

Depending on the remaining free disk space, Directory Server behaves different:

- If the free disk space reaches the defined threshold, Directory Server:
  - Disables verbose logging
  - Disables access access logging
  - Deletes archived log files

NOTE

Directory Server always continues writing error logs, even if the threshold is reached.

- If the free disk space is lower than the half of the configured threshold, Directory Server shuts down within a defined grace period.
- If the available disk space is ever lower than 4 KB, Directory Server shuts down immediately.

If disk space is freed up, then Directory Server aborts the shutdown process and re-enables all of the previously disabled log settings.

2.4.1. Configuring Local Disk Monitoring Using the Command Line

To configure local disk monitoring using the command line:

1. Enable the disk monitoring feature, set a threshold value, and a grace period:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com config replace nsslapd-disk-monitoring=on nsslapd-disk-monitoring-threshold=3000000000 nsslapd-disk-monitoring-grace-period=60
```

This command sets the threshold of free disk space to 3 GB and the grace period to 60 seconds.

2. Optionally, configure that Directory Server neither disables access logging nor deletes archived logs, by enabling the ***nsslapd-disk-monitoring-logging-critical*** parameter:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com config replace nsslapd-disk-monitoring-logging-critical=on
```

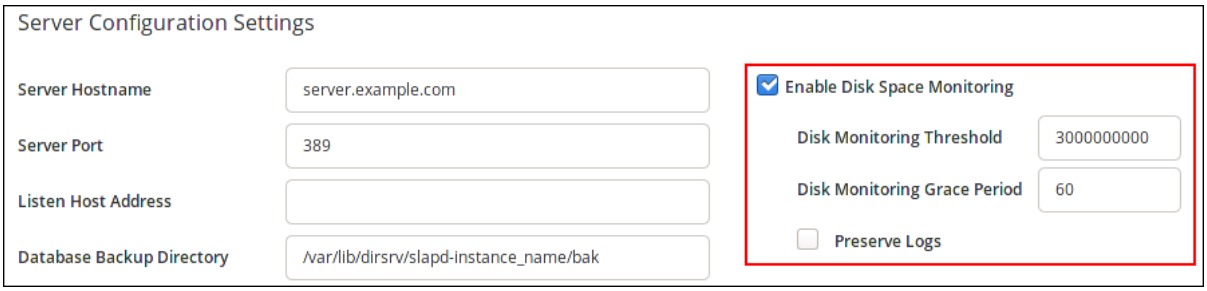
3. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

2.4.2. Configuring Local Disk Monitoring Using the Web Console

To configure local disk monitoring using the Web Console:

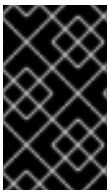
1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. Open the **Server Settings** menu, and select **Server Configuration**.
4. Select **Enable Disk Space Monitoring**.



5. Set the threshold in bytes and the grace period in seconds.
6. Optionally, configure that Directory Server neither disables access logging nor deletes archived logs by selecting **Preserve Logs**.
7. Click **Save Configuration**.
8. Click the **Actions** button, and select **Restart Instance**.

2.5. IMPROVING LOGGING PERFORMANCE

A large Directory Server deployment can create a large amount of log contents. To improve the performance under heavy load, disable access log buffering. With access log buffering disabled, Directory Server writes log entries directly to the disk.



IMPORTANT

Access logging is very helpful for debugging issues in the server and monitoring client connections and failed connection attempts. Do not disable access logging in a normal operating environment.

2.5.1. Disabling Access Log Buffering Using the Command Line

To disable access log buffering using the command line:

1. Set the ***nsslapd-accesslog-logbuffering*** parameter to **off**:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com config replace nsslapd-accesslog-logbuffering=off
```

2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

2.5.2. Disabling Access Log Buffering Using the Web Console

To disable access log buffering using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. Open **Server Settings → Logging → Access Log**.
4. Select **Disable Access Log Buffering**.
5. Click **Save Configuration**.
6. Click the **Actions** button, and select **Restart Instance**.

CHAPTER 3. TUNING THE NUMBER OF LOCKS

Lock mechanisms in Directory Server control how many copies of Directory Server processes can run at the same time. For example, during an import job, Directory Server sets a lock in the **/run/lock/dirsrv/slapd-*instance_name*/imports/** directory to prevent the **ns-slapd** (Directory Server) process, another import, or export operations from running.

If the server runs out of available locks, the following error is logged in the **/var/log/dirsrv/slapd-*instance_name*/errors** file:

```
libdb: Lock table is out of available locks
```

If error messages indicate that the lock table is out of available locks, double the number of locks. If the problem persists, double the value again.

3.1. MONITORING THE NUMBER OF LOCKS

To monitor the number of locks using the command line, enter:

```
# ldapsearch -D "cn=Directory Manager" -W -p 389 -h server.example.com -x
    -s sub -b "cn=database,cn=monitor,cn=ldbm database,cn=plugins,cn=config"
    nsslapd-db-current-locks nsslapd-db-max-locks
```

For details about the monitoring attributes, see the descriptions in the Directory Server Configuration, Command, and File Reference.

3.2. SETTING THE NUMBER OF LOCKS USING THE COMMAND LINE

To set the number of locks using the command line:

1. Use the **dsconf backend config set** command to update the number of locks. For example, to set the value to **20000**:

   ```
   # dsconf -D "cn=Directory Manager" ldap://server.example.com backend config set --
   locks=20000
   ```

2. Restart the Directory Server instance:

   ```
   # dsctl instance_name restart
   ```

3.3. SETTING THE NUMBER OF LOCKS USING THE WEB CONSOLE

To set the number of locks using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.

2. Select the instance.

3. Open the **Database** menu, and select **Global Database Configuration**.

4. Click **Show Advanced Settings**.
5. Update the value in the **Database Locks** field.
6. Click **Save Configuration**.
7. Click the **Actions** button, and select **Restart Instance**.

CHAPTER 4. IMPROVING SEARCH PERFORMANCE (AND BALANCING READ PERFORMANCE)

The most effective way to improve search operations against the directory is to configure thorough indexes for entries, combined with reasonable limits on search results.

4.1. USING INDEXES

An index (as it implies) is a tag that shows that a certain entry contains a certain attribute, without having to contain any other detail about the entry (which saves space and makes returning search results faster). Each index is organized around a Directory Server attribute and a certain way of matching that attribute:

- *Presence index (pres)* simply shows what entries contain an attribute.
- *Equality index (eq)* shows which attribute values match a specific search string.
- *Approximate index (approx)* is used for efficient *sounds-like* searches, which shows entries which have a value that phonetically matches a string.
- *Substring index (sub)* matches any substring of an attribute value to the given search string. (This index if very expensive for the server to maintain.)
- *International index* uses a matching rule to match strings in a directory which contains values in languages other than English.

NOTE

Indexing is described in much more detail in the *Managing Indexes* chapter in the *Red Hat Directory Server Administration Guide*.

However, just creating indexes is not directly going to increase server performance. Maintaining indexes puts a burden on the Directory Server for every modify, add, and delete operation by having to verify every attribute in the change against every index maintained by the server:

1. The Directory Server receives an add or modify operation.
2. The Directory Server examines the indexing attributes to determine whether an index is maintained for the attribute values.
3. If the created attribute values are indexed, then the Directory Server generates the new index entries.
4. Once the server completes the indexing, the actual attribute values are created according to the client request.

For example, the Directory Server adds the entry:

```
dn: cn=John Doe, ou=People,dc=example,dc=com
objectclass: top
objectClass: person
objectClass: orgperson
objectClass: inetorgperson
cn: John Doe
```

```
cn: John
sn: Doe
ou: Manufacturing
ou: people
telephoneNumber: 408 555 8834
description: Manufacturing lead for the Z238 line of widgets.
```

The Directory Server is maintaining the following indexes:

- Equality, approximate, and substring indexes for ***cn*** (common name) and ***sn*** (surname) attributes.
- Equality and substring indexes for the telephone number attribute.
- Substring indexes for the description attribute.

When adding that entry to the directory, the Directory Server must perform these steps:

1. Create the ***cn*** equality index entry for **John** and **John Doe**.
2. Create the appropriate ***cn*** approximate index entries for **John** and **John Doe**.
3. Create the appropriate ***cn*** substring index entries for **John** and **John Doe**.
4. Create the ***sn*** equality index entry for **Doe**.
5. Create the appropriate ***sn*** approximate index entry for **Doe**.
6. Create the appropriate ***sn*** substring index entries for **Doe**.
7. Create the telephone number equality index entry for **408 555 8834**.
8. Create the appropriate telephone number substring index entries for **408 555 8834**.
9. Create the appropriate description substring index entries for **Manufacturing lead for the Z238 line of widgets**. A large number of substring entries are generated for this string.

Before creating new indexes, make sure to balance the overhead of maintaining the indexes against the potential improvements in search performance. Especially important, match the *types* of indexes that you maintain to the type of information stored in the directory and the type of information users routinely search for.

- Approximate indexes are not efficient for attributes commonly containing numbers, such as telephone numbers.
- Substring indexes do not work for binary attributes.
- Equality indexes should be avoided if the value is big (such as attributes intended to contain photographs or passwords containing encrypted data).
- Maintaining indexes for attributes not commonly used in a search increases overhead without improving global searching performance.
- Attributes that are not indexed can still be specified in search requests, although the search performance may be degraded significantly, depending on the type of search.
- The more indexes you maintain, the more disk space you require.

NOTE

Creating indexes is much more effective for directories which have a high search operation load and low modify operation load.

4.2. TUNING DIRECTORY SERVER RESOURCE SETTINGS

You can configure several parameters to manage and improve the amount of resources Directory Server uses.

4.2.1. Updating Directory Server Resource Settings Using the Command Line

To update the server resource settings using the command line:

1. Update the performance settings:

```
dsconf -D "cn=Directory Manager" ldap://server.example.com config replace
parameter_name=setting
```

You can set the following parameters:

- ***nsslapd-threadnumber***: Sets the number of worker threads.
- ***nsslapd-maxdescriptors***: Sets the maximum number of file descriptors.
- ***nsslapd-timelimit***: Sets the search time limit.
- ***nsslapd-sizelimit***: Sets the search size limit.
- ***nsslapd-pagedsizelimit***: Sets the paged search size limit.
- ***nsslapd-idletimeout***: Sets the idle connection timeout.
- ***nsslapd-ioblocktimeout***: Sets the input/output (I/O) block timeout.
- ***nsslapd-ndn-cache-enabled***: Enables or disables the normalized DN cache.
- ***nsslapd-ndn-cache-max-size***: Sets the normalized DN cache size, if ***nsslapd-ndn-cache-enabled*** is enabled.
- ***nsslapd-outbound-ldap-io-timeout***: Sets the outbound I/O timeout.
- ***nsslapd-maxbersize***: Sets the maximum Basic Encoding Rules (BER) size.
- ***nsslapd-maxsasliosize***: Sets the maximum Simple Authentication and Security Layer (SASL) I/O size.
- ***nsslapd-listen-backlog-size***: Sets the maximum number of sockets available to receive incoming connections.
- ***nsslapd-max-filter-nest-level***: Sets the maximum nested filter level.
- ***nsslapd-ignore-virtual-attrs***: Enables or disables virtual attribute lookups.
- ***nsslapd-connection-nocanon***: Enables or disables revers DNS lookups.

- ***nsslapd-enable-turbo-mode***: Enables or disables the turbo mode feature.

For further details about these parameters, see their descriptions in the *Red Hat Directory Server Configuration, Command, and File Reference*..

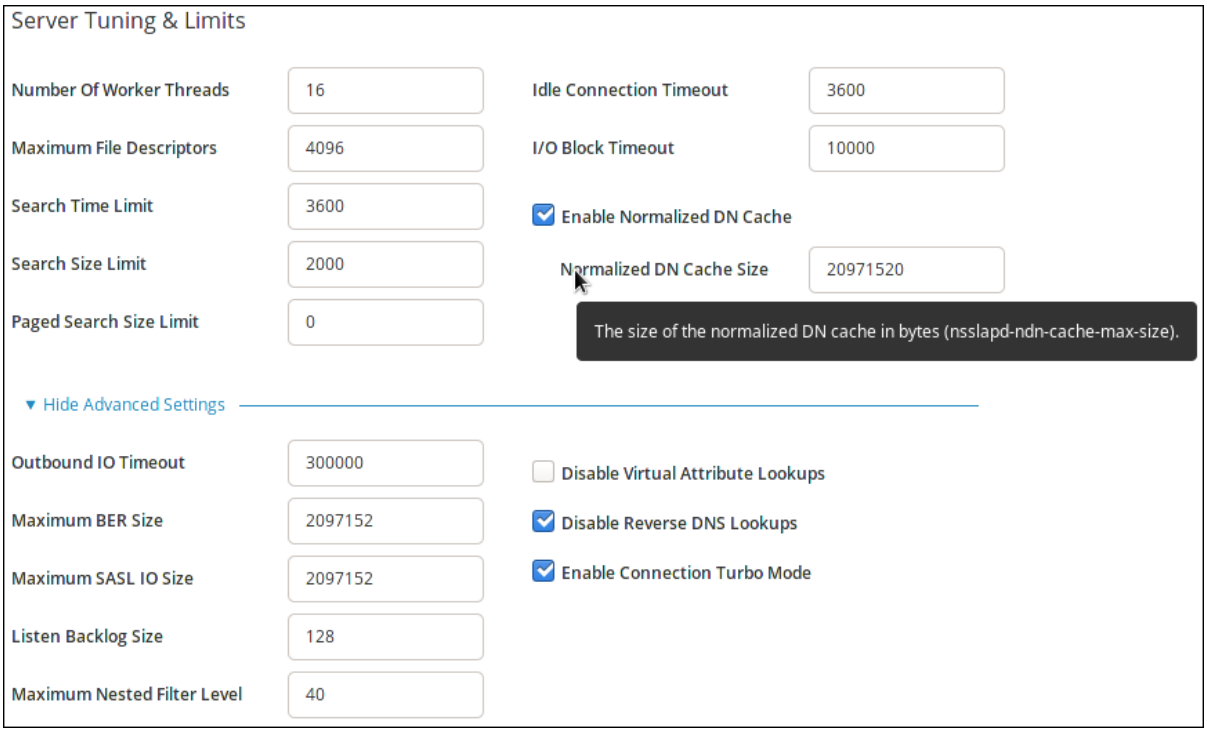
2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

4.2.2. Updating Directory Server Resource Settings Using the Web Console

To update the server resource settings using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. Open the **Server Settings** menu, and select **Tuning & Limits**.
4. Update the settings. Optionally, click **Show Advanced Settings** to display all settings.



To display a tooltip and the corresponding attribute name in the **cn=config** entry for a parameter, hover the mouse cursor over the setting. For further details, see the parameter's description in the *Red Hat Directory Server Configuration, Command, and File Reference.* .

5. Click **Save Configuration**.
6. Click the **Actions** button, and select **Restart Instance**.

4.3. SETTING INDEX SCAN LIMITS

In large directories, the search results list can get huge. A directory with a million **inetorgperson** entries would have a million entries that were returned with a filter like **(objectclass=inetorgperson)**, and an index for the ***sn*** attribute would have at least a million entries in it.

Loading a long ID list from the database significantly reduces search performance. The configuration parameter, **nsslapd-idlistscanlimit**, sets a limit on the number of IDs that are read before a key is considered to match the entire primary index (meaning the search is treated as an unindexed search with a different set of resource limits).

For large indexes, it is actually more efficient to treat any search which matches the index as an unindexed search. The search operation only has to look in one place to process results (the entire directory) rather than searching through an index that is nearly the size of a directory, plus the directory itself.

The default value of the **nsslapd-idlistscanlimit** attribute is **4000**, which is gives good performance for a common range of database sizes and access patterns. It's usually not necessary to change this value. If the database index is slightly larger than the 4000 entries, but still significantly smaller than the overall directory, then raising the scan limit improves searches which would otherwise hit the default limit of 4000.

On the other hand, lowering the limit can significantly speed up searches that would otherwise hit the 4000 entry limit, but where it is not necessary to scan every entry.

4.3.1. Setting an Index Scan Limit Using the Command Line

To set an index scan limit using the command line:

1. For example, to set the number of entry IDs that Directory Server searches during a search operation to **8000**:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend config set --
idlistscanlimit=8000
```

2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

4.3.2. Setting an Index Scan Limit Using the Web Console

To set an index scan limit using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select **Global Database Configuration**.
4. Update the value in the **ID List Scan Limit** field.
5. Click **Save Configuration**.
6. Click the **Actions** button, and select **Restart Instance**.

4.4. FINE GRAINED ID LIST SIZE

In large databases, some queries can consume a large amount of CPU and RAM resources. To improve the performance, you can set a default ID scan limit that applies to all indexes in the database using the **nsslapd-idlistscanlimit** attribute. However in some cases it is useful to define a limit for certain indexes, or use no ID list. You can set individual settings for ID list scan limits for different types of search filters using the **nsIndexIDListScanLimit** attribute.

To set a limit, for example for the ***objectClass*** attribute, add the **nsIndexIDListScanLimit** parameter to the DN **cn=objectclass,cn=index,cn=userRoot,cn=ldbm database,cn=plugins,cn=config**.

The **nsIndexIDListScanLimit** attribute is multi valued and takes the following list of parameters as a value:

```
nsIndexIDListScanLimit: limit=NNN [type=eq[,sub,...]] [flags=AND[,XXX,...]] [values=val[,val,...]]
```

- **limit**: The maximum size of the ID list. Valid values are:
  - **-1**: Unlimited.
  - **0**: Do not use the index.
  - **1 to the maximum 32-bit integer (2147483647)**: Maximum number of IDs.
- **type**: Optional. The type of the index. **eq**, **sub**, **pres**, and so on. The value must be one of the actual ***nsIndexType*** specified for the index definition. For example, you cannot use **type=eq** if you do not have **nsIndexType=eq** defined.
- **flags**: Optional. Flags that alter the behavior of applying the scan limit. Valid values are:
  - **AND**: Apply the scan limit only to searches in which the attribute appears in an **AND** clause.
  - **OR**: Apply the scan limit only to searches in which the attribute appears in an **OR** clause.
- **values**: Optional. Comma separated list of values which must match the search filter in order for the limit to be applied. Since the matches are done one at a time, the values will match if any of the values matches.

  The values must be used with only one type at a time.

  The values must correspond to the index type, and must correspond to the syntax of the attribute to which the index is applied. For example, if you specified the integer based attribute ***uidNumber*** and it is indexed for **eq**, you cannot use **type=eq values=abc**.

  If the value contains spaces, commas, NULL, or other values which require to be escaped, the LDAP filter escape syntax should be used: backslash (\) followed by the 2 hex digit code for the character. In the following example, the commas in the DN value are escaped with **\2C**.

  ```
  nsIndexIDListScanLimit: limit=0 type=eq
  values=uid=user\2Cou=People\2Cdc=example\2Cdc=com
  ```

Example 4.1. Setting nsIndexIDListScanLimit

In a large database with 10 million entries that contain the object class **inetOrgPerson**, a search for **(&(objectClass=inetOrgPerson)(uid=user))** creates first an ID list containing all 10 million IDs matching **objectClass=inetOrgPerson**. When the database applies the second part of the filter, it

searches the result list for objects matching **uid=user**. In this cases it is useful to define a limit for certain indexes, or use no ID list at all.

To set that no ID list is created for **objectClass=inetOrgPerson** in **AND** clauses, add the following **nsIndexIDListScanLimit**:

```
# ldapmodify -D "cn=Directory Manager" -W -p 389 -h server.example.com -x
dn: cn=objectclass,cn=index,cn=userRoot,cn=ldbm database,cn=plugins,cn=config
changetype: modify
replace: nsIndexIDListScanLimit
nsIndexIDListScanLimit: limit=0 type=eq flags=AND values=inetOrgPerson

modifying entry "cn=objectclass,cn=index,cn=userRoot,cn=ldbm database,cn=plugins,cn=config"
```

No ID list is created for **objectClass=inetOrgPerson** when used in an **AND** clause. In all other situations the value of ***nsslapd-idlistscanlimit*** is applied.

4.5. TUNING THE DATABASE CACHE FOR SEARCHES

The database attributes that affect search performance mainly define the amount of memory available to the server. The maximum values that can be set for the database's cache size attributes depends on the amount of real memory on the machine. Roughly, the amount of available memory on the machine should always be greater than sum total of the default database cache size and sum of each entry cache size.

Use caution when changing these cache sizing attributes. The ability to improve server performance with these attributes depends on the size of the database, the amount of physical memory available on the machine, and whether directory searches are random (that is, if the directory clients are searching for random and widely scattered directory data).

If the database does not fit into memory and if searches are random, attempting to increase the values set on these attributes does not help directory performance. In fact, changing these attributes may harm overall performance.

The attributes of each database used to store directory data can be resized.

To improve the cache hit ratio on search operations, increase the amount of data that the Directory Server maintains in the database cache, as described in Section 6.4, “Setting the Database Cache Size”, by editing the values for the ***nsslapd-dbcachesize*** parameter.

4.6. MANAGING SPECIAL ENTRIES

Directory Server stores the **cn=config** entry in the **/etc/dirsrv/slapd-*instance_name*/dse.ldif** configuration file and not in the same highly scalable database as regular entries. For this reason, do not store regular user or groups in **cn=config**.

CHAPTER 5. TUNING TRANSACTION LOGGING

Every Directory Server contains a transaction log which writes operations for all the databases it manages. Whenever a directory database operation such as a modify is performed, the server creates a single database transaction for all of the database operations invoked as a result of that LDAP operation. This includes both updating the entry data in the entry index file and updating all of the attribute indexes. If *all* of the operations succeed, the server commits the transaction, writes the operations to the transaction log, and verifies that the entire transaction is written to disk. If *any* of these operations fail, the server rolls back the transaction, and all of the operations are discarded. This all-or-nothing approach in the server guarantees that an update operation is *atomic*. Either the entire operation succeeds permanently and irrevocably, or it fails.

Periodically, the Directory Server (through internal housekeeping threads) flushes the contents of the transaction logs to the actual database index files and checks if the transaction logs require trimming.

If the server experiences a failure, such as a power outage, and shuts down abnormally, the information about recent directory changes is still saved by the transaction log. When the server restarts, the directory automatically detects the error condition and uses the database transaction log to recover the database.

Although database transaction logging and database recovery are automatic processes that require no intervention, it can be advisable to tune some of the database transaction logging attributes to optimize performance.

WARNING

The transaction logging attributes are provided only for system modifications and diagnostics. These settings should be changed only with the guidance of Red Hat Technical Support. Setting these attributes and other configuration attributes inconsistently may cause the directory to be unstable.

5.1. MOVING THE DATABASE DIRECTORY TO A SEPARATE DISK OR PARTITION

To achieve higher performance, store the directory server databases and transaction log on a fast drive, such as a nonvolatile memory express (NVMe) drive or an SSD.

For example, if you already run a Directory Server instance and want to mount the **/dev/nvme0n1p1** partition to the **/var/lib/dirsrv/slapd-*instance_name*/db/** directory:

1. Stop the instance:

```
# systemctl stop dirsrv@instance_name
```

2. Mount the **/dev/nvme0n1p1** partition to a temporary directory. For example:

```
# mount /dev/nvme0n1p1 /mnt/
```

3. Copy the content of the **/var/lib/dirsrv/slapd-*instance_name*/db/** directory to the temporary mount point:

```
# mv /var/lib/dirsrv/slapd-instance_name/db/* /mnt/
```

4. Unmount the temporary directory:

```
# umount /mnt/
```

5. If **/var/lib/dirsrv/slapd-*instance_name*/db/** is also a separate mount point, unmount the directory:

```
# umount /var/lib/dirsrv/slapd-instance_name/db/
```

6. Update the **/etc/fstab** file to mount the **/dev/nvme0n1p1** partition automatically to **/var/lib/dirsrv/slapd-*instance_name*/db/** when the system boots. For details, see the corresponding section in the *Red Hat System Administrator's Guide*.

7. Mount the file system. If you added the entry to **/etc/fstab**:

```
# mount /var/lib/dirsrv/slapd-instance_name/db/
```

8. If SELinux is running in **enforcing** mode, restore the SELinux context:

```
# restorecon -Rv /var/lib/dirsrv/slapd-instance_name/db/
```

9. Start the instance:

```
# systemctl start dirsrv@instance_name
```

5.2. CHANGING THE DATABASE CHECKPOINT INTERVAL

At regular intervals, the Directory Server writes operations logged in the transaction log to the database index files and logs a checkpoint entry in the database transaction log. By indicating which changes have already been written to the database indexes, checkpoint entries indicate where to begin recovery from the transaction log, thus speeding up the recovery process.

By default, the Directory Server is set up to send a checkpoint entry to the database transaction log every 60 seconds. Increasing the checkpoint interval may increase the performance of directory write operations. However, increasing the checkpoint interval may also increase the amount of time required to recover directory databases after a disorderly shutdown and require more disk space due to large database transaction log files. Therefore, only modify this attribute if you are familiar with database optimization and can fully assess the effect of the change.

5.2.1. Changing the Database Checkpoint Interval Using the Command Line

To change the database checkpoint interval using the command line, enter:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend config set --checkpoint-interval=120
```

This example changes the interval to 120 seconds.

5.2.2. Changing the Database Checkpoint Interval Using the Web Console

To change the database checkpoint interval using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select **Global Database Configuration**.
4. Click **Show Advanced Settings**.
5. Update the value in the **Database Checkpoint Interval** field.
6. Click **Save Configuration**.

5.3. DISABLING DURABLE TRANSACTIONS

Durable transaction logging means that each LDAP update operation, comprised of a sequence of database operations in a transaction, is physically written to disk. Even though each LDAP operation can be comprised of multiple database operations, each LDAP operation is treated as a single database transaction. Each LDAP operation is both atomic and durable.

WARNING

Turning off durable transactions can improve Directory Server write performance at the risk of data loss.

When durable transaction logging is disabled, every directory database operation is written to the database transaction log file but may not be physically written to disk immediately. If a directory change was written to the logical database transaction log file but not physically written to disk at the time of a system crash, the change cannot be recovered. When durable transactions are disabled, the recovered database is consistent but does not reflect the results of any LDAP write operations that completed just before the system crash.

By default, durable database transaction logging is enabled. To disable durable transaction logging:

1. Stop the Directory Server instance:

```
# dsctl instance_name stop
```

2. Edit the **/etc/dirsrv/slapd-*instance_name*/dse.ldif** file, and set the ***nsslapd-db-durable-transaction*** parameter in the **cn=config,cn=ldbm database,cn=plugins,cn=config** entry to **off**:

```
dn: cn=config,cn=ldbm database,cn=plugins,cn=config
...
nsslapd-db-durable-transaction: off
```

```
...
```

3. Start the Directory Server instance:

```
# dsctl instance_name start
```

5.4. SPECIFYING TRANSACTION BATCHING

To improve the update performance when a full transaction durability is not required, use the following command:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend config set --txn-batch-val=value
```

The ***--txn-batch-val*** specifies how many transactions be batched before Directory Server commits them to the transaction log. Setting this value to a value greater than **0** causes the server to delay committing transactions until the number of queued transactions is equal to this value.

CHAPTER 6. MANAGING THE DATABASE CACHE SETTINGS

Directory Server uses the following caches:

- The *Entry cache*, which contains individual directory entries.
- The *DN cache* is used to associate DNs and RDNs with entries.
- The *Database cache*, which contains the database index files ***.db** and ***.db4** files.

For the highest performance improvements, all cache sizes must be able to store all of their records. If you do not use the recommended auto-sizing feature and have not enough RAM available, assign free memory to the caches in the previously shown order.

6.1. THE DATABASE AND ENTRY CACHE AUTO-SIZING FEATURE

By default, Directory Server automatically determine the optimized size for the database and entry cache. Auto-sizing optimizes the size of both caches based on the hardware resources of the server when the instance starts.

IMPORTANT

Red Hat recommends to use the auto-tuning settings. Do not set the entry cache size manually.

6.1.1. Manually Re-enabling the Database and Entry Cache Auto-sizing

If you upgraded the instance from a version prior to 10.1.1, or previously manually set an entry cache size, you can enable the auto-tuning for the entry cache.

The following parameters in the **cn=config,cn=ldbm database,cn=plugins,cn=config** entry control the auto-sizing:

nsslapd-cache-autosize

This settings controls if auto-sizing is enabled for the database and entry cache. Auto-sizing is enabled:

- For both the database and entry cache, if the ***nsslapd-cache-autosize*** parameter is set to a value greater than **0**.
- For the database cache, if the ***nsslapd-cache-autosize*** and ***nsslapd-dbcachesize*** parameters are set to **0**.
- For the entry cache, if the ***nsslapd-cache-autosize*** and ***nsslapd-cachememsize*** parameters are set to **0**.

nsslapd-cache-autosize-split

The value sets the percentage of RAM that is used for the database cache. The remaining percentage is used for the entry cache.

Using more than 1.5 GB RAM for the database cache does not improve the performance. Therefore, Directory Server limits the database cache 1.5 GB.

To enable the database and entry cache auto-sizing:

1. Stop the Directory Server instance:

```
# systemctl stop dirsrv@instance_name
```

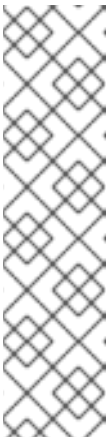
2. Backup the **/etc/dirsrv/slapd-*instance_name*/dse.ldif** file:

```
# cp /etc/dirsrv/slapd-instance_name/dse.ldif \
    /etc/dirsrv/slapd-instance_name/dse.ldif.bak.$(date "+%F_%H-%M-%S")
```

3. Edit the **/etc/dirsrv/slapd-*instance_name*/dse.ldif** file:

   a. Set the percentage of free system RAM to use for the database and entry cache. For example, to set 10%:

```
nsslapd-cache-autosize: 10
```



NOTE

If you set the ***nsslapd-cache-autosize*** parameter to **0**, you must additionally set:

- the ***nsslapd-dbcachesize*** in the **cn=config,cn=ldbm database,cn=plugins,cn=config** entry to **0** to enable the auto-sized database cache.
- the ***nsslapd-cachememsize*** in the **cn=*database_name*,cn=ldbm database,cn=plugins,cn=config** entry to **0** to enable the auto-sized entry cache for a database.

   b. Optionally, set the percentage used from the free system RAM for the database cache. For example, to set 40%:

```
nsslapd-cache-autosize-split: 40
```

   Directory Server uses the remaining 60% of free memory for the entry cache.

   c. Save the changes.

4. Start the Directory Server instance:

```
# systemctl start dirsrv@instance_name
```

Example 6.1. The *nsslapd-cache-autosize* and *nsslapd-cache-autosize-split* Parameter

The following settings are the default for both parameters:

```
nsslapd-cache-autosize: 10
nsslapd-cache-autosize-split: 40
```

Using these settings, 10% of the system's free RAM is used (***nsslapd-cache-autosize***). From this memory, 40% are used for the database cache (***nsslapd-cache-autosize-split***) and the remaining 60% for the entry cache.

Depending on the free RAM, this results in the following cache sizes:

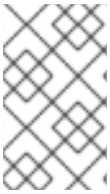
GB of Free RAM	Database Cache Size	Entry Cache Size
1 GB	40 MB	62 MB
2 GB	82 MB	122 MB
4 GB	164 MB	245 MB
8 GB	328 MB	492 MB
16 GB	512 MB [a]	1,126 MB
32 GB	512 MB [a]	2,764 MB
64 GB	512 MB [a]	6,042 MB
128 GB	512 MB [a]	12,596 MB

[a] Directory Server applies the 512 MB limit for the ***nsslapd-dbcachesize*** parameter.

6.2. MANUALLY SETTING THE ENTRY CACHE SIZE

The entry cache is used to store directory entries that are used during search and read operations. Setting the entry cache to a size that enables Directory Server to store all records has the highest performance impact on search operations.

If entry caching is not configured, Directory Server reads the entry from the **id2entry.db** database file and converts the DNs from the on-disk format to the in-memory format. Entries that are stored in the cache enable the server to skip the disk I/O and conversion steps.



NOTE

Instead of manually setting the entry cache size Red Hat recommends the auto-sizing feature for optimized settings based on the hardware resources. For details, see Section 6.1.1, “Manually Re-enabling the Database and Entry Cache Auto-sizing” .

6.2.1. Manually Setting the Entry Cache Size Using the Command Line

To manually set the entry cache size using the command line:

1. Disable automatic cache tuning:
   -

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend config set --cache-autosize=0
```

2. Display the suffixes and their corresponding back end:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com suffix list
dc=example,dc=com (userroot)
```

This command displays the name of the back end database next to each suffix. You require the suffix's database name in the next step.

3. Set the entry cache size for the database:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend suffix set --cache-memsize=2147483648 userRoot
```

This command sets the entry cache to 2 gigabytes.

4. Restart the Directory Service instance:

```
# dsctl instance_name restart
```

6.2.2. Manually Setting the Entry Cache Size Using the Web Console

To manually set the entry cache size using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select **Global Database Configuration**.
4. Disable **Automatic Cache Tuning**.
5. Click **Save Configuration**.
6. Click the **Actions** button, and select **Restart Instance**.
7. Set the size of the database cache in the **Entry Cache Size (bytes)** field.
8. Click **Save Configuration**.
9. Click the **Actions** button, and select **Restart Instance**.

6.3. SETTING THE SIZE OF THE DN CACHE

The **entryrdn** index is used to associate DNs and RDNs with entries. It enables the server to efficiently perform subtree **rename**, entry **move**, and **moddn** operations. The DN cache is used to cache the in-memory representation of the **entryrdn** index to avoid expensive file I/O and transformation operations. For best performance, especially with but not limited to entry **rename** and **move** operations, set the DN cache to a size that enables Directory Server to cache all DNs in the database.

If a DN is not stored in the cache, Directory Server reads the DN from the **entryrdn.db** index database file and converts the DNs from the on-disk format to the in-memory format. DNs that are stored in the cache enable the server to skip the disk I/O and conversion steps.

6.3.1. Setting the Size of the DN Cache Using the Command Line

To set the DN cache size of a database using the command line:

1. Display the suffixes and their corresponding back end:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com suffix list
dc=example,dc=com (userroot)
```

   This command displays the name of the back end database next to each suffix. You require the suffix's database name in the next step.

2. Use the following command to set the DN cache size:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend suffix set --
dncache-memsize=20971520 userRoot
```

   This command sets the DN cache for the **userRoot** database to 20 megabytes.

3. Restart the Directory Service instance:

```
# dsctl instance_name restart
```

6.3.2. Setting the Size of the DN Cache Using the Web Console

To set DN cache size of a database using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select the suffix for which you want to set the DN cache size.
4. Enter the size in bytes into the **DN Cache Size (bytes)** field.
5. Click **Save Configuration**.
6. Click the **Actions** button, and select **Restart Instance**.

6.4. SETTING THE DATABASE CACHE SIZE

The database cache contains the Berkeley database index files for the database, meaning all of the ***.db** and other files used for attribute indexing by the database. This value is passed to the Berkeley DB API function **set_cachesize()**.

This cache size has less of an impact on Directory Server performance than the entry cache size, but if there is available RAM after the entry cache size is set, increase the amount of memory allocated to the database cache.

The operating system also has a file system cache which may compete with the database cache for RAM usage. Refer to the operating system documentation to find information on file system cache settings and monitoring the file system cache.

NOTE

Instead of manually setting the entry cache size Red Hat recommends the auto-sizing feature for optimized settings based on the hardware resources. For details, see Section 6.1.1, “Manually Re-enabling the Database and Entry Cache Auto-sizing” .

6.4.1. Manually Setting the Database Cache Size Using the Command Line

To manually set the database cache size using the command line:

1. Disable automatic cache tuning, and set the database cache size:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com backend config set --cache-autosize=0 --dbcachesize=268435456
```

   This command sets the database cache to 256 megabytes.

2. Restart the Directory Service instance:

```
# dsctl instance_name restart
```

6.4.2. Manually Setting the Database Cache Size Using the Web Console

To manually set the database cache size using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select **Global Database Configuration**.
4. Disable **Automatic Cache Tuning**.
5. Click **Save Configuration**.
6. Set the **Database Cache Size (bytes)** field to the database cache size.
7. Click **Save Configuration**.
8. Click the **Actions** button, and select **Restart Instance**.

6.4.3. Storing the Database Cache on a RAM Disk

If your system running the Directory Server instance has enough free RAM, you can optionally store the database cache on a RAM disk for further performance improvements:

1. Create a directory for the database cache and metadata on the RAM disk:

```
# mkdir -p /dev/shm/slapd-instance_name/
```

2. Set the following permissions on the directory:

```
# chown dirsrv:dirsrv /dev/shm/slapd-instance_name/
# chmod 770 /dev/shm/slapd-instance_name/
```

3. Stop the Directory Server instance:

```
# systemctl stop dirsrv@instance_name
```

4. Edit the **/etc/dirsrv/slapd-*instance_name*/dse.ldif** file and set the new path in the ***nsslapd-db-home-directory*** attribute in the **cn=config,cn=ldbm database,cn=plugins,cn=config** entry:

```
dn: cn=config,cn=ldbm database,cn=plugins,cn=config
...
nsslapd-db-home-directory: /dev/shm/slapd-instance_name/
```

If the ***nsslapd-db-home-directory*** attribute does not exist, add it with the new value to the **cn=config,cn=ldbm database,cn=plugins,cn=config** entry.

5. Start the Directory Server instance:

```
# systemctl start dirsrv@instance_name
```

NOTE

When the database cache is stored on a RAM disk, Directory Server needs to recreate it after each reboot. As a consequence, the service start and initial operations are slower until the cache is recreated.

CHAPTER 7. SETTING THE NUMBER OF DIRECTORY SERVER THREADS

The number of threads Directory Server uses to handle simultaneous connections affects the performance of the server. For example, if all threads are busy handling time-consuming tasks (such as **add** operations), new incoming connections are queued until a free thread can process the request.

If the server provides a low number of CPU threads, configuring a higher number of threads can increase the performance. However, on a server with many CPU threads, setting a too high value does not further increase the performance.

By default, Directory Server automatically calculates the number of threads automatically. This number is based on the hardware resources of the server when the instance starts.

NOTE

Red Hat recommends to use the auto-tuning settings. Do not set the number of threads manually.

7.1. AUTOMATIC THREAD TUNING

If you enable automatic thread tuning, Directory Server will use the following optimized number of threads:

Number of CPU Threads	Number of Directory Server Threads
1	16
2	16
4	24
8	32
16	48
32	64
64	96
128	192
256	384
512	512 [a]
1024	512 [a]

Number of CPU Threads	Number of Directory Server Threads
2048	512 [a]

[a] The recommended maximum number of threads is applied.

7.1.1. Enabling Automatic Thread Tuning Using the Command Line

Directory Server can automatically set the number of threads based on the available hardware threads. To enable this feature:

1. Enable automatic setting of the number of threads:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com config replace nsslapd-threadnumber="-1"
```

2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

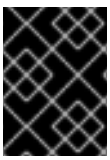
IMPORTANT

If you enabled the automatic setting of the number of threads, the ***nsslapd-threadnumber*** parameter shows the calculated number of threads while Directory Server is running.

7.1.2. Enabling Automatic Thread Tuning Using the Web Console

Directory Server can automatically set the number of threads based on the available hardware threads. To enable this feature:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. Open the **Server Settings** menu, and select **Tuning & Limits**.
4. Set the **Number Of Worker Threads** field to **-1**.
5. Click **Save**.
6. Click the **Actions** button, and select **Restart Instance**.



IMPORTANT

If you enabled the automatic setting, the **Number Of Worker Threads** field shows the calculated number of threads while Directory Server is running.

7.2. MANUALLY SETTING THE NUMBER OF THREAD

In certain situations, it can be necessary to manually set a fixed number of Directory Server threads instead of using the automatic thread tuning.

NOTE

If the number of hardware threads changes, for example, because you increased the CPU cores of the virtual machine that runs the Directory Server instance, you must manually update the number of threads. For details about using the optimized and automatic setting, see Section 7.1, “Automatic Thread Tuning”.

7.2.1. Manually Setting the Number of Threads Using the Command Line

To manually set the number of threads using the command line:

1. Set the number of threads:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com config replace nsslapd-threadnumber="64"
```

   This command sets the number of threads to **64**.

2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

7.2.2. Manually Setting the Number of Threads Using the Web Console

To manually set the number of threads using the Web Console:

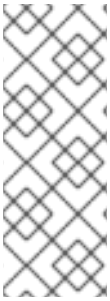
1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. Open the **Server Settings** menu, and select **Tuning & Limits**.
4. Set the **Number Of Worker Threads** field to the number of threads.
5. Click **Save**.
6. Click the **Actions** button, and select **Restart Instance**.

CHAPTER 8. TUNING THE REPLICATION PERFORMANCE

8.1. IMPROVING THE MULTI-MASTER REPLICATION EFFICIENCY

The replication latency in a multi-master replication environment, especially if the servers are connected using a wide area network (WAN), can be high in case of multiple masters are receiving updates at the same time. This happens when one master exclusively accesses a replica without releasing it for a long time. In such situations, other masters cannot send updates to this consumer, which increases the replication latency

To release a replica after a fixed amount of time, set the ***nsds5ReplicaReleaseTimeout*** parameter on replication masters and hubs.



NOTE

The **60** second default value is ideal for most environments. A value set too high or too low can have a negative impact on the replication performance. If the value is set too low, replication servers are constantly reacquiring one another and servers are not able to send many updates. In a high-traffic replication environment, a longer timeout can improve situations where one master exclusively accesses a replica. However, in most cases, a value higher than **120** seconds slows down replication.

8.1.1. Setting the Replication Release Timeout Using the Command Line

To set the replication release timeout using the command line:

1. Set the timeout value:

```
# dsconf -D "cn=Directory Manager" ldap://supplier.example.com replication set --
suffix="dc=example,dc=com" --repl-release-timeout=70
```

   This command sets the replication release timeout value for the **dc=example,dc=com** suffix to **70** seconds.

2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

8.1.2. Setting the Replication Release Timeout Using the Web Console

To set the replication release timeout using the Web Console:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. Open the **Replication** menu, and select **Configuration**.
4. Click **Show Advanced Settings**.
5. Set the timeout value in the **Replication Release Timeout** field.

6. Click **Save**.
7. Click the **Actions** button, and select **Restart Instance**.

CHAPTER 9. TUNING DATABASE LINK PERFORMANCE

Database link performance can be improved through changes to the Directory Server's connection and thread management.

9.1. MANAGING CONNECTIONS TO THE REMOTE SERVER

Each database link maintains a pool of connections to a remote server. This section describes how to optimize them.

9.1.1. Managing Connections to the Remote Server Using the Command Line

This section describes how you update the settings for a specific database, as well as the default settings.

9.1.1.1. Updating the Database Link Connection Management Settings for a Specific Database

To update the database link connection management settings for a specific database:

1. Use the following command to update a setting for a database link:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com chaining link-set
parameter=value link_name
```

   For a list of parameters you can set, enter:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com chaining link-set --help
```

2. Restart the Directory Server instance:

```
# dsctl instance_name restart
```

9.1.1.2. Updating the Default Database Link Connection Management Settings

To update the default database link connection management settings, use the following command:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com chaining config-set-def
parameter=value
```

For a list of parameters you can set, enter:

```
# dsconf -D "cn=Directory Manager" ldap://server.example.com chaining config-set-def --help
```

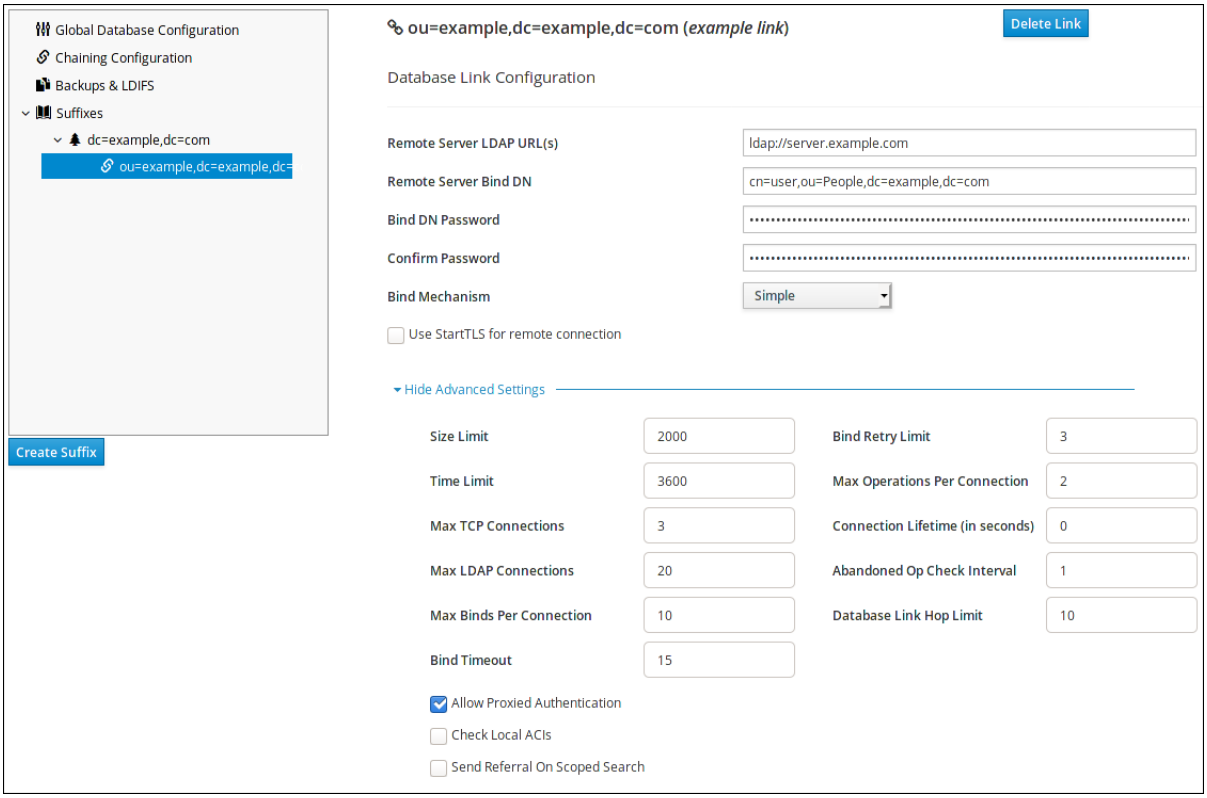
9.1.2. Managing Connections to the Remote Server Using the Web Console

This section describes how you update the settings for a specific database, as well as the default settings.

9.1.2.1. Updating the Database Link Connection Management Settings for a Specific Database

To update the database link connection management settings for a specific database:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select the database link configuration you want to update.
4. Click **Show Advanced Settings**.
5. Update the fields in the advanced settings area:



   To display a tooltip and the corresponding attribute name in the **cn=config** entry for a parameter, hover the mouse cursor over the setting. For further details, see the parameter's description in the *Red Hat Directory Server Configuration, Command, and File Reference.* .

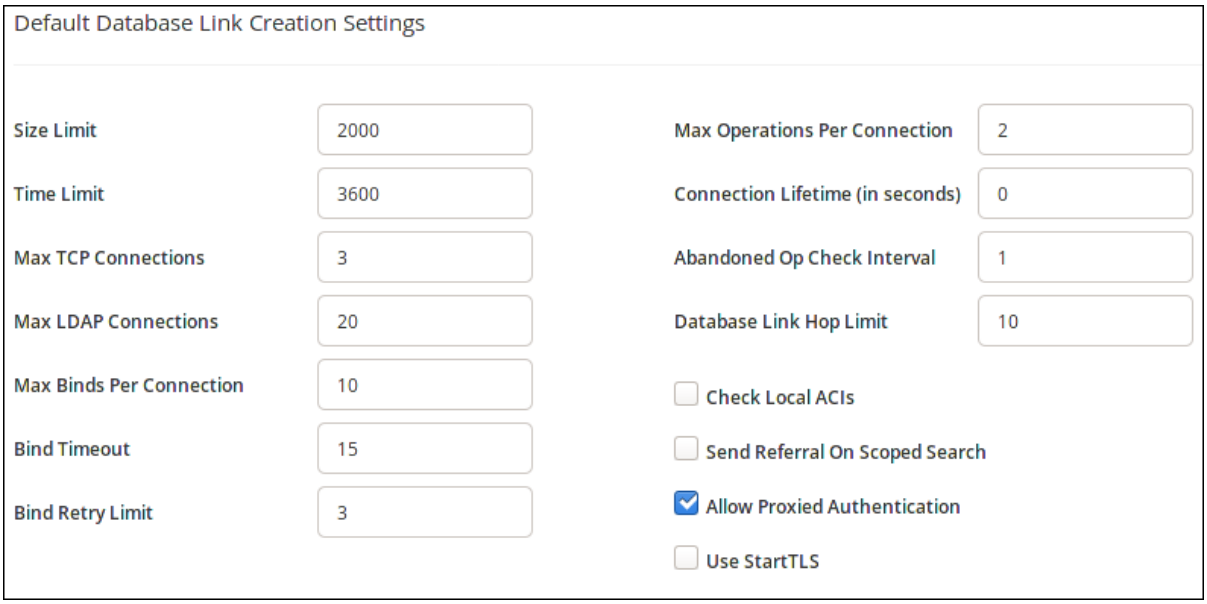
6. Click **Save Configuration**.
7. Click the **Actions** button, and select **Restart Instance**.

9.1.2.2. Updating the Default Database Link Connection Management Settings

To update the default database link connection management settings:

1. Open the Directory Server user interface in the web console. For details, see Logging Into Directory Server Using the Web Console section in the *Red Hat Directory Server Administration Guide*.
2. Select the instance.
3. On the **Database** tab, select **Chaining Configuration**.

4. Update the fields in the **Default Database Link Creation Settings** area:



   To display a tooltip and the corresponding attribute name in the **cn=config** entry for a parameter, hover the mouse cursor over the setting. For further details, see the parameter's description in the *Red Hat Directory Server Configuration, Command, and File Reference.* .

5. Click **Save Default Settings**.

6. Click the **Actions** button, and select **Restart Instance**.

9.2. DETECTING ERRORS DURING NORMAL PROCESSING

Protect server performance by detecting errors during the normal chaining operation between the database link and the remote server. The database link has two attributes — ***nsMaxResponseDelay*** and ***nsMaxTestResponseDelay*** — which work together to determine if the remote server is no longer responding.

The first attribute, ***nsMaxResponseDelay***, sets a maximum duration for an LDAP operation to complete. If the operation takes more than the amount of time specified in this attribute, the database link's server suspects that the remote server is no longer online.

Once the ***nsMaxResponseDelay*** period has been met, the database link pings the remote server. During the ping, the database link issues another LDAP request, a simple search request for an object that does not exist in the remote server. The duration of the ping is set using the ***nsMaxTestResponseDelay***.

If the remote server does not respond before the ***nsMaxTestResponseDelay*** period has passed, then an error is returned, and the connection is flagged as down. All connections between the database link and remote server will be blocked for 30 seconds, protecting the server from a performance degradation. After 30 seconds, operation requests made by the database link to the remote server continue as normal.

Both attributes are stored in the **cn=config,cn=chaining database,cn=plugins,cn=config** entry. The following table describes the attributes in more detail:

Table 9.1. Database Link Processing Error Detection Parameters

Attribute Name	Description
nsMaxResponseDelay	Maximum amount of time it can take a remote server to respond to an LDAP operation request made by a database link before an error is suspected. This period is given in seconds. The default delay period is **60** seconds. Once this delay period has been met, the database link tests the connection with the remote server.
nsMaxTestResponseDelay	Duration of the test issued by the database link to check whether the remote server is responding. If a response from the remote server is not returned before this period has passed, the database link assumes the remote server is down, and the connection is not used for subsequent operations. This period is given in seconds. The default test response delay period is **15** seconds.

CHAPTER 10. IMPROVING IMPORT PERFORMANCE

Very large entry sizes or a large number of entries can negatively impact server performance during import operations. This section describes how to tune both Directory Server settings and operating system settings to improve the import performance.

10.1. TUNING DIRECTORY SERVER FOR LARGE DATABASE IMPORTS AND IMPORTS WITH LARGE ATTRIBUTES

Update the entry cache in the following scenarios:

- You want to import a very large database.
- You want to import a database with large attributes, such as binary attributes that store certificate chains or images.

For details, about setting the size of the entry cache, see Section 6.1, “The Database and Entry Cache Auto-Sizing Feature” and Section 6.2, “Manually Setting the Entry Cache Size” .

10.2. TUNING DIRECTORY SERVER WHEN IMPORTING A LARGE NUMBERS OF ENTRIES

When you import a large number of entries, operating system settings can limit the performance of Directory Server.

- To increase the maximum number of processes temporarily, enter:

```
# ulimit -u 4096
```

- To increase the maximum number of processes permanently, see “How to set ulimit values ”.

APPENDIX A. REVISION HISTORY

Note that revision numbers relate to the edition of this manual, not to version numbers of Red Hat Directory Server.

Revision 11.0-1 **Tue Nov 05 2019** **Marc Muehlfeld**

Red Hat Directory Server 11.0 release of this guide.