Endeca® Latitude

Administrator's Guide

Version 2.2.2 Rev. A • June 2014

ORACLE

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Preface

Endeca® Latitude applications guide people to better decisions by combining the ease of search with the analytic power of business intelligence. Users get self-service access to the data they need without needing to specify in advance the queries or views they need. At the same time, the user experience is data driven, continuously revealing the salient relationships in the underlying data for them to explore.

The heart of Endeca's technology is the MDEX Engine.™ The MDEX Engine is a hybrid between an analytical database and a search engine that makes possible a new kind of Agile BI. It provides guided exploration, search, and analysis on any kind of information: structured or unstructured, inside the firm or from external sources.

Endeca Latitude includes data integration and content enrichment tools to load both structured and unstructured data. It also includes Latitude Studio, a set of tools to configure user experience features including search, analytics, and visualizations. This enables IT to partner with the business to gather requirements and rapidly iterate a solution.

About this guide

This guide describes the administrative tasks related to Endeca Latitude.

Who should use this guide

This guide is intended for system administrators who administer and maintain an Endeca Latitude implementation.

This guide assumes that the Latitude software is already installed on a development server. It may be already installed in a production environment. It also assumes that you, or your Endeca Services representatives, have already configured the application on the development server.

You can choose to read specific topics from this guide individually as needed while maintaining your Latitude implementation after it has been initially deployed.

Conventions used in this guide

This guide uses the following typographical conventions:

Code examples, inline references to code elements, file names, and user input are set in `monospace` font. In the case of long lines of code, or when inline monospace text occurs at the end of a line, the following symbol is used to show that the content continues on to the next line: ¬

When copying and pasting such examples, ensure that any occurrences of the symbol and the corresponding line break are deleted and any remaining space is closed up.

Contacting Oracle Support

Oracle Support provides registered users with important information regarding Oracle Endeca software, implementation questions, product and solution help, as well as overall news and updates.

You can contact Oracle Support through Oracle's Support portal, My Oracle Support at *https://support.oracle.com*.

Chapter 1

Introduction

This section describes the stage at which you take control of the operation and maintenance of your Endeca implementation.

Taking ownership of your Latitude implementation

As a system administrator, you take ownership of the Latitude implementation at a certain stage. This topic describes the context in which you will perform administrative tasks to maintain the stable operation of a properly functioning Latitude implementation.

This guide assumes that by this point in using the Endeca Latitude software, you or your team have done the following:

- Planned and provisioned the hardware needed for the staging and production environments.
- Installed the Endeca components, including the MDEX Engine, Latitude Studio, and Latitude Data Integrator.
- Read the *Latitude Quick Start Guide*.

  Planned the user-facing details of your application, such as the Endeca attributes that will be displayed in Latitude Studio, the search interfaces to be used in the Latitude **Search Box** component, and so on. The *Latitude Studio User's Guide* is especially useful in helping you plan your user interface.

In addition, the guide assumes that you have performed the following application-building tasks:

- You have completed the process of extracting source information from your incoming data sources.
- You have completed the process of using Latitude Data Integrator to load your configuration schema and your source the data into the MDEX Engine, thus creating the Endeca index files.
- You have created a working prototype of your Latitude Studio front-end application for your end users. This front-end application can be used to issue requests to the running MDEX Engine in a production environment.
- You have deployed your Endeca Latitude solution in a staging environment, and are either preparing to deploy it in production, or have already deployed it in production.

Overview of administrator tasks

This topic provides a brief overview of the administrator tasks described in this guide.

This guide assumes that you are performing administrator tasks on both the MDEX Engine and Latitude Studio. The types of task that are described in this guide are the following (as grouped by their chapter):

Chapter	Tasks
Using the Administration Web Service	Use the Administration Web Service for MDEX Engine administrative tasks.
Job Monitoring	Obtain information about the jobs that are being currently processed by the MDEX Engine.
Capturing Snapshots	Create snapshots of a running MDEX Engine and use them as a part of your backup and archiving strategy.
Dgraph Administrative Tasks	• Check the Dgraph with the ping command. • Manage Dgraph core dump files. • Collect debugging information to help solve problems. • Troubleshoot Dgraph socket and port errors. • Identify Dgraph connection errors.
Administrative Operations and Logging Variables	• Shut down a running MDEX Engine. • Flush the dynamic cache. • Force a query log roll. • Merge update generations and sets the system's merge policy. • Roll back a transaction that is in progress. • Check the MDEX Engine Statistics page. • Rebuild the aspell dictionary for spelling correction. • Modify the logging configuration for the MDEX Engine.
Managing the Merge Policy	• Merge update generations. • Set and manage the merge policy for the MDEX Engine.
MDEX Engine Process Management	• Create a Windows service for running the MDEX Engine in service mode. • Add an `inittab` entry so that `init` can start the MDEX Engine on a Linux machine.

Chapter	Tasks
Deploying Latitude in a Clustered Environment	Set up and manage a cluster of MDEX Engine nodes.
Using Endeca SSL Certificate Utilities	• Generate standard and custom SSL certificate files to be used for SSL connections to the MDEX Engine. • Convert PEM-format certificates to the standard Java KeyStore (JKS) format. • Configure the MDEX Engine for SSL mutual authentication.
Latitude Studio Administrative Tasks	• Perform administrative functions of Latitude Studio from the **Control Panel**. • Install a new theme. • Set up the email server for Bookmarks support.

Chapter 2

Using the Administration Web Service

This section describes how to use the Administration Web Service with the MDEX Engine.

About the Administration Web Service

The Administration Web Service enables IT engineers to administer and maintain the MDEX Engine server.

Accessing the Administration Web Service

The Administration Web Service is declared in `admin.wsdl`.

You can access the Administration Web Service at the following URL:

```
http://localhost:<port>/ws/admin
```

Using the Administration Web Service

The Administration Web Service contains administrative operations for creating a snapshot and listing running jobs.

For example `createSnapshotOperation($name, $path)` creates a snapshot of the MDEX Engine state as a tree of hard links under `$name` in directory `$path`.

Operation description

The Administration Web Service takes as its input parameters to the functions it contains and performs the requested operations.

Request

The input to the Administration Web Service depends on the function. For example:

- To create the MDEX Engine snapshot, specify a name and a directory path to the snapshot file.
- To list jobs, use the operation for listing jobs.

Response

The Administration Web Service returns:

- An `<operation successful>` response element if there are no problems.
- A `<fault>` element if an exception was thrown internally.

Operations

The Administration Web Service contains the following operations:

Operation	Description
`createSnapshotOperation`	Create a snapshot representing a consistent view of the state of the MDEX Engine at a specific point in time. As an argument, specify the name for a snapshot, such as `NewSnapshot`, and an absolute path to the snapshot directory in the URI format, such as `file:///mydirectory/home/snapshots/`.
`listJobsOperation`	List the jobs that are currently running in the MDEX Engine, such as queries, updating operations or administrative services.

Example

The following examples show the Administration Web Service request and response bodies for creating a snapshot.

To access the Administration Web Service, send a SOAP request to the following URL:

```
http://localhost:<port>/ws/admin
```

This example shows the Post body of the Administration Web Service request that creates a snapshot:

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
                    xmlns:admin="http://www.endeca.com/XQuery/admin/lib/2010">
<soapenv:Header/>
<soapenv:Body>
    <admin:Request>
        <admin:createSnapshotOperation path=
"file:///mydirectory/home/snapshots/" name="NewSnapshot"
outerTransactionId="25"/>
    </admin:Request>
</soapenv:Body>
</soapenv:Envelope>
```

This example shows the response body of the Administration Web Service request:

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/">
    <soapenv:Header/>
    <soapenv:Body>
        <admin:Response xmlns:admin="http://www.endeca.com/XQuery/admin/lib/2010">
            <admin:createSnapshotSuccess/>
        </admin:Response>
    </soapenv:Body>
</soapenv:Envelope>
```

Note: For more information about the functions used in the Administration Web Service, see the Administration API section of the *MDEX Engine API Reference*.

Chapter 3

Job Monitoring

This section describes how you, as a system administrator, can use the Administration Web Service to obtain information about, monitor, and control long-running jobs in the MDEX Engine - for example, updates or long-running queries.

About job monitoring

In many instances, it is useful to have more information about the jobs that are being currently processed by the MDEX Engine.

When the MDEX Engine processes record updates, all other operations are temporarily stopped, waiting for the update operations to complete, and then restarted after the updates are finished. In such instances a system administrator needs to have more information about which operations are currently being processed by the MDEX Engine.

When administering an MDEX Engine, it is useful to manage long-running jobs in the following scenarios:

- The data architect updates the configuration, for example by issuing a request to make an attribute (in your records schema) value searchable, and the MDEX Engine becomes unresponsive because it is running an update operation. The data architect can make a request to see when the MDEX Engine had started running the update.
- An administrator of the Endeca application sends a query to the MDEX Engine and the MDEX Engine becomes unresponsive because it is already running a long-running query. The administrator can make a request to see when the MDEX Engine had started processing the query.
- An administrator of the Endeca application would like to send an update and needs to verify whether any other updates are already being processed or are queued up before submitting a new update. Making an Administration Web Service request allows the administrator to understand whether a new update will begin processing immediately.
- An administrator of the Endeca application wants to check which updates have been submitted recently.

About jobs

You can monitor several types of jobs.

You can monitor the following types of jobs:

- A query. This can be any type of a web service request that submits a query to the MDEX Engine.

- An update. This is an update to the records sent by any MDEX Engine web services (and not the Bulk Ingest Interface).
- An administrative operation. This can be a request for any administrative operation.

Requesting a list of jobs

Using the `listJobsOperation` of the Administration Web Service, you can make a job monitoring request for a list of jobs that are currently being processed by the MDEX Engine or are waiting in the queue.

To issue a job monitoring request:

1. Specify the `listJobsOperation` to the Administration Web Service, as in the following example:

```
<admin:request xmlns:admin="http://www.endeca.com/MDEX/admin/2010>
                <admin:listJobsOperation/>
</admin:request>
```

The response contains a list of currently running jobs, and includes the following information:

- The job ID. This is an internal ID assigned by the MDEX Engine.
- The job start time. It indicates the time at which the MDEX Engine received a request for this job, and has an outstanding request for processing it. The start time does not indicate that the job had actually started at that time.
- Job type. The job type indicates the type of job that is being monitored. It can be `Admin`, `Query`, or `Update`.

Example

In this example of the Administration Web Service response, you can see that a query with the job ID 10 is currently running. You can also observe its start time. In addition, the response indicates that a request of type `Admin` has been issued as well, with the Job ID 11 (this job represents the job monitoring request itself).

```
<admin:response xmlns:admin="http://www.endeca.com/MDEX/admin/2010">
  <admin:jobs>
    <admin:job jobId="10">
      <admin:startTime>2011-04-18T10:26:41.449Z</admin:startTime>
      <admin:jobType>Query</admin:jobType>
    </admin:job>
    <admin:job jobId="11">
      <admin:startTime>2011-04-18T10:26:41.449Z</admin:startTime>
      <admin:jobType>Admin</admin:jobType>
    </admin:job>
  </admin:jobs>
</admin:response>
```

Chapter 4

Capturing Snapshots

You can create snapshots of a running MDEX Engine and use them as a part of your backup and archiving strategy. This section describes the snapshot process.

About snapshots

A snapshot represents a consistent view of the state of the MDEX Engine index at a specific point in time. By taking a snapshot, you can capture the state of the index without shutting down the MDEX Engine.

Snapshots operate at the data layer level of the MDEX Engine index. The data layer implements a versioned data store in the MDEX Engine index, which includes a collection of files such as data structures and indices. When you create a snapshot, the data layer identifies the set of files that comprise a version, and captures the state of the system as it exists at that moment.

A backup operation without taking the snapshot would involve the need to stop the MDEX Engine and copy its index, which can take a long time. In contrast, you can create a snapshot while the MDEX Engine is handling updates and queries, without downtime. After a snapshot is complete, you can plan and create a backup at your convenience.

A snapshot contains all the files needed to restore the MDEX Engine to a specific state.

To create a snapshot, you issue a request to the MDEX Engine through `createSnapshotOperation` in the Administration Web Service. In a cluster of MDEX Engine nodes, this operation should be performed on the leader node only.

After you take the snapshot, you can back up the state in a manner compatible with your archiving strategy, whether you have an elaborate backup infrastructure or a simpler solution based on CIFS or NFS protocols.

If the need arises, you can restore an MDEX Engine from a snapshot with the `cpmdex` command.

Important: Because snapshots represent internal files needed to restore the MDEX Engine data structures, they are not human-readable and should be treated as read-only. Modifying a snapshot can corrupt the MDEX Engine.

Restrictions for taking a snapshot

The following restrictions apply when taking snapshots.

- The `createSnapshotOperation` cannot be combined with other operations in the same Web service request.
- Do not submit snapshot requests when the MDEX Engine is running updates.
- Do not submit snapshot requests when the MDEX Engine is running a transaction request issued by the Transaction Web Service (or a component in LDI for starting a transaction).
- The `createSnapshotOperation` requires a URI absolute path indicating where the snapshot should be recorded; it should have the following format: `file:///localdisk/username/dir`. Specifying a relative path causes the operation to fail.
- If you are running a cluster of MDEX Engine nodes (as opposed to running the MDEX Engine on a single server that is not part of the cluster), run the `createSnapshotOperation` on the leader node.
- Do not modify snapshot files. Because snapshots represent internal files needed to restore the MDEX Engine data structures, they are not human-readable and should be treated as read-only. Modifying a snapshot can corrupt the MDEX Engine.

Creating a snapshot

You create a snapshot with the `createSnapshotOperation` interface in the Administration Web Service.

Before taking the snapshot, ensure that you have reviewed the list of restrictions.

To create a snapshot:

1. Run the client application that will invoke the Administration Web Service.
2. Specify the `snap_URI` and the `snap_name` in the following XML snippet:

   ```
   <admin:createSnapshotOperation path="${snap_URI}" name="${snap_name}"/>
   ```

   - `snap_URI` represents an absolute URI path to the file system location, and is located on the same file system as the MDEX Engine. It should be of the format `file:///localdisk/username/dir`.
   - `snap_name` represents the name of the snapshot.

   The Web service returns a confirmation message if the snapshot was successfully captured.

   Note: You should treat snapshots as read-only. Modifying a snapshot could corrupt your running MDEX Engine.

After you capture the snapshot, copy it to a safe location using the archiving method of your choice. Deleting a snapshot does not affect the MDEX Engine.

Restoring an MDEX Engine from a snapshot

You can restore an MDEX Engine from an archived snapshot using the `cpmdex` command. The command copies files from the archived snapshot into the index of the MDEX Engine.

The MDEX Engine `bin` directory contains `cpmdex.cmd` (Windows) and `cpmdex.sh` (Linux) versions of this command.

The **`cpmdex`** command takes as input the path to the archived snapshot and the path to the MDEX Engine instance which will be restored.

Important: Before running the **`cpmdex`** command, use `dgraph --version` to ensure that the version of MDEX Engine index to which you are restoring from the snapshot matches the version of the MDEX Engine index from which the snapshot was captured.

To restore the MDEX Engine index from a snapshot:

1. Stop the MDEX Engine that are you are about to restore using `/admin?op=exit`.

   If you are running multiple MDEX Engine instances in a cluster, stop all MDEX Engine nodes.
2. From a command prompt, run the **`cpmdex`** command.

   If you are restoring the MDEX Engine index in a cluster, run this command on a leader node.

   An example on Windows is:

   ```
   cpmdex -a backup\2010-07-20 -m endeca\myapp\my_mdex
   ```

   An example on Linux is:

   ```
   $ cpmdex.sh -a mnt/backup/2010-07-20 -m home/endeca/myapp/my_mdex
   ```
3. Start the MDEX Engine.

cpmdex syntax

This topic contains syntax for the **`cpmdex`** command.

The syntax for the **`cpmdex`** command is as follows:

```
cpmdex -a <archive_path> -m <mdex_path> -t <transfer_path>
```

The **`cpmdex`** command uses the following parameters:

Options	Description
`-a <archive_path>`	Required. The absolute file path to the directory containing the archived snapshot.
`-m <mdex_path>`	Required. The absolute file path to the directory where the snapshot should be restored. The end of this path should match the value passed to the Dgraph executable when it is started.

Options	Description
`-t <transfer_path>`	The file path to a directory to which the snapshot should be moved. This option uses a move operation, instead of a copy, to restore the files to the MDEX Engine. You may want to use this option if the backup has already been copied from the archive to the local file system and you want to save considerable I/O bandwidth.
`-h`	The help for this command.

In this example, the **cpmdex** command copies the snapshot from the `backup\2011-03-20` directory and restores it to the `endeca\myapp\my_mdex` directory on Windows:

```
cpmdex -a backup\2011-03-20 -m endeca\myapp\my_mdex
```

Chapter 5

Dgraph Administrative Tasks

This section describes some basic administrative tasks for the Dgraph. In addition, it contains Dgraph troubleshooting tips and describes the Dgraph logs.

Checking the Dgraph with the ping command

A quick way of checking the health of a Dgraph is to ping it.

To check the aliveness of a Dgraph:

1. Issue the following command:

   ```
   http://<DgraphServerNameOrIP:DgraphPort>/admin?op=ping
   ```

   It returns a lightweight HTML response page with the following content:

   ```
   dgraph <host:port> responding at <date/time>
   ```

Note: You can also view the MDEX Engine Statistics page to check whether the MDEX Engine is running and accepting queries.

About connecting Web browsers to your MDEX Engine

For security reasons, you should never allow user Web browsers to connect directly to your MDEX Engine server (although an administrator may choose to connect directly to the MDEX Engine server using proper precautions).

Browsers started by non-administrators should always connect to your application through an application server.

IPv4 and IPv6 address support

The MDEX Engine supports both IPv4 (Internet Protocol Version 4) and IPv6 (Internet Protocol Version 6) addressing schemes for connections. This IPv4 and IPv6 addressing support is configured automatically in the MDEX Engine, so there is no need for the administrator to do any explicit addressing configuration.

Managing Dgraph core dump files

In the rare case of a Dgraph crash, the Dgraph writes its core dump files on disk.

When the Dgraph runs on a very large data set, its in-memory representation of the index size may exceed the size of the physical RAM. If such a Dgraph process fails, it may need to write out potentially very large core dump files on disk.

To troubleshoot the Dgraph, it is often useful to preserve the entire set of core files written out as a result of such failures. When there is not enough disk space, only a portion of the files is written to disk until this process stops. Since the most valuable troubleshooting information is contained in the last portion of core files, to make these files meaningful for troubleshooting purposes, it is important to provision enough disk space to capture the files in their entirety.

Two situations are possible, depending on your goal:

- To troubleshoot a Dgraph crash, provision enough disk space to capture the entire set of core files. In this case, the files will be saved at the expense of potentially filling up the disk.
- To prevent filling up the disk, you can limit the size of these files on the operating system level. In this case, with large Dgraph applications, only a portion of core files is saved on disk. This may limit their usefulness for debugging purposes.

Managing Dgraph crash dump files on Windows

Managing Dgraph core dump files on Linux

Managing Dgraph crash dump files on Windows

On Windows, all Dgraph crash dump files are saved on disk by default.

The MDEX Engine uses the `MiniDump` function from the Microsoft `DbgHelp` library.

Provision enough disk space to accommodate core files based on this estimate:

- The projected upper limit for the size of these files is equal, at a maximum, to the size of the physical memory used by the MDEX Engine plus index size. Often the files take up less space than that.

Managing Dgraph core dump files on Linux

Endeca recommends using the `ulimit -c unlimited` setting for Dgraph core dump files. Non-limited core files contain all Dgraph data that is resident in memory (RSS of the Dgraph).

Since large MDEX applications may take up the entire amount of available RAM, the core dump files can also grow large and take up the space equal to the size of the physical RAM on disk plus index size.

Provision enough disk space to accommodate core files based on this estimate:

- The projected upper limit for the size of these files should be equal, at a maximum, to the size of the physical RAM. Often the files take up less space than that.

Note: If you are not setting `ulimit -c unlimited`, you could be seeing the MDEX Engine crashes that do not write any core files to disk, since on some Linux installations the default for `ulimit -c` is set to 0.

Alternatively, it is possible to limit the size of core files with the `ulimit -c <size>` command, although this is not recommended. If you set the limit size in this way, the core files cannot be used for debugging, although their presence will confirm that the Dgraph had crashed. To be able to troubleshoot the crash, change this setting to `ulimit -c unlimited`, and reproduce the crash while capturing the entire core file. Similarly, to enable Endeca Support to troubleshoot the crash, you will need to reproduce the crash while capturing the full core file.

Collecting debugging information

Before attempting to debug an issue with the MDEX Engine, collect the following information.

- Hardware specifications and configuration.
- Description of the Endeca topology (servers, number of Dgraphs).
- The data from the MDEX Engine Statistics page.
- The contents of the pipeline directory.
- Dgraph input.
- Partial update files.
- Description of typical partial updates.
- Description of which Dgraphs are affected.

Logs created by the Dgraph

Logs created by the Dgraph

The Dgraph creates several logs, although some of these logs depend on your implementation and the Endeca components that you may be using. This topic provides a summary of these logs.

You can use these Dgraph logs to troubleshoot MDEX Engine queries, or to track performance of particular queries or updates.

Dgraph request log

The Dgraph request log is always created. You can use it to debug both requests and update processing. It contains one entry for each request processed. The requests are sorted by their timestamp.

If you are using the Dgraph from the command line, create the path to the request log in the Dgraph working directory with the filename `dgraph.reqlog`.

By default, the Dgraph truncates the contents of the body for POST requests at 64K. This default setting saves disk space in the log, especially during the process of adding large numbers of records to the MDEX Engine. If you need to review the log for the full contents of the POST request body, contact Endeca Support.

Dgraph error log

The Dgraph error log is created only if you redirect `stderr` to a file, using a command line or a `dgraph --out` flag. Otherwise, error messages appear in `stderr`.

The Dgraph error log includes startup messages as well as warning and error messages. It can be configured via Dgraph flags (such as `-v`). Also, the `/admin?op=logroll` command forces a query log roll, with the side effect of remapping `stdout`.

Troubleshooting socket and port errors with Dgraph

The Dgraph cannot start if its process cannot bind to a socket and its port cannot initialize. This error tends to occur when you upgrade the MDEX Engine and attempt to use a port that is already occupied by another process on your server.

The following errors appear in the Dgraph log:

```
ERROR (date and time)
DGRAPH {dgraph,baseline}: Unable to bind
to socket [err=`Result too large',errno=34]
FATAL (date and time)
DGRAPH {dgraph,baseline}: Unable to initialize the
main server port: 8000
```

The `"Unable to bind to socket"` errors usually indicate that the port in question is already in use by another process.

The Windows command-line utility `netstat -ano` lists all ports in use along with the process ID of the process using them. Use this utility to identify the process ID occupying port 8000, and locate that process in the Windows Task Manager to confirm that it is used by another process. This prevents the Dgraph from starting.

To identify ports in use on your Windows system:

1. Run `netstat -ano`

   This command lists ports and process IDs of all processes that are running.
2. Examine which process occupies the port that the Dgraph is trying to use. In this example, it is port 8000.
3. Run the Dgraph on another port, or ensure that the previously occupied port can be freed to be used by the MDEX Engine.

Running multiple Dgraphs on the same Windows machine

If you have more than one Dgraph starting on a single Windows machine, each Dgraph constructs its port in isolation.

This prevents multiple Dgraphs running on a single machine from presenting inconsistent behavior.

Troubleshooting baseline update failures

To debug baseline update failures, examine the Dgraph request log.

Review the logs around the time of the baseline update failure, to rule out issues in the Dgraph.

Notice the times when health checks were sent to the Dgraph, the Dgraph was restarted, the partial updates were issued, and the last query was issued. For example, this modified abstract from the Dgraph request log shows activity for a period of time:

```
12096521815/1/09 14:29 last search query
12096522265/1/09 14:30 health check
12096526095/1/09 14:36 last health check for x time
12096571605/1/09 15:52 health checks resume
12096574435/1/09 15:57 last empty health check
12096601195/1/09 16:41 Dgraph startup
12096601435/1/09 16:42 first query
```

Notice that the Dgraph did not receive any requests besides health checks for a period of time from 14:29 to 15:57. The log does not include error messages. The Dgraph was not restarted during this time. These observations indicate that the problem that led to the baseline update failure in this example possibly occurred outside of the Dgraph.

Identifying connection errors

If the Dgraph standard out log contains `connection broken` messages, although it may look like the problem occurred with the Dgraph, the actual cause of the problem is usually a broken connection between the server that hosts the front-end application and the server that hosts the Dgraph.

In the case of connection errors, various parts of the Endeca implementation issue the following error and warning messages:

- The Dgraph standard out log contains warnings similar to the following:

  ```
  WARN [DATE TIME] UTC (1239830549803)
  DGRAPH {dgraph}: Aborting request: connection broken: client 10.10.21.21
  ```

- And finally, the Dgraph request log contains an abnormal `status 0` message similar to the following:

  ```
  1239830549803 10.6.35.35 - 349 0 19.35 0.00 0 - 0 0 - -
  ```

Typically, the `connection broken` message means that the Dgraph encountered an unexpected failure in the connection between the client and the Dgraph. This type of error may occur outside the Dgraph, such as in the network, or be caused by the timeout of the client application session.

Investigate the connection between the client and the Dgraph. For example, to prevent timeouts of the client application sessions, you may decide to implement front-end application retries.

Chapter 6

Administrative Operations and Logging Variables

The MDEX Engine supports many administrative and configuration operations that you can access through simple URLs. You can use these operations and their logging variables to control the behavior of the MDEX Engine cleanly from within the system.

About administrative and configuration operations

Administrative and configuration operations make it possible to check Dgraph statistics, and enable or disable diagnostic flags without having to stop a running Dgraph. They also let you stop and restart the Dgraphs. This section lists URLs exposed by the Dgraph, describes the functions of each URL, and defines the syntax of those URLs.

The syntax of administrative and configuration operations

In the following listings, `<host>` refers to the hostname or IP address of the MDEX Engine and `<port>` refers to the port on which the MDEX Engine is listening. Queries to these URLs are handled in the MDEX Engine's request queue like any other request—that is, they are handled on a first-come, first-served basis. They are also reported in the MDEX Engine request log like any other request.

For administrative operations, the syntax is:

```
http://<host>:<port>/admin?op=<supported-operation>
```

For configuration operations, the syntax is:

```
http://<host>:<port>/config?op=<supported-operation>
```

Note: If you are using HTTPS mode, use `https` in the URL.

List of administrative operations

Administrative (or admin) operations listed in this topic allow you to control the behavior of the MDEX Engine from within the system.

The MDEX Engine recognizes the following admin operations:

Admin operation	Description
`/admin?op=exit`	Shuts down a running MDEX Engine after completing all in-progress requests and background merges. You can also specify an optional timeout limit that immediately shuts down the MDEX Engine if the shutdown operation takes longer than the specified timeout limit.
`/admin?op=flush`	Specifies when the MDEX Engine should flush its dynamic cache.
`/admin?op=help`	Returns the usage page for all of the admin operations.
`/admin?op=logroll`	Forces a query log roll, with the side effect of remapping `stdout`.
`/admin?op=merge`	Merges update generations and sets the system's merge policy.
`/admin?op=ping`	Checks the aliveness of an MDEX Engine and returns a lightweight message.
`/admin?op=reload-services`	A Web services operation that reloads the application's main and library modules.
`admin?op=rollback&outerTransactionId="myID"`*`ID`*	In case a running transaction with the specified ID fails, this operation lets you roll back to the previously committed version of the MDEX Engine index and stop the transaction.
`/admin?op=stats`	Returns the MDEX Engine Statistics page.
`/admin?op=statsreset`	Resets the MDEX Engine Statistics page.
`/admin?op=updateaspell`	Rebuilds the aspell dictionary for spelling correction from the data corpus while continuing to issue queries and partial updates to the MDEX Engine and without stopping and restarting it.

exit

flush

help

logroll

exit

`/admin?op=exit` gracefully shuts down a running MDEX Engine.

The `/admin?op=exit` command has two formats:

- The base version does not use the `timelimit` option.
- The timeout version uses the `timelimit` option.

Using the base version

The format of the base version is:

```
/admin?op=exit
```

The `exit` operation works as follows:

- Any new non-admin request will get an HTTP response code 503 (Service Unavailable).
- Any in-progress request will finish normally (including updates).
- The MDEX Engine will wait to exit until the following conditions have been met:
  - All requests have finished (including updates).
  - All background merging has been completed.

The `exit` operation's output to the browser looks similar to the following:

```
Dgraph admin, OK
Dgraph shutting down at Thu Feb 17 13:12:54 2011
```

The command also writes shutdown information to the Dgraph error log, as in this example:

```
Shutdown request with received at Thu Feb 17 13:12:54 2011.
Shutdown will complete when all outstanding jobs are complete.
All dgraph transactions completed at Thu Feb 17 13:12:54 2011, exiting normally (pid=4128)
```

The base `exit` operation is the recommended way to shut down the MDEX Engine because it gracefully completes all transactions and exits cleanly. However, note that because the MDEX Engine waits until all background merging has completed, the shutdown process could potentially take several hours if the request occurs during a major merge. Therefore, if the speed of the shutdown is more important than the completing a merge, you should consider using the `timelimit` option to set a time limit for the shutdown operation.

Using the timelimit option

The timeout version lets you specify a time limit, in seconds, of the shutdown procedure. The format of the timeout version is:

```
/admin?op=exit&timelimit=seconds
```

where *seconds* is a positive integer.

This example uses a time limit of 30 seconds:

```
/admin?op=exit&timelimit=30
```

The `exit&timelimit` operation works as follows:

- A time limit of 0 (zero) will shut down the MDEX Engine immediately.
- Any queries still in progress when the time limit is reached will not return a result to the client (i.e., the client will observe a closed connection).
- Any queries still in progress when the time limit is reached will not be logged in the Dgraph log.
- Any updates still in progress when the time limit is reached will not be applied.
- Any background merges still in progress when the time limit is reached will be aborted at the end of the timeout.
- The number of in-progress queries is written to the Dgraph error log just before exiting, along with a message stating that the shutdown time limit was reached.

Issuing an `exit` command with a time limit ensures that the MDEX Engine shuts down within that time limit, regardless of prior or following `exit` queries (i.e., `exit` commands with a time limit can only shorten the MDEX Engine's time to live). These examples demonstrate what happens when successive `exit` commands are issued:

- If `exit&timelimit=30` is issued and 10 seconds later `exit&timelimit=0` is issued, the MDEX Engine will exit immediately when the second request is issued (if it hasn't already exited).
- If `exit&timelimit=30` is issued and 10 seconds later `exit&timelimit=5` is issued, the MDEX Engine will exit 5 seconds after the second request, or when all queries are drained (whichever comes first).
- If `exit&timelimit=30` is issued and 10 seconds later `exit&timelimit=30` is issued, the MDEX Engine will exit 30 seconds after the first request, or when all queries are drained (whichever comes first).
- If `exit&timelimit=30` is issued and 10 seconds later the base `exit` command is issued, the MDEX Engine will exit 30 seconds after the first request, or when all queries are drained (whichever comes first).
- If `exit` is issued and 10 seconds later `exit&timelimit=30` is issued, the MDEX Engine will exit 30 seconds after the second request, or when all queries are drained (whichever comes first).

An `exit&timelimit=30` operation's output to the browser looks like this:

```
Dgraph admin, OK
Dgraph shutting down within 30 seconds at Thu Feb 17 14:09:38 2011
```

The command also writes shutdown information to the Dgraph error log, as in this example for an `exit&timelimit=30` command:

```
Shutdown request with time limit of 30 seconds received at Thu Feb 17 14:09:38 2011.
Shutdown will complete when all outstanding jobs are complete, or within 30 seconds, whichever
happens earlier.
All dgraph transactions completed at Thu Feb 17 13:12:54 2011, exiting normally (pid=4128)
```

If command were for an immediate shutdown (`exit&timelimit=0`) and queries were still in progress, the Dgraph error log would contain a message similar to this example:

```
Shutdown request with time limit of 0 seconds received at Thu Feb 17 14:18:46 2011.
Shutdown will complete when all outstanding jobs are complete, or within 0 seconds, whichever
happens earlier.
Shutdown time limit reached at Thu Feb 17 14:18:46 2011, exiting with jobs still in progress:
1 request is still active or queued, and will not be logged to the request log
1 job is currently executing, and will be killed.
0 jobs are queued, and will not be executed.
```

flush

`/admin?op=flush` flushes the Dgraph cache.

The `flush` operation clears all entries from the Dgraph cache. It returns the following message:

```
flushing cache...
```

help

`/admin?op=help` returns the usage page for all of the administrative operations.

logroll

`/admin?op=logroll` forces a query log roll, with the side effect of remapping `stdout`.

The `logroll` command returns a message similar to the following:

```
rolling log... Successfully remapped stdout/stderr to specified
path "C:\Endeca\apps\JanWine\logs\dgraphs\Dgraph2\Dgraph2.log".
Successfully rolled log file.
```

merge

`/admin?op=merge` forces a merge, and (optionally) changes the merge policy of a running MDEX Engine. In a cluster of MDEX Engine nodes, this command should be used on the leader node only.

Managing the Merge Policy

ping

`/admin?op=ping` checks the aliveness of an MDEX Engine and returns a lightweight message.

You can view the MDEX Engine Statistics page to check whether the MDEX Engine is running and accepting queries, but that comes with some overhead. A quicker way to check the aliveness of a Dgraph is by running the `ping` command.

Because ping requests are given the highest priority and are processed synchronously (as they are received), a ping response time is independent of the number of outstanding requests in the MDEX Engine.

The `ping` command returns a lightweight page that lists the MDEX Engine, the current date and time, such as the following:

```
dgraph example.endeca.com:8000 responding at Wed Oct 27 15:35:27 2010
```

You can use this operation to monitor the health or heartbeat of the MDEX Engine, and as a health check for load balancers.

reload-services

`/admin?op=reload-services` is a Web services operation that reloads the application's main and library modules.

The `admin?op=reload-services` operation causes the Dgraph to process all existing preceding queries, temporarily stop processing other queries and begin to process `admin?op=reload-services`. After it finishes processing this operation, the Dgraph resumes processing queries that queued up temporarily behind this request.

In a cluster of MDEX Engine nodes, this command should be run on the leader node only.

Note: `admin?op=reload-services` can be a time-consuming operation.

rollback

The `admin?op=rollback` operation is useful in operational environments that use transactions. In case a running transaction fails, this operation lets you roll back to the previously committed version of the MDEX Engine index and commit the transaction.

Since transactions are recommended when you run updates in a cluster, the `admin?op=rollback` operation is a useful tool for using on the leader node in the cluster, in the context of controlling the results of an outer transaction that may be running on the leader node.

Instead of running this command directly, the most convenient way to utilize this command is through a Latitude connector in LDI, **Transaction RunGraph**. This connector starts an outer transaction, and allows adding sub-graphs or other connectors inside this outer transaction. In case of failures, you can specify options to the **Transaction RunGraph** connector. One of the options is **Rollback**. This option runs the `admin?op=rollback` command on the node on which a transaction is open, referencing the transaction ID. This ensures that all actions from all sub-graphs or components that were part of the **Transaction RunGraph** project are rolled back and not committed to the MDEX Engine index, and that the transaction is committed.

The following statements describe the `admin?op=rollback` command:

- Use this command only if an outer transaction has been started on the node, referencing a transaction ID, as in the following example:

  ```
  admin?op=rollback&outerTransactionId=43
  ```

  Note: The transaction ID can be either specified to the Transaction Web Service when you start a transaction, or, if you don't specify it, the Web Service generates the ID automatically. Also, if you are using the **Transaction RunGraph** connector for running transactions, this connector automatically uses the ID string `"transaction"`.

- If you issue this command with the transaction ID that does not match the ID of the currently running transaction, the error message notifies you of the transaction ID that is in progress.
- If you issue this command and no outer transaction has been started, the command issues an error but not a fatal one — it returns with an HTTP 200 code (success), with an error message similar to the following example:

  ```
  Dgraph admin, OK. Dgraph Cannot roll back outer transaction
  ```

```
My_transaction at Mon Sep 19 11:16:09 2011
(11:17:21 AM)
```

- If you are not using this command in the context of LDI and are using it directly, you can issue it at any point during a running outer transaction on the node on which the transaction is open. Once issued, this command ensures operations running within the transaction are rolled back to the index state prior to when the transaction was started. This command also stops the transaction.
- If you are running a cluster of MDEX Engine nodes, issue this command on the leader node only. This command is rejected if you attempt to run it on any other node.

  Once the command completes, it stops the outer transaction, and the leader resumes serving queries on the last version of the index available before the start of the outer transaction.
- Only one `admin?op=rollback` operation can be processed at a time.

stats

`/admin?op=stats` returns the MDEX Engine Statistics page.

The MDEX Engine Statistics page provides a detailed breakdown of what the Dgraph is doing, and is a useful source of information about your Endeca implementation's configuration and performance. It provides information such as startup time, last data indexing time, and indexing data path. This lets you focus your tuning and load-balancing efforts. By examining this page, you can see where the Dgraph is spending its time. Begin your tuning efforts by identifying the features on the **Details** tab Hotspots section with the highest totals.

statsreset

`/admin?op=statsreset` resets the MDEX Engine Statistics page.

The `statsreset` operation returns the following message:

```
resetting server stats...
```

updateaspell

The `admin?op=updateaspell` administrative operation lets you rebuild the aspell dictionary for spelling correction from the data corpus while continuing to issue queries and updates to the MDEX Engine and without stopping and restarting it.

Run this command after you have added data records to the MDEX Engine, to enable spelling correction in the MDEX Engine.

During the data ingest process, you can run the `admin?op=updateaspell`command periodically to update the spelling dictionary used by the MDEX Engine for Automatic Spelling Correction and DYM.

In a cluster of MDEX Engine nodes, this command should be run on the leader node only.

The `admin?op=updateaspell` operation performs the following actions:

- Crawls the text search index for all terms which meet the constraint settings.

  The constraint settings include minimum word occurrences and maximum and minimum number of characters, for records and attribute values. The MDEX Engine uses these constraints to update the spelling dictionary. You can change them in the Global Configuration Record.
- Compiles a temporary text version of the `aspell` word list, `<db_prefix>.worddat`.

- Converts this word list to the binary format required by `aspell`
- Writes the generated binary file into the current index representation in the MDEX Engine.
- Makes the updated `aspell` spelling dictionary available in the MDEX Engine for processing of all queries arriving after this index update. The MDEX Engine uses this updated dictionary when processing all future queries.

Note: Because of the nature of continuous query, once the MDEX Engine processes this administrative request, it will start using the updated spelling dictionary after a certain point in its processing, and all newly incoming queries will be answered against the updated spelling dictionary. However, it is not possible to identify after which particular partial update or after which query the MDEX Engine will start using the newly updated spelling dictionary.

The Dgraph applies the updated settings while continuing to run queries and without needing to restart.

Only one `admin?op=updateaspell` operation can be processed at a time.

Note: If `admin?op=updateaspell` is started within a transaction, it must reference a transaction ID, as in the following example:

```
admin?op=updateaspell&outerTransactionId=42
```

The `admin?op=updateaspell` operation returns output similar to the following in the Dgraph error log:

```
...
spellengine aspell ran successfully.
```

If you start the Dgraph with the `-v` flag, the output also contains a line similar to the following:

```
Time taken for updateaspell, including wait time on any
previous updateaspell, was 290.378174 ms.
```

About MDEX Engine logging variables

You can use logging variables with config operations. This lets you obtain detailed information about Dgraph processing, to help diagnose unexpected application behavior or performance problems, without stopping and restarting the Dgraph or requiring a configuration update.

Although you can also specify general verbose logging at the Dgraph command line with the `-v` flag, it requires a Dgraph restart to take effect.

Logging variable operation syntax

List of configuration operations

List of supported logging variables

Logging variable operation syntax

MDEX Engine logging variables are toggled using the `/config?op=log-enable&name=<variable-name>` and `/config?op=log-disable&name=<variable-name>` operations.

You can include multiple logging variables in a single request. Unrecognized logging variables generate warnings.

For example, this operation:

```
/config?op=log-enable&name=requestverbose
```

turns on verbose logging for queries, while this operation:

```
config?op=log-enable&name=textsearchrelrankverbose&name=textsearchspellverbose
```

turns on verbose logging for both the text search relevance ranking and spelling features.

However, this operation:

```
config?op=log-enable&name=allmylogs
```

returns an `unsupported logging setting` message.

In addition, the following operations are supported:

- `/config?op=log-status` returns a list of all logging variables with their values (true or false).
- The special name `all` can be used with `/config?op=log-enable` or `/config?op=log-disable` to set all logging variables.

List of configuration operations

Configuration (or config) operations listed in this topic allow you to modify configuration and logging information for the MDEX Engine from within the system.

The Dgraph recognizes the following config operations:

Config operation	Description
`/config?op=help`	Returns the usage page for all of the config operations.
`/config?op=log-enable`	Enables verbose logging for one or more specified variables.
`/config?op=log-disable`	Disables verbose logging for one or more specified variables.
`/config?op=log-status`	Returns verbose logging status.

List of supported logging variables

The following table describes the supported logging variables that you can use with related config operations to toggle logging verbosity for specified features.

Logging variable names are not case sensitive.

Variable	Description
`verbose`	Enables verbose mode.
`requestverbose`	Prints information about each request to `stdout`.
`updateverbose`	Show verbose messages while processing updates.

Variable	Description
`recordfilterperfverbose`	Enables verbose information about record filter performance.
`textsearchrelrankverbose`	Enables verbose information about relevance ranking during search query processing.
`textsearchspellverbose`	Enables verbose output for spelling correction features.
`dgraphperfverbose`	Enables verbose performance debugging messages during core Dgraph navigation computations.
`dgraphrefinementgroupverbose`	Enables refinement verbose/debugging messages.

log-enable

log-disable

log-status

help

log-enable

The `log-enable` operation lets you turn on verbose logging.

You can include multiple logging variables in a single request. Unrecognized logging variables generate warnings.

For example, this operation:

```
/config?op=log-enable&name=requestverbose
```

turns on verbose logging for queries, while this operation:

```
config?op=log-enable&name=textsearchrelrankverbose&name=textsearchspellverbose
```

turns on verbose logging for both the text search relevance ranking and spelling features.

However, this operation:

```
config?op=log-enable&name=allmylogs
```

returns an "Unsupported logging setting" message.

log-disable

The `log-disable` operation turns off verbose logging.

`/config?op=log-disable` with no arguments returns the same output as `log-status`.

log-status

The `log-status` operation returns a list of all logging variables with their values (true or false).

For example, if you have enabled verbose logging on two of the features, you would see a message similar to the following:

```
Logging settings:

verbose - FALSE
requestverbose - TRUE
updateverbose - FALSE
recordfilterperfverbose - FALSE
textsearchrelrankverbose - TRUE
textsearchspellverbose - FALSE
dgraphperfverbose - FALSE
dgraphrefinementgroupverbose - FALSE
```

help

`/config?op=help` returns the usage page for all of the config operations.

Chapter 7

Managing the Merge Policy

This chapter describes how to set and manage an MDEX Engine's merge policy.

Using a merge policy for incremental updates

A merge policy for the MDEX Engine determines how frequently it merges incremental update generations in its index.

The data layer that stores the index of the MDEX Engine as a versioning data store. As a result:

- Old versions can be accessed while new versions are created.
- Old versions are garbage-collected when no longer needed.

A version is persisted as a sequence of generation files. A new version appends a new generation file to the sequence. Query latency depends, in part, on the number and size of generation files used to store the index.

Generation files are combined through a process called *merging*. Merging is a background task that does not affect MDEX Engine functionality, but may affect its performance. Because of this, you can set a *merge policy* that dictates the aggressiveness of the merges. In a clustered environment, merge policy can be set on the leader node only.

Types of merge policies

You can set the merge policy to one of two settings: balanced or aggressive.

- **Balanced:** This policy strikes a balance between low latency and high throughput. This is the default policy of the MDEX Engine.
- **Aggressive:** This policy merges frequently and completely to keep query latency low at the expense of average throughput.

The balanced policy is recommended for the majority of applications. However, aggressive merging may help those applications that meet the following criteria:

- Query latency is the primary concern.

- A large fraction of the records (for example, 20%) are either modified or deleted by incremental updates before re-baselines.
- The time to perform an aggressive merge is less than the time between incremental updates.

Note: Under normal conditions, you do not need to change the default balanced policy. However, you may need to change to an aggressive policy based on a recommendation from Endeca Support.

Setting or changing the merge policy

The `mdex-config_MergePolicy` attribute in the system's Global Configuration Record (or GCR) sets the merge policy for the MDEX Engine.

You can set the merge policy with the Configuration Web Service API.

In addition, you can use the URL `merge` command to change the merge policy of a running MDEX Engine or to force a merge.

If you are running a cluster of MDEX Engine nodes, changing the merge policy (either through a Configuration Web Service request or with the `merge` command) can be performed on the leader node only.

Both of these methods are discussed in the following topics.

Setting the merge policy with the Configuration Service API

You can get and set the merge policy with API calls.

The following two topics describe how to use the Configuration Web Service to programmatically get and set the merge policy in the GCR.

Getting the merge policy programmatically

You can retrieve the MDEX Engine's Global Configuration Record to see the current setting for the merge policy.

To programmatically retrieve the Global Configuration Record:

1. Use a URL command similar to the following example to make certain that the Configuration Web Service is running on the MDEX Engine. You should see `config` as one of the available Web services.

   ```
   http://localhost:5555/ws
   ```

2. Use the `getGlobalConfigRecord` function retrieve the Global Configuration Record via the Configuration Web Service, as in this example:

   In a cluster of MDEX Engine nodes, this request should be sent to the leader node only.

   ```
   <soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
      <soap:Body>
         <config:configTransaction outerTransactionId="42"
            xmlns:config="http://www.endeca.com/MDEX/config/services/types"
            xmlns:mdex="http://www.endeca.com/MDEX/XQuery/2009/09">
            <config:getGlobalConfigRecord />
         </config:configTransaction>
      </soap:Body>
   </soap:Envelope>
   ```

Note: This request also specifies the `outerTransactionId="42"`. This is required only if a request is run once the outer transaction with this ID has been started. If no transaction has been started, the attribute for specifying the ID should be omitted from the request.

The `results` response from the Conversation Web Service should look like this example (the SOAP elements have been removed):

```
<config-service:results
   xmlns:config-service="http://www.endeca.com/MDEX/config/services/types">
   <mdex:globalConfigRecord xmlns:mdex="http://www.endeca.com/MDEX/XQuery/2009/09">
      <mdex:record xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
         ...
         <mdex-config_Key type="mdex:string">global</mdex-config_Key>
         <mdex-config_MergePolicy type="mdex:string">balanced</mdex-config_MergePolicy>
         ...
      </mdex:record>
   </mdex:globalConfigRecord>
</config-service:results>
```

In this example, the merge policy is set to `balanced` for this MDEX Engine.

Setting the merge policy programmatically

You can programmatically set the merge policy for the MDEX Engine by updating the Global Configuration Record.

To set the merge policy in the Global Configuration Record:

1. Use a URL command (similar to the following example) to make certain that the Configuration Web Service is running on the MDEX Engine. You should see `config` as one of the available Web services.

   ```
   http://localhost:5555/ws
   ```

2. Use the `putGlobalConfigRecord` function to set the value of the `mdex-config_MergePolicy` attribute in the Global Configuration Record, as in this example that changes the merge policy to `aggressive` (note that all attributes must be put, but the example omits most of them for the sake of clarity):

   In a cluster of MDEX Engine nodes, this request should be sent to the leader node only.

   ```
   <config:configTransaction outerTransactionId="42"
      xmlns:config="http://www.endeca.com/MDEX/config/services/types"
      xmlns:mdex="http://www.endeca.com/MDEX/XQuery/2009/09">
      <config:putGlobalConfigRecord>
        <mdex:record xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
          ...
             <mdex-config_Key type="mdex:string">global</mdex-config_Key>
             <mdex-config_MergePolicy type="mdex:string">aggressive</mdex-config_MergePolicy>
          ...
        </mdex:record>
      </config:putGlobalConfigRecord>
   </config:configTransaction>
   ```

   Note: This request also specifies the `outerTransactionId="42"`. This is required only if a request is run once the outer transaction with this ID has been started. If no transaction has been started, the attribute for specifying the ID should be omitted from the request.

The `results` response from the Configuration Web Service should look like this example (the SOAP elements have been removed):

```
<config-service:results
   xmlns:config-service="http://www.endeca.com/MDEX/config/services/types>
```

Changing the merge policy of a running MDEX Engine

The URL `merge` command can be used to change the merge policy of a running MDEX Engine.

The sticky version of the `merge` command is intended to change the merge policy of a running MDEX Engine. The duration of the policy change is for the life of the current Dgraph process (that is, until the MDEX Engine is restarted) or until another sticky change is performed during the current Dgraph process.

The format of the sticky version of the command is:

```
/admin?op=merge&mergepolicy=<policy>&stickymergepolicy
```

where *policy* is either `balanced` or `aggressive`.

The command also performs a merge operation if warranted.

This example:

```
http://localhost:8000/admin?op=merge&mergepolicy=aggressive&stickymergepolicy
```

forces a merge operation (if one is needed) and changes the current merge policy to an aggressive policy.

Forcing a merge

The URL `merge` command can also be used to force a merge.

Manually forcing a merge is considered a one-time version, because after the merge operation is performed (via a temporary `aggressive` change to the merge policy), the merge policy reverts to its previous setting.

The one-time version of the `merge` command is used to perform a complete merge of all generations without making a change to the default merge policy.

In a cluster of nodes, you can use this command on the leader node only.

The format of the one-time version of the command is:

```
/admin?op=merge&mergepolicy=<version>
```

The following example assumes that the MDEX Engine is using a balanced merge policy, and you want to temporarily apply an aggressive policy so that the merging can be performed.

```
http://localhost:8000/admin?op=merge&mergepolicy=aggressive
```

When you issue the command, the resulting Web page will look like this example:

```
Dgraph admin, OK.
Dgraph Manual merge started at Sat March 26 09:52:47 2011
```

After the merging is performed, the merge policy reverts to its previous setting.

Chapter 8

MDEX Engine Process Management

This chapter describes how to control the MDEX Engine process from the Windows Services utility or the Linux `inittab`.

Running the MDEX Engine as a Windows service

You can create a Windows service for running the MDEX Engine in service mode.

The Windows SC tool (`sc.exe`) communicates with the Windows Service Controller and installed Windows services. The SC tool allows you to create a Windows service for the MDEX Engine. You can then start and stop the MDEX Engine from the Windows Services utility, as well as make configuration changes (such as configuring the service to automatically restart in case of a failure).

Note: The SC tool (`sc.exe`) is case-insensitive.

For more information, refer to these Web pages on the Microsoft site:

- For more information on creating Windows services: *http://support.microsoft.com/kb/251192*
- For more information on the `sc.exe` command: *http://technet.microsoft.com/en-us/library/bb490995.aspx*

SC Create command syntax

This topic describes the various options of the `SC` command with the `Create` command option.

The `SC` command communicates with the Windows Service Controller and installed services. When used with its `create` command option, you can use it to create a Windows service under which the MDEX Engine will run.

The `SC Create` command uses the following format:

```
sc [remoteServername] create Servicename
   binpath= "path\to\dgraph.exe dgraphFlags path\to\mdex_db"
   [Optionname= Optionvalue...]
```

where:

- *remoteServername* is an optional parameter that specifies the name of the server if you want to run the command on a remote computer. The name must start with two backslash (\) characters. Do not use this parameter if you are running `SC` on the local computer.

- `create` is the command to be run by SC (this command name is mandatory to create a service).
- *Servicename* is the name of the Windows service to be created. This is the name given to the service key in the registry. Note that this name is different from the display name.
- `binpath` is a mandatory parameter that specifies information for the `dgraph.exe` command.
- *Optionname* specifies optional parameters, which are described in the table below.

The `binpath` parameter specifies this information for the `dgraph.exe` command:

- The absolute path to the `dgraph.exe` command.
- The Dgraph flags used when the MDEX Engine is started. Note that you must use the Dgraph `--out` flag when the MDEX Engine is run in service mode.
- The absolute path to the Dgraph database (that is, the database created by the `mkmdex` utility). Be sure to use the same database name that was supplied to `mkmdex` (that is, do not use the "_indexes" suffix that was added by `mkmdex`).

A space must be used between the `binpath` parameter and its argument. You should also use double quotes around the argument.

SC Create options

You can use these SC `Create` options to further customize the Windows service. Note that the option name includes the equal sign, and a space is required between the equal sign and the option value.

Option Name/Values	Meaning
`type=` `<serviceType>`	The type of service to be created. Use the own parameter value, which means the service runs in its own process. It does not share an executable file with other services. This is the default for the `sc create` command. Note that other service types are available, but you should use the own value.
`start=` `<startType>`	The start type for the service: • `auto` – A service that automatically starts each time the computer is restarted. • `demand` – A service that must be manually started. This is the default value if `start=` is not specified. `demand` maps to `Manual` in the Services Control Manager. • `delayed-auto` – The SCM supports delayed auto-start services to improve system performance at boot time without affecting the user experience. The SCM makes a list of delayed auto-start services during boot and starts them one at a time after the delay has passed, honoring dependencies. There is no specific time guarantee as to when the service will be started. • `disabled` – A service that cannot be started. To start a disabled service, change the start type to another start value.

Option Name/Values	Meaning
`error=` <errorSeverity>	The severity of error if the service does not start during boot: • `normal` – The error is logged and a message box is displayed informing the user that a service has failed to start. System startup will continue. This is the default setting. • `severe` – The error is logged (if possible). The computer attempts to restart with the last-known-good configuration. This could result in the computer being able to restart, but the service may still be unable to run. • `critical` – The error is logged (if possible). The computer attempts to restart with the last-known-good configuration. If the last-known-good configuration fails, system startup also fails, and the boot process halts with a Stop error. • `ignore` – The error is logged and startup continues. No notification is given to the user beyond recording the error in the Event Log.
`group=` <loadOrderGroup>	Name of group of which this service is a member. The list of groups are stored in the registry under the ServiceGroupOrder key. Default is null.
`tag=` `yes|no`	Do not use this parameter as tags are used only for device driver service types.
`depend=` <dependencies>	Names of services or groups that must start before this service. Each name is separated by / (forward slash).
`obj=` <accountName>	Name of the account under in the service will run. The specified account must exist and must be a valid account. Default is **LocalSystem**.
`password=` <password>	Password of the `obj` account. A password is required if an account other than the **LocalSystem** account is used.
`displayname=` <displayName>	A friendly, meaningful name that can be used in user-interface programs to identify the service to users. For example, if the service name is **MService**, you can specify **Endeca MDEX Engine** as the display name so that will be more meaningful when shown in the Windows Services Control Manager.

SC Create example

The following `SC Create` example creates a Windows service for the MDEX Engine (note that the command is on one line, but is indented here for ease of reading):

```
sc create MDEXService displayname= "Endeca MDEX Engine"
   type= own error= severe obj= "CORPDEV\EndecaUser" password= banx912
   binpath= "c:\endeca\latitude\2.2.2\mdex\bin\dgraph.exe --port 5555
     --threads 4
```

```
     --pidfile c:\mdex_db\dgraph.pid
     --log c:\mdex_db\dgraph.log
     --out c:\mdex_db\dgraph.out c:\mdex_db\mdexdb"
```

The sample command does the following:

- Creates a Windows service named **MDEXService**.
- Uses **Endeca MDEX Engine** as the display name for the service.
- Sets the service type as `own` (which means the service runs in its own process).
- Sets `severe` as the severity of error if the service does not start during the boot process.
- Specifies that the service run under the **CORPDEV\EndecaUser** user account, which has **banx912** as its password.
- Sets the binary path of the `dgraph.exe` executable and specifies `c:\mdex_db\mdexdb` as the MDEX Engine database prefix. Also specifies the locations of the query and error logs and the Dgraph PID file.

For ease of use, you can place the command in a batch script.

Creating the MDEX Engine Windows service

Use the `SC` command's `Create` option to create the MDEX Engine Windows service.

Before running this create-service procedure, make sure that you have Administrator rights.

When creating the service, you must specify the Dgraph `--out` flag as part of the `SC Create` command's `binpath` parameter. Failure to do so will result in the MDEX Engine not being able to start.

To create a Windows service for the MDEX Engine:

1. Click on the **Start** button in the Windows taskbar.
2. Locate the Command Prompt menu item and right-click on the Command Prompt.
3. On the pop-up right click context menu, select **Run as administrator**.
4. In the Command Prompt, enter the `SC Create` command with the appropriate options.

   If the command was successful, the SCM will return this message:

   ```
   [SC] CreateService SUCCESS
   ```

If the command was not successful, the SCM may return this message:

```
[SC] OpenSCManager FAILED 5:

Access is denied.
```

If you do receive this error, verify that you are a member of the Administrators group on the machine (for example, by using the Microsoft Management Console). If you do have Administrator rights, check that you are opening the Command Prompt with the **Run as administrator** option.

After the service has been created, you can use the `SC Config` command to change any parameter set by the `SC Create` command.

Setting a service description

Use the SC command's `Description` option to set a description for the MDEX Engine Windows service.

Before adding a description to the service, make sure that you have Administrator rights.

When you create a service with the SC `Create` command, you cannot set a service description. However, after creating the service, you can use the SC command's `Description` option to add a new description or to modify an existing description.

The format of the SC `Description` command is:

```
sc description Servicename descriptionText
```

where *Servicename* is the name of the service to modify and *descriptionText* is the new description within double quotes. There is no limit to the number of characters that can be contained in the service description.

To add or modify the description of the MDEX Engine Windows service:

1. Stop the MDEX Engine Windows service.
2. Click the **Start** button in the Windows taskbar.
3. In the menu, right-click **Command Prompt**.
4. On the pop-up right click context menu, select **Run as administrator**.
5. At the command prompt, enter the `sc description` command with the service name and new description, as in this example, which sets a description for the MDEXService:

   ```
   sc description MDEXService "Provides search and analytics functions."
   ```

If the command was successful, the SCM will return this message:

```
[SC] ChangeServiceConfig2 SUCCESS
```

Modifying the service configuration

Use the SC command's `Config` option to modify the configuration of the MDEX Engine service.

Before attempting to modify the service configuration, make sure that you have Administrator rights.

After you create the MDEX Engine service with the SC `Create` command, you can use the SC `Config` command to modify the service configuration. Because both commands use the exact same set of parameters, any parameter that you set with SC `Create` can be modified with SC `Config`. The command is especially useful when you want to add or remove Dgraph flags from the current `binpath` setting.

The format of the SC `Config` command is:

```
sc [remoteServername] config Servicename Optionname= Optionvalue...
```

where *Servicename* is the name of the existing MDEX Engine Windows service to be modified.

When using the SC `Config` command, you specify only the parameter settings that will be changed. Any parameter setting that is not specified will remain as-is in the service configuration. Note that to change the service description, you must use the SC `Description` command.

To modify the MDEX Engine Windows service:

1. Stop the MDEX Engine Windows service.
2. Click the **Start** button in the Windows taskbar.

3. In the menu, right-click **Command Prompt**.
4. On the pop-up right click context menu, select **Run as administrator**.
5. At the command prompt, enter the `SC Config` command with the service name to be modified and the parameters to be changed, as in this example that adds a Dgraph flag to the `binpath` configuration:

```
sc config MDEXService binpath= "c:\endeca\latitude\2.2.2\mdex\bin\graph.exe
--port 5555 --ancestor_counts --pidfile c:\mdex_db\dgraph.pid --threads 4
--log c:\mdex_db\dgraph.log --out c:\mdex_db\dgraph.out c:\mdex_db\mdexdb"
```

If the command was successful, the SCM will return this message:

```
[SC] ChangeServiceConfig SUCCESS
```

Deleting the MDEX Engine Windows service

Use the `SC` command's `Delete` option to remove the MDEX Engine Windows service.

Before deleting the service, make sure that you have Administrator rights.

The format of the `SC Delete` command is:

```
sc delete Servicename
```

where *Servicename* is the name of the service to be deleted.

To delete the MDEX Engine Windows service:

1. Stop the MDEX Engine Windows service.
2. Click the **Start** button in the Windows taskbar.
3. In the menu, right-click **Command Prompt**.
4. On the pop-up right click context menu, select **Run as administrator**.
5. At the command prompt, enter the `SC Delete` command with the service name to be deleted, as in this example:

```
sc delete MDEXService
```

If the command was successful, the SCM will return this message:

```
[SC] DeleteService SUCCESS
```

If the command was not successful, the SCM may return this message:

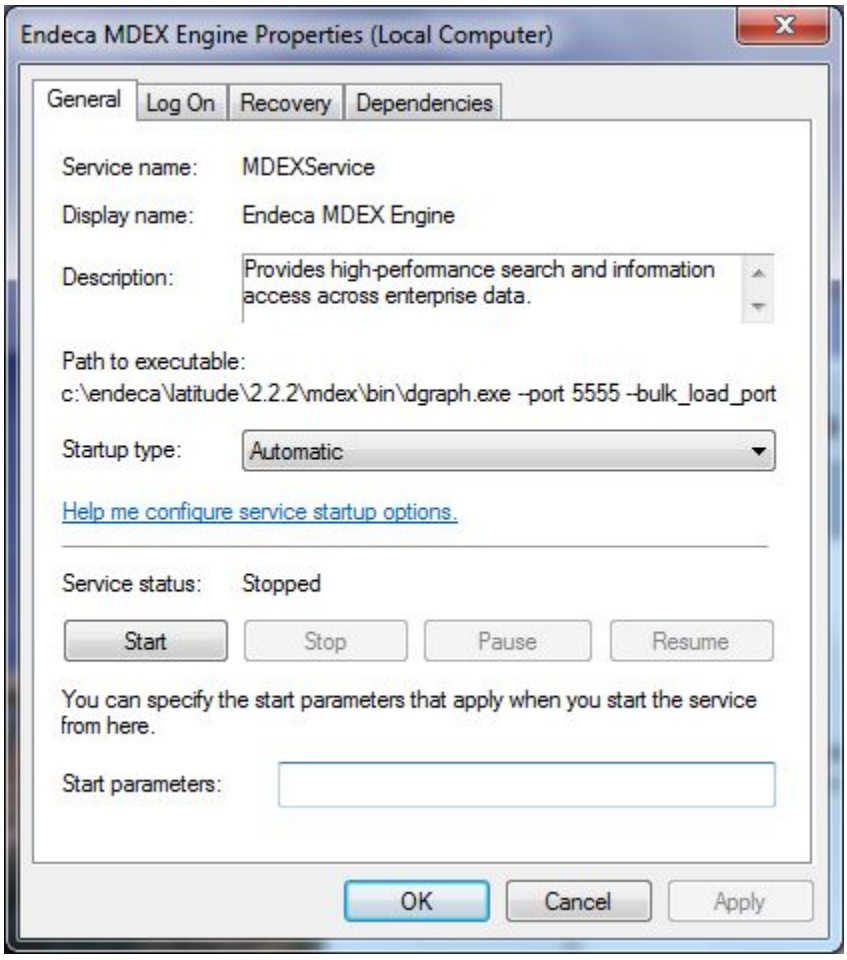
```
[SC] OpenService FAILED 5:

Access is denied.
```

If you do receive this error, first verify that you are a member of the Administrators group on the machine. If you do have Administrator rights, check that you are opening the **Command Prompt** with the **Run as administrator** option.

Using the Windows Services utility

The Windows Services utility allows you to control and configure the MDEX Engine service.

The MDEX Engine service, when selected in the Windows Services utility, looks like this example:



General tab

The **General** tab allows you to start and stop the MDEX Engine service. Either operation will log an appropriate message to the MDEX Engine's stdout/stderr log.

Clicking the **Stop** button sends a shutdown request (with time limit of 120 seconds) to the MDEX Engine. The shutdown will complete when all outstanding jobs are complete, or within 120 seconds, whichever happens first. Unfinished jobs are handled as follows:

- A query still in progress when the time limit is reached will not return a result to the client and will not be logged in the Dgraph log.
- An update still in progress when the time limit is reached will not be applied.
- A background merge still in progress when the time limit is reached will be aborted at the end of the timeout.

- The number of in-progress queries is written to the Dgraph error log just before exiting, along with a message stating that the shutdown time limit was reached.

You can use the **Startup type** drop-down menu to change the startup type to Automatic, Automatic (Delayed Start), Manual, or Disabled. Clicking the help link displays usage information for this option.

Note that the **Start parameters** field has no effect on the service.

Log On tab

The **Log On** tab allows you to change the account under which the MDEX Engine service runs. This option is especially useful if you created the service to run under the Local System account and want to change to a user account. The tab has a help link that provides detailed information on configuring the user account log on options.

Recovery tab

The **Recovery** tab is used to configure recovery actions when a service fails. You can configure the MDEX Engine service for automatic restart. That is, the MDEX Engine service will restart in the case of a crash or machine reboot.

To obtain information on how to configure the computer's response if the MDEX Engine fails, click the "Help me set up recovery actions" link on the tab.

Logging in service mode

MDEX Engine logging is supported in service mode.

When the MDEX Engine is run in service mode, it will log startup and shutdown messages to its stdout/stderr log, which is specified by the Dgraph `--out` flag.

When the service is started:

```
INFO 03/01/11 20:55:44.578 UTC (1299012944577) DGRAPH {dgraph,baseline,
service}    Starting in service mode.
```

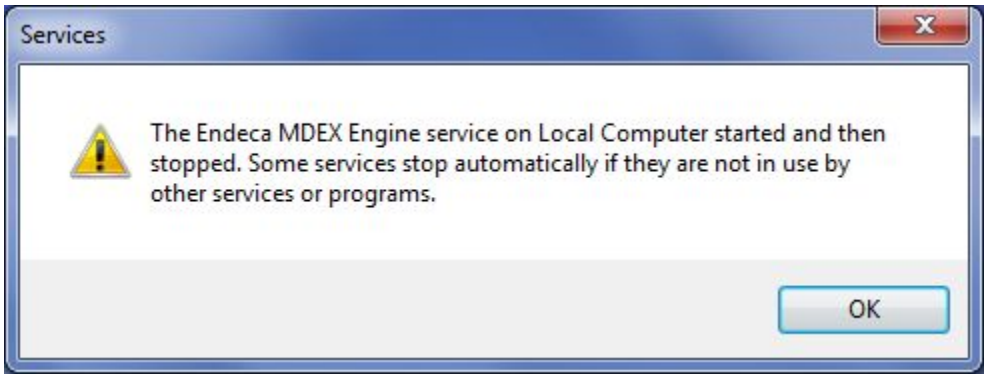
When the service is stopped by the user (such as from the Windows Services utility):

```
INFO 03/01/11 21:32:14.500 UTC (1299015134500) DGRAPH {dgraph,service}
Stopping on user request.
Shutdown request with time limit of 120 seconds received at Tue Mar 01
16:32:14 2011.
Shutdown will complete when all outstanding jobs are complete, or within
120 seconds, whichever happens earlier.
```

When the service is stopped as part of a system shutdown:

```
INFO 03/01/11 21:53:41.469 UTC (1299016421469) DGRAPH {dgraph,service}
Stopping on system shutdown.
Shutdown request with time limit of 15 seconds received at Tue Mar 01
16:53:41 2011.
Shutdown will complete when all outstanding jobs are complete, or within
15 seconds, whichever happens earlier.
```

If Dgraph stdout/stderr is not redirected to a file in service mode, all log messages will be lost. Therefore, when the MDEX Engine is run in service mode, the Dgraph `--out` flag is required. If the Dgraph `--out` flag is not supplied, the service will not start. If you try to start it from the Windows Services utility, Windows displays this error message:



To recover from this situation, use the SC `Config` command to modify the `binpath` parameter of the service and add the `--out` flag.

Starting the MDEX Engine from inittab

In a Linux production environment, the MDEX Engine can be started by `init` from `inittab`.

In a Linux development environment, the MDEX Engine can be started from the command line. In a Linux production environment, however, Endeca recommends that it be started by `init` from `inittab`. If the service crashes or is terminated, `init` automatically restarts it.

The `inittab` entry should be formatted like this:

```
dg:2345:respawn:/bin/su - <dgraph_user> -c "/absolute/path/to/bin
/dgraph <dgraph_flags> <mdex_indices>"
```

where:

- **dg** is the `inittab` entry identifier.
- **2345** lists the runlevels for which the specified action should be taken.
- **respawn** is the action to be taken, which is that the process will be restarted whenever it terminates.
- **/bin/su** specifies the process to be executed. In this case, a non-root user will run the `dgraph` command. It is a best practice to run the Dgraph as a user other than root.
- **-c dgraph <dgraph_flags> <mdex_indices>** specifies that the `dgraph` command will be run with the specified Dgraph flags, using the absolute path to the Dgraph database (that is, the database created by the `mkmdex` utility).

Note that you must use the Dgraph `--out` flag to direct stdout/stderr output to a log file.

Chapter 9

Deploying Latitude in a Cluster

This section discusses how to deploy a Latitude application in a cluster with multiple nodes hosting the MDEX Engine instances.

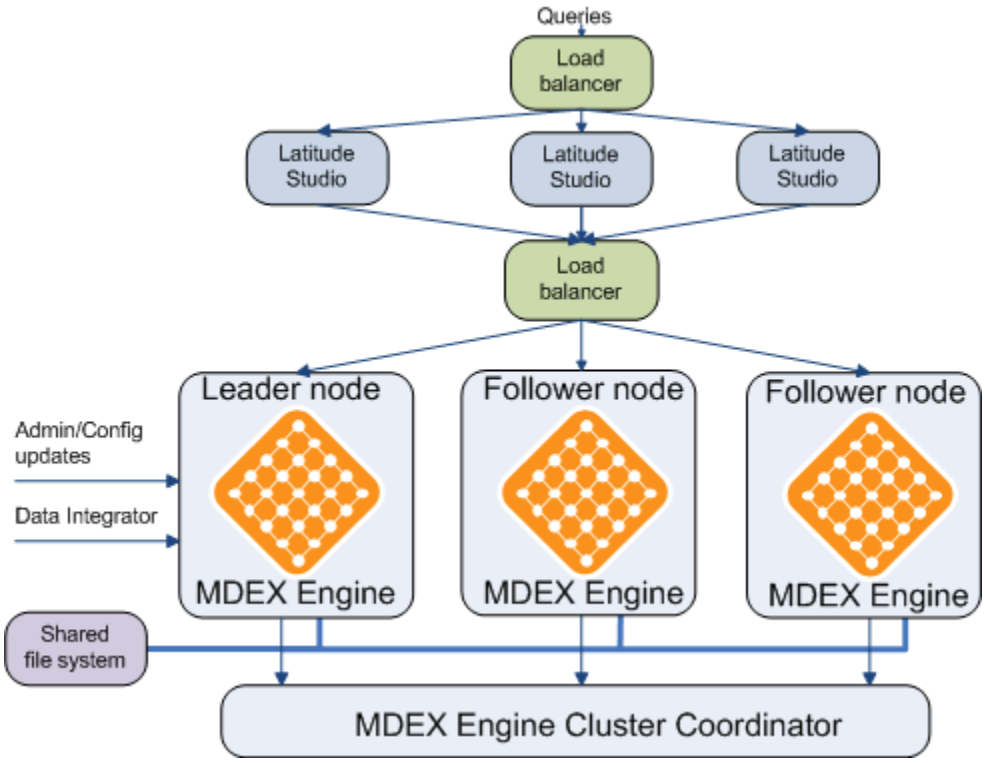
Cluster overview

This topic introduces the cluster of MDEX Engine nodes and describes its capabilities.

About the cluster

A cluster is composed of a set of MDEX Engine nodes. All nodes can serve query requests. Only one node is identified as the leader node; All other nodes are follower nodes. All of the MDEX Engine nodes share and use one copy of the on-disk representation of the MDEX Engine index.

The Cluster Coordinator provides communication between the nodes in the cluster. The Cluster Coordinator is also used to notify the follower nodes about index updates and updates to the configuration.



Cluster capabilities

A cluster of MDEX Engine nodes provides the following capabilities:

- **Enhanced availability of query processing by the MDEX Engine**. In a cluster, if one of the nodes fails, queries continue to be processed by other nodes in the cluster.
- **Increased throughput by the MDEX Engine**. In a cluster, you change throughput capacity by adding or removing nodes. By adding nodes you can spread the query load across multiple MDEX Engine instances without the need to increase storage requirements at the same rate. You can add or remove nodes dynamically, without having to stop the cluster.

In a cluster, you can perform the following administrative tasks:

- Add one or more MDEX Engine instances to a cluster.
- Remove MDEX Engine instances while allowing the cluster to continue running.
- Identify a single node to which you can send data during an initial index data load and subsequent updates. (The administration and configuration updates must also be sent to this node.) All types of updates are automatically propagated to all MDEX Engine nodes while one or more MDEX Engine nodes continue to process queries.

Latitude cluster architecture

This topic discusses cluster architecture in the development and production environments.

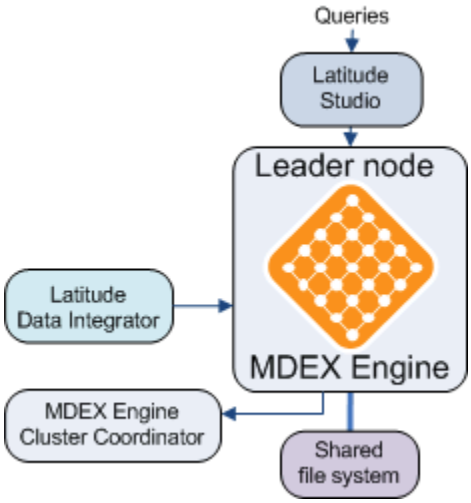
In the development environment, you can start with a simple single-node cluster configuration and expand it by adding more nodes. When you move to a production environment, you can duplicate a multi-node development cluster.

A single-node cluster in the development environment

In a development environment, the simplest version of a cluster may consist of just one node hosting an instance of the MDEX Engine. This node is by definition the leader node — in a single-node cluster, the only node is considered the leader node by default.

Note: You are not required to run a single instance of the MDEX Engine in a cluster. Without the cluster services, having a single running MDEX Engine instance is a valid configuration for starting in the development environment.

This diagram represents a single-node cluster in a development environment:



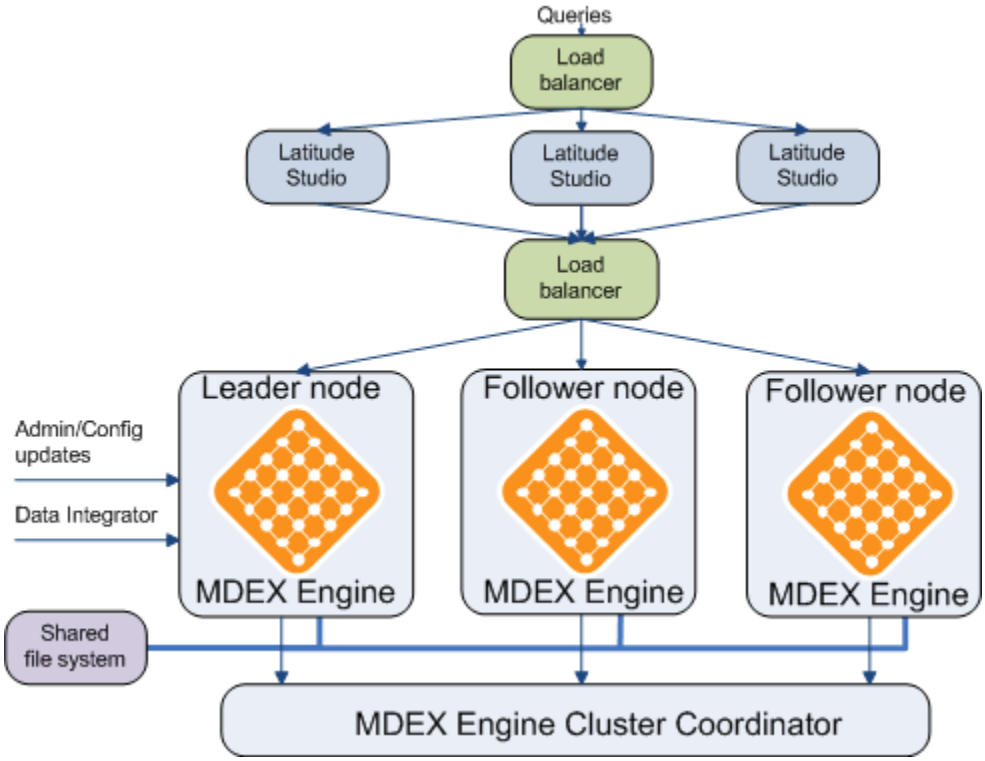
In this diagram:

- The leader node is hosting an MDEX Engine and is receiving query requests from Latitude Studio.
- The leader node's host and port are included in the configuration for connectors from the Latitude Data Integrator, which can send various kinds of data and updates to the MDEX Engine index.
- The leader node must have write access to a shared file system on which the MDEX Engine index is stored. All other follower nodes that you add later must have read access to this file system.
- Finally, the cluster is managed by the MDEX Engine Cluster Coordinator. In a single-node cluster, the Cluster Coordinator service runs on the same server on which the MDEX Engine is running.

A multiple-node cluster in the development environment

In the development environment, many cluster configurations are possible; they depend on the requirements for your application. For example, while a single leader node is always required, the number of additional follower nodes hosting the MDEX Engine instances may vary.

This diagram represents a possible multiple-node cluster in a production environment:



In this diagram, starting from the top, the following actions take place:

- The queries are sent to the load balancer that is configured in front of several servers hosting Latitude Studio instances.
- The instances of Latitude Studio point to a second load balancer between Latitude Studio and the MDEX Engine cluster. This load balancer is configured to recognize the leader node and all follower nodes.
- The Latitude Data Integrator is configured to communicate with the host and port of the leader node to ensure a point of communication for sending data and updates.
- All nodes in the cluster communicate with each other through the MDEX Engine Cluster Coordinator. The Cluster Coordinator service must be running on the leader node.
- All nodes in the cluster have access to a shared file system on which a shared index is stored.

Important cluster concepts

This topic introduces the leader and follower nodes and the Cluster Coordinator.

In a cluster composed of nodes, each of which hosts an MDEX Engine instance, the following definitions are used:

- Leader node
- Follower node
- Cluster Coordinator

Leader node

A single node in the cluster responsible for processing queries and for receiving updates to the index and to the configuration. This node is responsible for obtaining information about the latest index and propagating this information to the follower nodes through the Cluster Coordinator.

When you create a new cluster, you start the leader node first and then add follower nodes. The leader node has the following characteristics:

- Each cluster must have one and only one leader node.
- The leader node must have write access to the same shared file system on which the MDEX Engine index is stored and to which all follower nodes also have access.
- The Cluster Coordinator service must be running on the leader node.
- The entities outside the cluster of MDEX Engine nodes (such as connectors in the Latitude Data Integrator and components of Latitude Studio) must be able to access the leader node.

The leader node periodically receives full or incremental index updates from the Latitude Data Integrator. It also receives administration or configuration updates. It is the only node in the cluster that has access with write permissions to the on-disk representation of the MDEX Engine index.

Once the leader node acquires access to the new version of the MDEX Engine index, it updates the index, adding new information to it and deleting information that has become obsolete. The Cluster Coordinator notifies all follower nodes, alerting them to start using the updated index. The follower nodes acquire read-only access to an updated index.

Follower node

A node in the cluster responsible for processing queries. The follower node does not update the index, although it has read-only access to its latest copy.

You can start a follower node after you have started the leader node and the Cluster Coordinator. The follower node has the following characteristics:

- Each cluster can have more than one follower node.
- In a single-node cluster, a leader is also a follower.
- Each follower node must have a unique name across the cluster. The name also must be a valid directory name (characters such as slashes (/) are not allowed).
- All follower nodes must reference the host name and port of the Cluster Coordinator service.

- All follower nodes must have read-only access to the same shared file system on which the MDEX Engine index is stored. (The leader node must have write access to the file system.)

During the process of acquiring access to the recently updated index, both the follower and the leader nodes continue to serve queries. Each query is processed against a specific version of the index that is available to a cluster node at any given time. Query processing performance may slow down as the follower nodes acquire read-only access to the updated index.

Cluster Coordinator

An entity that provides a mechanism for the MDEX Engine nodes to communicate with each other.

The Cluster Coordinator controls the heartbeat function, the file sharing function between the cluster nodes, and the propagation of updates to the follower nodes once the leader node acquires access to an updated MDEX Engine index.

Before you begin

This section discusses requirements for installation related to deploying a cluster, as well as tips for planning your cluster architecture.

System and hardware requirements

This section outlines the operating system and hardware requirements for deploying Latitude in a clustered environment.

Operating system requirements

A cluster of MDEX Engine nodes can be deployed on either Windows or Linux.

You cannot create a cluster in which some nodes are running on Windows while other nodes are running on Linux.

Shared file system requirements

This topic describes the requirements for the shared file system in a cluster.

- All nodes in the cluster must have access to a shared file system on which the index is stored. The leader node must have write access, and the follower nodes must have read access.
- File system size. You can start a cluster with a single node that serves both as the leader and a follower node. As you add additional follower nodes, file system size requirements (as measured by the high-water mark parameters for shared storage) increase modestly and do not increase proportionally to the number of follower nodes.
- Performance. Even in a single-node cluster, using an index on remote storage affects node startup time and performance associated with processing of index updates. In a multi-node cluster, all MDEX Engine nodes are accessing the index at the same time. This coordinated access may affect performance for the network or shared file system, especially when large updates are accessed for the first time.

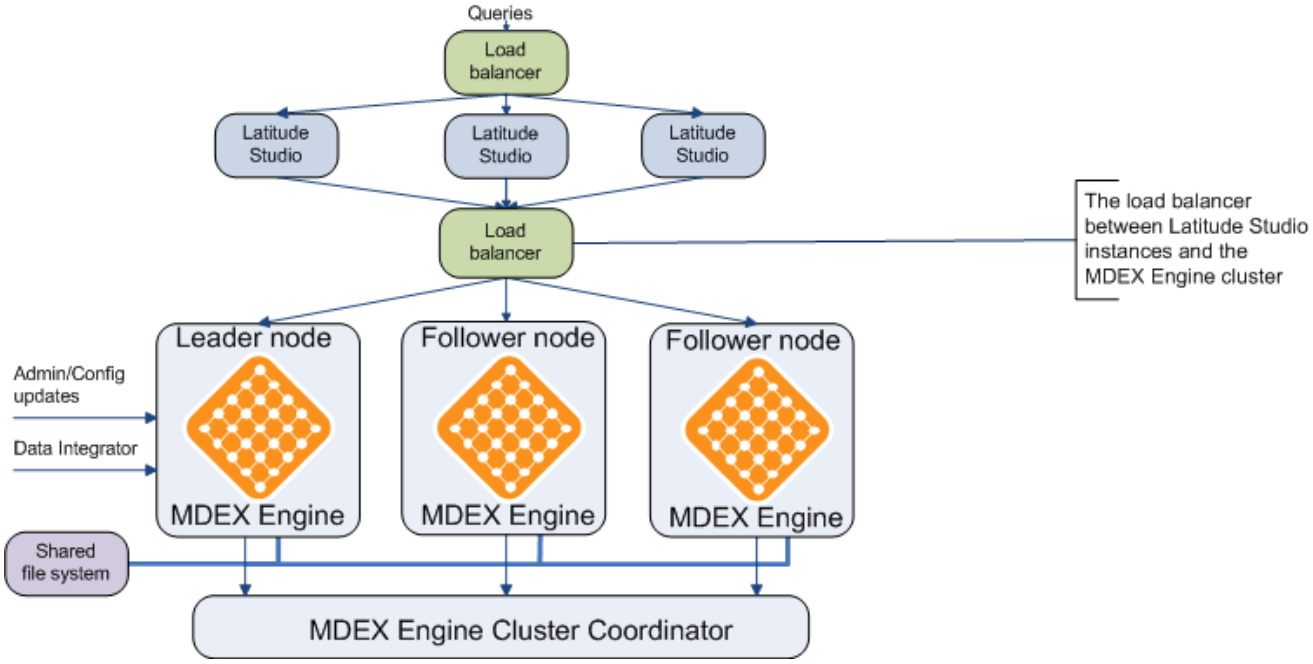
Load balancer requirements

In most production deployments, it is desirable to configure a load balancer between Latitude Studio and a cluster of the MDEX Engine nodes. This topic discusses the load balancer considerations associated with the Latitude cluster.

The following diagram of a typical multi-node cluster shows two load balancers:

- A load balancer in front of a number of servers hosting Latitude Studio
- A load balancer between Latitude Studio servers and the cluster of MDEX Engine nodes

This topic discusses the load balancer between Latitude Studio instances and the MDEX Engine cluster. In the diagram, it is the load balancer with the callout:



The following considerations apply to this load balancer:

- Include host names and ports of all nodes into the load balancer configuration. This ensures that regular query-type (non-updating) requests from Latitude Studio are sent to any of the nodes in the cluster.

  Note: Latitude Studio data sources that send both updating and non-updating requests to a cluster should include not only the load balancer's host name and port, but also an update host name and update port that reference the leader node. If the leader node changes, the configuration of the data source must be updated, but the load balancer's configuration does not need to change.

- If you add nodes to the cluster, you must update the configuration of the load balancer with the host names and ports of the added nodes.
- You may optionally configure the load balancer to use session affinity. In this case, all MDEX Engine queries from a given Latitude Studio session end up on the same MDEX Engine. This allows the MDEX Engine to use its cache to avoid redundant processing on related queries from one page view. A series of page views also benefits from cache contents. For instance, a record search that remains in the filter state through multiple page views will not have to be calculated repeatedly for each click.

Configuring session affinity also helps minimize consistency problems as updates propagate from the leader to the follower nodes in the cluster (if you are not using transactions to run updates).

Connecting a cluster with a load balancer

Load balancer and outer transactions

In a cluster, updates are sent to the leader node only. During an outer transaction, the leader node responds to any queries, including the `admin?op=ping` command, with an HTTP status code 403. This way, the load balancer can be configured to automatically detect whether a transaction is in progress and remove the leader node from answering queries, while other nodes in the cluster continue to respond to user requests in Latitude Studio.

The following bullets describe the logic behind this requirement:

- In a cluster, updates to the records in the index (or any other updates) are sent to the leader node only. In general, it is best to wrap updates in an outer transaction operation.

  Such updates can be configured in LDI, with the use of the **Transaction RunGraph** Latitude connector. This connector lets you create a graph that starts an outer transaction, runs one or more sub-graphs, and if they complete successfully, commits an outer transaction. If any of the sub-graphs fail, the changes made within a transaction are rolled back and the transaction is committed.
- While an outer transaction is open, the leader node returns an HTTP status code 403 ("request forbidden") to any queries that are issued outside of the transaction. In this way the load balancer must be able to identify when the leader node runs a transaction, so that requests can be directed to other nodes in the cluster.
- To identify whether a leader node is still processing an outer transaction, issue an `/admin?op=ping` request. An HTTP status code 403 means that the transaction is in progress.

For more information on running transactions, see the *LDI MDEX Engine Components Guide*.

Connecting a cluster with a load balancer

About the Cluster Coordinator

The cluster coordinator provides a mechanism for the MDEX Engine nodes to communicate with each other while ensuring increased availability of the MDEX Engine.

The Cluster Coordinator has the following characteristics:

- It is a shared information repository that provides a set of distributed coordination services.

  It ensures that all systems in the cluster coordinate their actions relative to all other systems running in your environment. If one of the nodes communicates any cluster information, all other nodes recognize it and react to it in manner that ensures synchronization, event notification, and coordination between the nodes.

  The communication and coordination mechanisms continue to work in the case when connections or cluster nodes fail.
- The Cluster Coordinator logs messages using the `log4j` file included with its installation in the `/conf` directory. When the Cluster Coordinator service is running on a node, log messages can be logged to the console (default) and/or a log file depending on the `log4j` configuration.

Deployment strategy for the Cluster Coordinator service and MDEX Engine nodes

To create a cluster, the Cluster Coordinator service must be running on at least one node. Endeca recommends that you start a single Cluster Coordinator service on the node that will be designated as the leader node, and then start the MDEX Engine on all nodes by referencing the host and port of the Cluster Coordinator.

Note: The port for the Cluster Coordinator is a dedicated port used for cluster node communication.

Starting and stopping the Cluster Coordinator service

To ensure that MDEX Engine nodes can function together in a cluster, the Cluster Coordinator service must be running on the leader node and all the nodes must be started with references to the host name and port of the Cluster Coordinator service.

You start the Cluster Coordinator service on the leader node only.

It is assumed that the Cluster Coordinator package has been downloaded and installed on the leader node.

To start or stop the Cluster Coordinator service:

1. On the server that will serve as the leader node, go to the `Latitude\<version>\ClusterCoordinator\bin` directory and locate the `clusterCoordinator` script.

   The script has a different extension for Windows and Linux.

2. From this directory, run the script as follows:
   - To start, run:
     ```
     clusterCoordinator start
     ```
   - To stop, run:
     ```
     clusterCoordinator stop
     ```

   Note: If you provide a full path to the script on the command line, you can also run it from another directory. In this case, the Cluster Coordinator creates its `dataDir` in the path from which you run the script.

   When the Cluster Coordinator is started on a server, it uses the host name of this server, and the port 2181. (You can change the Cluster Coordinator configuration to use another port, using its configuration file.)

After the Cluster Coordinator service has been started on a node, you can start the MDEX Engine on this node. This will be the leader node.

The configuration file for the Cluster Coordinator

The Cluster Coordinator service uses a configuration file which specifies the settings for it.

Note: This topic provides reference information about this file. For the cluster to work, this file does not require any modifications.

After the installation of the Cluster Coordinator, the configuration file is placed in the `Latitude\<version>\ClusterCoordinator\conf` directory. When you run the `clusterCoordinator` script, it detects the configuration file.

Format

The configuration file should have the following format:

```
# Modified and renamed from source by
# Endeca Technologies

# The number of milliseconds of each tick
tickTime=2000
# The number of ticks that the initial
# synchronization phase can take
initLimit=10
# The number of ticks that can pass between
# sending a request and getting an acknowledgment
syncLimit=5
# the directory where the Cluster Coordinator snapshot is stored.
dataDir=.
# the port at which the clients will connect
clientPort=2181
```

Where:

Entry	Description
`tickTime`	The basic time unit in milliseconds used by the Cluster Coordinator. It is used for heartbeats. For example, `tickTime` can be 2000 milliseconds. The minimum session timeout is twice the `tickTime`.
`initLimit`	The number of ticks that the initial synchronization phase can take. This number specifies the length of time the nodes have to connect to the leader node.
`syncLimit`	The number of ticks that can take place between one node sending a request for an update and receiving an acknowledgment from the leader node.
`dataDir`	The directory where the in-memory database snapshots for the Cluster Coordinator and the transaction log of updates to its database are stored. This directory is created in the same file system location from which you run the Cluster Coordinator script. You can specify to store the log of updates to the database in another directory, using the `log4j` file stored in the `/conf` directory of the Cluster Coordinator installation.
`clientPort`	The port at which clients should connect to the Cluster Coordinator service. As configured after the initial installation, this port is 2181.

Planning cluster nodes

To plan cluster nodes, you specify which ones will serve as follower nodes. The one node in a cluster that is not a follower is the leader node.

To plan your cluster nodes:

1. Write down each node's host and port.

   You will need this information to identify which of your nodes should serve as a leader node and to designate other nodes as follower nodes.

2. Provision a shared file system on which the MDEX Engine index will be stored.

   When you will install and start MDEX Engine instances, they should each point to the index on this file system and have access to it. (Read-only access is sufficient for follower nodes; write access is required for the leader node.)

3. On the node you would like to designate as the leader node, reserve the port 2181.

   This port is used by the Cluster Coordinator service (unless you configure it to use another port). You will also specify this port when starting all nodes in your cluster.

Cluster behavior

The Cluster Coordinator ensures that the MDEX Engine nodes in the cluster provide query processing that is stable in the face of individual follower node failures. This topic discusses cluster behavior in various scenarios, such as cluster startup, updates to the index, and response to a node failure.

Bringing a cluster online

On startup, the following actions take place:

- Any MDEX Engine node can be started in either a leader or follower mode. The leader node must be started first. Any number of follower nodes and exactly one leader node can be added to a cluster.
- If you attempt to start two leader nodes in the same cluster, you will receive an error.
- If you attempt to start a follower node before the leader node has been started, the follower node will issue an error and will not start until the leader node is started.
- Once started, each node registers with the Cluster Coordinator that manages the distributed state of the cluster.

  One node for which you do not specify that it must be a follower is the leader; you identify all other nodes as follower nodes.
- The leader node determines the current version of the index and informs the Cluster Coordinator.
- Once the leader node has been started, the follower nodes can be started.
- After all follower nodes have started, each of them acquires read-only access to the current version of the index.
- Follower nodes do not alter the index files in any way; they continue answering queries based on the index version to which they have read-only access at startup, even if the leader node is in the process of updating, merging or deleting index files on disk.

Follower nodes refuse all updating web service and HTTP requests (such as `admin?op=updateaspell`) with a 403 HTTP status code (forbidden).

Processing an update

In a cluster, updates to the records in the index (or any other updates) are sent to the leader node only.

The leader node processes the update and commits it to the on-disk index. The Cluster Coordinator informs all follower nodes that a new index version is available. The leader node and all follower nodes can continue to use files from the previous version of the index to finish query processing that had started against that version.

As each node finishes processing queries on the previous version, it releases references to it. Once the follower nodes are notified of the new version, they acquire read-only access to it and start using it.

Endeca recommends to wrap updates in the cluster in an outer transaction operation, although you may run updates on the leader node with or without using transactions.

- Updates that run without using an outer transaction take time to propagate across the nodes in the cluster. Some of them may succeed and some of them may fail. Because of this, at any given time while updates are running, portions of page views in Latitude Studio could be processed against different versions of the index and thus may be inconsistent.
- Updates that run within an outer transaction succeed or fail as a unit. As a result, page views in Latitude Studio reflect either the pre-update state of the index, or the state after all updates have been committed.

  The following statements describe how updates run within an outer transaction:

  - When an outer transaction is started, it locks out all queries on the leader node for its duration. The leader node starts processing updates that run within the transaction, and stops processing any queries that are issued outside of this transaction. It returns an HTTP status code 403 ("request forbidden") to any such queries. Until the transaction is committed, the follower nodes respond to queries against the previously available version of the index. You can configure the load balancer to identify when the leader node runs a transaction, so that it directs all requests to other nodes in the cluster for the duration of the outer transaction.
  - If all updates from a transaction are processed successfully, the transaction is committed. In this case, all updates are committed to the MDEX Engine index as a unit. All nodes in the cluster are informed of the updated index and start using it. The leader node resumes responding to queries from Latitude Studio.
  - If any of the updates within a transaction fail, all updates from the transaction are rolled back, and the transaction is committed. All nodes continue using the previously available version of the index. This is the default behavior that you can change in your LDI graph that runs updates, if needed.

    You can use the **Transaction RunGraph** Latitude connector in the LDI Designer to create a graph that starts and commits an outer transaction. Within this graph, you can run one or more graphs that perform updates. For information on how to run graphs that utilize transactions, see the *LDI MDEX Engine Components Guide*.

Responding to a node failure

In a cluster, a follower or a leader node may fail:

- Failure of the leader node. Responding to the expected or unexpected leader node failure is critical for system availability and data consistency. When the leader node goes offline, the Cluster Coordinator

detects this event, and the follower nodes stop receiving notifications about the new versions of the index. You need to restart the node.

- Failure of a follower node. When one of the follower nodes goes offline, it is removed from the cluster. The other nodes do not need to keep track of this event. If the follower node is restarted, it joins the cluster. The follower node should be restarted with the same name.

Responding to network failures of the Cluster Coordinator service

If a network connection fails between the nodes in the cluster that connect to the Cluster Coordinator service, the MDEX Engine on those nodes will shut down.

A node will rejoin the cluster once the MDEX Engine on the node is restarted (this will happen automatically if it is run as a service) and is able to establish a connection with the Cluster Coordinator service.

Building a cluster

This section discusses how to build a cluster by starting the leader node and adding follower nodes.

Starting the MDEX Engine as the leader node

When you start any MDEX Engine without specifying that it is a follower node, this node serves as the leader node.

The leader node must be started first (before any of the follower nodes have been started).

Before starting the leader node, ensure that the Cluster Coordinator service is running on this node. Note the host name and port of your Cluster Coordinator service, so that you can specify them when starting the MDEX Engine as the leader node.

You configure one and only one leader node in a cluster. Therefore, if you want to start the MDEX Engine as the leader, do not specify the `--follower` flag for it. The MDEX Engine instance that is started without the `--follower` flag becomes the leader node. You also do not have to specify a name for the leader node.

To start the MDEX Engine as the leader node:

1. Start the MDEX Engine on the node with the `dgraph` command as in the following example:

   ```
   dgraph
   --port 5555
   --coordinator_port 2181
   --coordinator_host My_cluster_coordinator_server.com
   --threads 16
   --log c:\mdex_db\dgraph1.log
   --out c:\mdex_db\dgraph1.out
   z:\shared_mdex_db\mdexdbdgraph
   ```

   In this example:

   - `z:\shared_mdex_db\mdexdbdgraph` is the location of the MDEX Engine index, which resides on a shared file system. All nodes in your cluster must point to the same location of the index on a shared file system and have access to it (with the leader node having write access, and follower nodes having read access).

- 2181 is the port used by the Cluster Coordinator (if you haven't changed it after installing the Cluster Coordinator).
- `My_cluster_coordinator_server.com` is the host name used by the Cluster Coordinator. This is the host name of the leader node.

Once the MDEX Engine is running on the leader node, this node receives updates to the index and configuration. The Cluster Coordinator propagates updates to the follower nodes.

2. Note the leader node's port and host name.

   You will need to reference this information in the configuration for the Latitude Data Integrator, so that the Integrator can send data and updates to the leader node. This information should be also useful when configuring the data sources in Latitude Studio.

Now that you have started the leader node, you can add one or more follower nodes.

Adding a follower node

You can add a follower node to the cluster after the leader node has been started, by starting the MDEX Engine with the `--follower` <*node_name*> flag.

Before starting an MDEX Engine that will serve as a follower node, ensure that the leader node has been started and the Cluster Coordinator service is running on the leader node. Note the host name and port of your Cluster Coordinator service, so that you can specify them when starting the MDEX Engine as a follower node.

The Dgraph flag `--follower` <*node_name*> specifies the follower node, where <*node_name*> is the name of the follower node. This name must be unique across the cluster. The name must also be a valid directory name (characters such as slashes (/) are not allowed).

Note: If you start a node without this flag, the Cluster Coordinator assumes this is the leader node. Since there can be only one leader node in the cluster, it is important to start just one node without the `--follower` <*node_name*> flag. In fact, the MDEX Engine will not start if it is asked to be the leader node when a leader node already exists.

To start an MDEX Engine as a follower node:

1. Issue the command as in the following example, specifying a unique name of the follower node in the `--follower` flag:

```
dgraph
--port 5556
--threads 16
--follower FollowerNode1
--coordinator_port 2181
--coordinator_host My_cluster_coordinator_server.com
--log c:\mdex_db\dgraph2.log
--out c:\mdex_db\dgraph2.out
z:\shared_mdex_db\mdexdbdgraph
```

   In this example:

   - `z:\shared_mdex_db\mdexdbdgraph` is the location of the MDEX Engine index, which resides on a shared file system.

All follower nodes in your cluster must point to the same location of the index on a shared file system and have read access to it.

- The `--coordinator_host` and `--coordinator_port` reference the host name and port of the Cluster Coordinator service.

  This service uses the host name of the leader node, and the port 2181 (unless you configure the Cluster Coordinator to use another port).

The node `FollowerNode1` is now known to the Cluster Coordinator as a follower node — when changes occur to the on-disk MDEX Engine index, the Cluster Coordinator notifies this node to start using the new version of the index.

2. Proceed by adding additional follower nodes if needed.

   For each follower node:

   - Specify a different name.
   - Reference the host name and port of the Cluster Coordinator service.
   - Ensure that the index is referenced in the same location on a shared file system as for other nodes in the cluster.

   Note: Since there is one Cluster Coordinator service running on the leader node, you can add more than one follower node, all referencing the same Cluster Coordinator service host name and port.

If a follower node fails, the cluster continues to run. Once you identify a follower node failure, restart the follower node with the same name and the node will join the cluster.

Summary of operations handled by the leader node and any node

This topic summarizes which specific requests to the MDEX Engine should be directed to the leader node and which can be handled by any node.

Operations on the leader node only

These operations should be directed to the leader node only:

- Updates to data records. If you are adding more records to the MDEX Engine cluster, they should be sent to the leader node.

  This means that operations from the Data Ingest Web Service and the bulk load interface should be directed to the leader node only.

- Snapshot operations from the Administrative Web Service. Operations for taking and applying a snapshot should be directed to the leader node only.
- Updating operations from the Configuration Web Service. All requests to the MDEX Engine that require changing schema for the MDEX Engine records or the configuration of the MDEX Engine features should be directed to the leader node.

  If such requests are sent by Latitude Studio components, this requirement is achieved by configuring data sources that include the update host name and update port that reference the leader node.

- Administrative operations for the MDEX Engine. The following administrative operations should be directed to the leader node:
  - `/admin?op=merge`
  - `/admin?op=reload-services`
  - `/admin?op=updateaspell`

Operations on any node

The following operations can be directed to any node in the cluster (including any of the follower nodes):

- Any request from the Conversation Web Service (this means any request from Latitude Studio asking for read-only queries against the data).
- Any request from the Administrative Web Service other than snapshot-related operations.
- Any request utilizing the read-only version of the Configuration Web Service.
- Some administrative operations for the MDEX Engine. The following administrative operations can be directed to any node in the cluster:
  - `/admin?op=exit`
  - `/admin?op=flush`
  - `/admin?op=logroll`
  - `/admin?op=stats`
  - `/admin?op=statsreset`

Connecting the leader node with the Data Integrator

The connectors in the Latitude Data Integrator that send data to the MDEX Engine must be configured to reference the host name and port of the leader node.

The MDEX Engine instance running on this node is capable of receiving updates, since it has write permissions to the MDEX Engine index.

It is assumed that by this point, you have configured a leader node in the cluster.

To reference the leader node in the Data Integrator configuration:

1. In the connector's configuration, specify the host name and port of the leader node.

Connecting a cluster with Latitude Studio

In a typical implementation, a cluster of MDEX Engine nodes is connected to one or more Latitude Studio servers through a load balancer. The host and port of this load balancer must be referenced in the data

sources for Latitude Studio components. In addition, for any updating operations or queries, Latitude Studio data sources need to include an update host name and update port that reference the leader node.

Connecting a cluster with a load balancer

The load balancer between a cluster and one or more Latitude Studio servers must be aware of all nodes in the cluster. In addition, all data sources in Latitude Studio must reference the host name and port of the load balancer server.

Configuration of the load balancer involves taking care of these high-level tasks:

- To connect the load balancer with a cluster of MDEX Engine nodes, reference the host names and ports of all nodes in the load balancer configuration.
- To connect the load balancer with Latitude Studio servers, each data source in Latitude Studio must specify the host name and port of the load balancer.

Load balancer requirements

Load balancer and outer transactions

Examples of data sources

Latitude Studio supports two different scenarios for integration with the MDEX Engine cluster: read-only access, and read-only access with a specified host and port name for a leader node in the cluster (to enable updating operations). This topic contains examples of data sources for each scenario.

Note: The examples in this topic are specific to the cluster requirements. For complete information on how to configure data sources, see the *Latitude Studio User's Guide*.

Example of a read-only data source

A component may have a backing data source that allows read-only access to a cluster of MDEX Engine nodes.

If a data source allows read-only access to a cluster, all viewing actions are enabled for a component, along with editing of component's preferences. However, you cannot edit attribute groups for a read-only data source using the **Attribute Settings** component in the **Control Panel**. This is because the **Attribute Settings** component only lets you edit attribute groups for data sources that have update operations enabled.

Here is an example of a data source with read-only access to a cluster:

```
{
   "server":"cluster_loadbalancer_server.company.com",
   "port":"15000",
   "name":"cluster read-only",
}
```

Note that this configuration looks identical to a standard non-clustered data source definition file. However, since the MDEX Engine is read-only, only read operations will be enabled in Latitude Studio.

Example of a read-only data source with updating access

A component may have a backing data source with read-only access to a cluster that also has an updating access (leader node) host name and port specified.

In this case, all viewing actions are enabled for a component, along with editing of component's preferences. In addition, you can change attribute settings for this data source the Attribute Settings component. Because the data source references the leader node that is responsible for handling updates, these changes are sent to the leader node. The index changes from the leader node are propagated to the other nodes in the cluster, but this may not happen immediately.

Here is an example of a read-only data source with the leader's node host name and port specified:

```
{
  "server":"cluster_loadbalancer_server.company.com",
  "port":"15000",
  "name":"cluster updatable",
  "updateServer":"leaderNode.company.com",
  "updatePort":"18000",
}
```

Configuring a data source for cluster access

This procedure describes the format of the data source that allows both the read-only access to any node in the cluster through a load balancer and the updating access to the leader node.

Before configuring data sources so that they can connect to your cluster, ensure that you have already configured a load balancer between the Latitude Studio servers and the cluster. You will need to specify the load balancer's host name and port in the data sources.

In a non-clustered environment, after you install Latitude Studio and the MDEX Engine, the default data source references the port and host name of the server on which the MDEX Engine must be running once it has been installed. In particular, the `endeca-portal\data\endeca-data-sources` directory in Latitude Studio includes a `default.json` data source file, which has an implicit id of **default**. This file includes host and port information for the default installation of a single MDEX Engine server.

In a clustered environment, which type of data source you should configure for a Latitude Studio component depends on the type of information that will be sent from this component to the MDEX Engine:

- Latitude Studio components that make standard read-only queries (without sending any updating requests) can send requests to any node in the cluster.

  Data sources for such components must reference only the host and port of the load balancer configured between the Latitude Studio servers and the cluster of MDEX Engine nodes. This is achieved by configuring in the data source the host name and port of the load balancer: `"server":"loadBalancerHost", "port":"loadBalancerPort"`.

- Those components that in addition to read-only queries must make updating requests for changing the configuration should direct their updating queries to the leader node.

  Data sources for such components must reference the host and port of the leader node, in addition to referencing the load balancer server. This is achieved by configuring in the data source the host name and port of the leader node:`"updateServer":"leaderNodeHost", "updatePort":"leaderNodePort"`.

To configure a data source that allows both read-only and updating access to a cluster:

1. Specify in the data sources the host name and port of the load balancer, as well as the host name and port of the leader node, as shown in this example:

   ```
   {
     "server":"loadBalancerHost",
   ```

```
  "port":"loadBalancerPort",
  "name":"cluster loadbalanced datasource",
  "updateServer":"leaderNodeHost",
  "updatePort":"leaderNodePort"
}
```

This configuration allows instances of Latitude Studio to distribute all of the normal queries across all MDEX Engine nodes in the cluster, while sending all update operations to the leader node only.

Note: When the leader node changes, you should update the data source definition file in Latitude Studio to specify a host name and port of the new leader node, but the load balancer configuration does not need to be changed.

Maintaining a cluster

This section contains tasks you need to perform for cluster maintenance.

Removing a follower node

To remove a follower node, stop the MDEX Engine on this node with the `/admin?op=exit` command. This command gracefully shuts down a running MDEX Engine.

When you stop the MDEX Engine on one of the follower nodes, this node is removed from the cluster.

exit

Changing the name of the leader node

To change the leader node, stop the existing cluster, start the Cluster Coordinator on another node, and recreate the cluster with the new leader node.

To change which node is the leader node:

1. Stop the existing cluster by stopping the nodes and the Cluster Coordinator service.
2. Start the Cluster Coordinator service on another node.
3. Recreate the cluster with another node as the leader, by referencing the new location of the Cluster Coordinator to all nodes.

Chapter 10

Using Endeca SSL Certificate Utilities

This section describes how to use the Endeca `enecerts` utility to generate standard and custom SSL certificate files to be used for SSL connections to the MDEX Engine. It also documents how to convert PEM-format certificates to the standard Java KeyStore (JKS) format.

Certificate files used by Endeca components

You configure SSL among the standard Endeca components by using a set of certificate files.

The certificate files are listed in the following table:

Certificate file	Description
`eneCert.pem`	Certificate file used by all Endeca clients and servers to specify their identity when using SSL. This certificate should be thought of as the identity of the Endeca system, or as the identity of all components of the Endeca system.
`eneCA.pem`	Certificate authority file used by all Endeca clients and servers to authenticate the other endpoint of a communication channel.
`eneCA.key`	Private key that is used by the `enecerts` certificate authority program to sign the `eneCert.pem` certificate.
`eneCA.cer`	Certificate authority file.
`eneCert.p12`	Personal Information Exchange (PKCS12-format) key file.

Because these certificate files are not provided in the Endeca Latitude packages, you must use the Endeca-provided `enecerts` utility (documented in the next topic) to generate them.

Generating SSL certificates

You can use the `enecerts` utility program to generate new SSL certificate files.

The two typical scenarios for generating SSL certificates are:

- You are setting up SSL for the first time and need to generate the set of standard certificates.
- You want to generate custom certificates, such as those with a private key size greater than the default 1024 bits.

The `enecerts` utility resides in the `bin` directory (located in the MDEX Engine root directory) under the name `enecerts` (`enecerts.exe` on Windows).

Generating standard SSL certificates on UNIX

This procedure shows how to generate the set of standard certificates with a 1024-bit private key size on UNIX platforms.

To generate the SSL certificates on a UNIX machine:

1. Make sure that the `bin` directory (located in the MDEX Engine root directory) is in your $PATH environment variable.
2. Change to the directory in which the certificate files should reside.
3. Run the `enecerts` utility that creates the certificates.
4. Enter an export password of your choice.

If the programs finishes successfully, it displays the list of certificates that it generated.

Generating standard SSL certificates on Windows

This procedure shows how to generate the set of standard certificates with a 1024-bit private key size on Windows platforms.

To generate the SSL certificates on a Windows machine:

1. Open a command prompt.

   Note: Make sure you are using a new command prompt window, not one that is left over from earlier tasks.

2. To ensure that the MDEX Engine environment variables are set for this user process, change to the MDEX Engine root directory, and then run the `mdex_setup.bat` script.
3. Change to the directory in which the certificate files should reside.
4. Run the `enecerts` utility that creates the certificates:

   ```
   enecerts
   ```

5. Enter an export password of your choice.

If the programs finishes successfully, it displays the list of certificates that it generated.

Generating custom certificates

You can use the `enecerts` utility to generate customized certificates.

You can generate two types of customized certificates by:

- Specifying a private key size larger or smaller than the default 1024-bit size.
- Using your own CA file and private key to generate the `eneCert.pem` certificate.

The next two sections describe these operations.

Specifying a different certificate key size

The `--keysize` flag of the `enecerts` utility lets users specify the size of the generated private key. The flag syntax is:

```
--keysize bits
```

where *bits* is the private key size in bits (default value is 1024).

For example, the following Windows command creates certificates with a private key size of 2048 bits:

```
enecerts --keysize 2048
```

Using your CA file to generate certificates

By default, the `enecerts` utility produces the `eneCert.pem` certificate (used by all clients and servers to specify their identity when using SSL) and the `eneCA.pem` CA certificate (used by all clients and servers that wish to authenticate the other endpoint of a communication channel).

If you have your own CA certificate and private-key files, you can use the `--CAkey` and `--CAcert` flags to generate the `eneCert.pem` certificate. The private-key file (.key extension) is used to digitally sign the public key that is generated by the `enecerts` utility. Both flags must be used for this operation.

The syntax for the `--CAkey` flag is:

```
--CAkey private-key
```

where *private-key* is your own .key file with the private key for the CA that should be used to sign the generated certificate.

The syntax for the `--CAcert` flag is:

```
--CAcert cert-pem
```

where *cert-pem* is your CA certificate (.pem extension). This file is the same type of file as the default `eneCA.pem` CA certificate.

For example, the following Windows command creates a signed certificate file using your own CA certificate and private-key files:

```
enecerts --CAkey myCA.key --CAcert myCA.pem
```

You would then use the resulting `eneCert.pem` certificate and your CA file (`myCA.pem` in the example) to configure SSL for your Endeca components. If you have multiple machines in your deployment, you must also copy these files to the other machines.

Copying the SSL certificates to other machines

All machines that are running your deployment must use the same SSL certificates.

If you have multiple machines in your deployment, the standard or custom SSL certificates should be created only once, on one machine. You must then copy them to the directories (on all other machines) from which the MDEX Engine is started. All of the machines must use the same SSL certificates.

Configuring the MDEX Engine for SSL mutual authentication

This topic describes high level steps required to configure an SSL mutual authentication between the MDEX Engine server and an external server. The authentication uses certificates signed by a certificate authority (CA). This setup may apply if your MDEX Engine and external servers are hosted outside the firewall, or if a two-way authentication is required between them.

When using Web services and XQuery with the MDEX Engine, client servers running non-Endeca software may need to access the MDEX Engine server securely. In such cases, a secure connection may need to be established between these servers by configuring the MDEX Engine server for authentication with SSL certificates.

This procedure is an example of how you can establish a mutual (two-way) authentication. Treat this procedure as a high-level recommendation rather than the only way to establish a secure connection. Other steps may be required depending on your specific security requirements.

In this procedure, you create two signed certificates. First, you create a private key and send a Certificate Signing Request (CSR) to a CA from the external server. Next, you create a private key and send a CSR from the server hosting the MDEX Engine. You can then start the MDEX Engine referencing the `sslcertfile` which contains the MDEX Engine private key and the signed certificate.

To configure an SSL mutual authentication between the MDEX Engine and an external server:

1. Create a private key and send a Certificate Signing Request (CSR) from the external server. You can create a private key and issue a CSR by using one of these methods:
   - Use the server's certificate management utility (if applicable)
   - Use `openssl` commands
   - Consult your security and server administrator for assistance.

   Note: Some CA vendors require that the CSR be generated from 2046-bit length private keys and not from 1024-bit length keys. Please confirm with your CA vendor before issuing the CSR.

2. Send the CSR to a CA for signing.

   A CA provides a bundled key file (including intermediate keys) along with a signed certificate.

   Note: You will need the bundled key file for the Dgraph `--sslcafile` startup flag later on in this procedure.

3. Add the signed certificate to the keystore of the external server.

   For information, refer to the server's documentation or your security administrator.

4. Create a private key and certificate for the MDEX Engine server using the openssl utility.

   For example, the following command creates a 2048-bit RSA key that is valid for a year:

   ```
   openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout MDEXCert.pem -out MDEXCert.pem
   ```

   The resulting `MDEXCert.pem` file stores both the private key and the certificate.

5. Create a Certificate Signing Request (CSR) from the `MDEXCert.pem` file, as follows:

   ```
   openssl req -new -key MDEXCert.pem -out MDEXCertCSR.pem
   ```

6. Send the `MDEXCertCSR.pem` file to the CA for signing.
7. Obtain from the CA a bundled key file (including intermediate keys) along with a signed certificate.
8. Create an empty file, such as `MDEXSSLCert.pem` to store the combination of the MDEX Engine private key and the signed certificate.

   You can do this by copying the entry for the private key (step 4) into the empty file, and appending the contents of the signed certificate (Step 7) underneath the private key entry in the new file.

9. Reference the file `MDEXSSLCert.pem` created in the previous step in the `--sslcertfile` startup flag for the Dgraph.
10. Add both the `sslcafile` and `sslcertfile` flags to your Dgraph startup options, as follows:

    ```
    --sslcafile <full_path_to_location_of_bundled_key_file_in_step2>

    --sslcertfile <full_path_to_location_of_MDEXSSLCert.pem>
    ```

11. (Optional) If the external server requires the bundled keys for the MDEX Engine that you obtained in step 7, add them accordingly to its keystore.

Converting PEM-format keys to JKS format

This topic describes how to convert PEM-format certificates to the standard Java KeyStore (JKS) format.

The Java KeyStores can be used for communication between Endeca components that are configured for SSL (for example, between Latitude Studio and the MDEX Engine, if both are SSL-enabled).

Two utilities are referenced in the instructions below:

- `openssl`, which is located in the `bin` directory of the MDEX Engine distribution.
- `keytool`, which is located in the `bin` directory of the JDK distribution.

This procedure assumes the following:

- You have run the appropriate version of the `mdex_setup` script for your operating system.

  This script adds the `utilities` directory and the MDEX Engine binaries to the search path, and allows you to run the `openssl` utility from the directory of your choice.

  It is documented as part of the MDEX Engine installation in the *Latitude Installation Guide*.

- Your path will allow you to use the `keytool` utility from the directory of your choice.
- You have already generated the set of standard SSL certificates with the `enecerts` command, as documented earlier in this section.
- All of the input files are located in the local directory.

To convert the PEM-format keys to Java KeyStores:

1. Convert the certificate from PEM to PKCS12, using the following command:

   ```
   openssl pkcs12 -export -out eneCert.pkcs12 -in eneCert.pem
   ```

   You may ignore the warning message this command issues.

2. Enter and repeat the export password (`endeca`).

3. Create and then delete an empty truststore for Tomcat, using the following commands:

   ```
   keytool -genkey -keyalg RSA -alias "endeca" -keystore truststore.ks
   keytool -delete -alias endeca -keystore truststore.ks
   ```

   The `-genkey` command creates the default certificate shown below. (This is a temporary certificate that is subsequently deleted by the `-delete` command, so it does not matter what information you enter here.)

   ```
   Enter keystore password:
   Re-enter new password:
   What is your first and last name?
     [Unknown]:
   What is the name of your organizational unit?
     [Unknown]:
   What is the name of your organization?
     [Unknown]:
   What is the name of your City or Locality?
     [Unknown]:
   What is the name of your State or Province?
     [Unknown]:
   What is the two-letter country code for this unit?
     [Unknown]:
   Is CN=Unknown, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct?
     [no]: yes

   Enter key password for <endeca>
           (RETURN if same as keystore password):
   Re-enter new password:
   ```

4. Import the CA into the truststore, using the following command:

   ```
   keytool -import -v -trustcacerts -alias endeca-ca -file eneCA.pem -keystore truststore.ks
   ```

5. Enter the keystore password (`endeca`).

6. At the prompt, "Trust this certificate?" type `yes`.

7. Create an empty Java KeyStore, using the following commands:

   ```
   keytool -genkey -keyalg RSA -alias "endeca" -keystore keystore.ks
   keytool -delete -alias endeca -keystore keystore.ks
   ```

   The `-genkey` command creates the default certificate shown below. (This is a temporary certificate that is subsequently deleted by the `-delete` command, so it does not matter what information you enter here.)

   ```
   Enter keystore password:
   Re-enter new password:
   What is your first and last name?
     [Unknown]:
   What is the name of your organizational unit?
     [Unknown]:
   What is the name of your organization?
     [Unknown]:
   What is the name of your City or Locality?
     [Unknown]:
   ```

```
What is the name of your State or Province?
  [Unknown]:
What is the two-letter country code for this unit?
  [Unknown]:
Is CN="Unknown", OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct?
  [no]: yes
```

8. Import your private key into the empty JKS, using the following command:

```
keytool -v -importkeystore -srckeystore eneCert.pkcs12 -srcstoretype PKCS12 -destkeystore
keystore.ks -deststoretype JKS
```

Chapter 11

Latitude Studio Administrative Tasks

This section describes some of the administrative tasks performed in Latitude Studio.

About Latitude Studio administrative tasks

The Latitude Studio administrator generally controls the installation and setup of Latitude Studio and manages its users.

For full documentation on administering the underlying Liferay Portal, see the *Liferay Portal Administrator's Guide* version 5.2.

About the Latitude Studio Control Panel

You use the Latitude Studio **Control Panel** to perform administrative functions in Latitude Studio.

The **Control Panel** contains configuration options such as layout controls, attribute group settings, portal settings, and server settings.

It also provides access to a wide range of administrative controls, including managing accounts, adding new users, and monitoring performance.

Overview of the Control Panel sections

The **Control Panel** consists of five sections, each of which contains a number of tools.

User:	The logged-in user's personal space. It allows users to manage their accounts and pages.
Latitude:	Provides access to Latitude Studio administrative components, including: • **Data Sources** • **Data Source Bindings** • **Attribute Settings** • **Framework Settings** • **Performance Metrics**

Portal:	Intended for portal administrators to manage the user community.
Server:	Provides access to server administration tools such as resource usage, logging, and server shutdown It also allows administrators to manage instances of Latitude Studio and to install plugins (including custom components and themes).
Layout Control:	Allows the administrator to manage the integration of Web content into Latitude Studio applications.

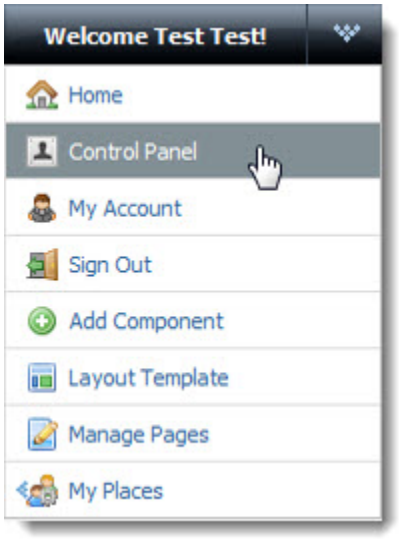
Accessing the Control Panel

The Latitude Studio **Control Panel** is available from the Dock menu.

After logging in to Latitude Studio, to display the **Control Panel**:

1. Point the cursor at the Dock in the upper-right corner of the page.

   The Dock is labeled "Welcome *<user name>*!"



2. From the drop-down menu, choose **Control Panel**.

Installing a new theme

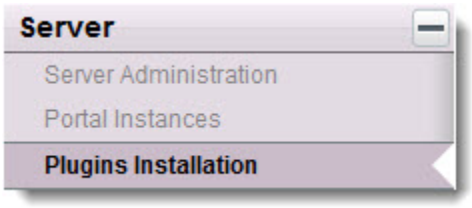
Themes define the look and feel of a Latitude Studio application. A Web developer can create a new theme for your application.

For more information about developing themes, see *http://www.liferay.com/web/guest/community/wiki/-/wiki/Main/Themes*.

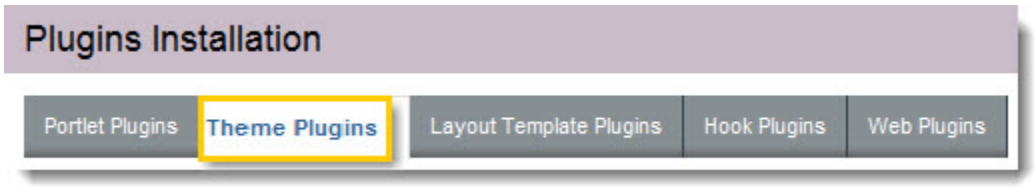
To install a new theme:

1. In the Dock, click **Control Panel**.

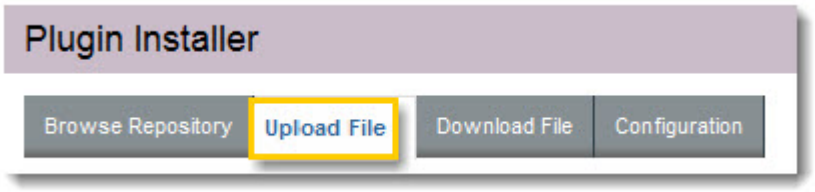
2. In the **Server** section of the **Control Panel**, click **Plugins Installation**.



3. In the **Plugins Installation** panel, click the **Theme Plugins** tab.



4. Click the **Install More Themes** button.
5. In the **Plugin Installer** panel, click **Upload File**.



6. Browse to select the theme's .war file, and then click **Open**.
7. Click **Install**.

Setting up the email server for Bookmarks support

The Latitude Studio contains a **Bookmarks** component. Before end users email bookmarks to other users, the Latitude Studio administrator must configure the mail server in the **Control Panel**.

To set up the mail server:

1. In the Dock, click **Control Panel**.
2. In the **Server** section of the **Control Panel Portal** menu, click **Server Administration**.
3. In the **Server Administration** panel, click the **Mail** tab.
4. On the **Mail** panel, fill out the following outgoing email settings:
   - **Outgoing SMTP Server**
   - **Outgoing Port**
   - **User Name**
   - **Password**

   For example:


Outgoing SMTP Server
acme.com.s7a1.pstmp.com
Outgoing Port
25
Use a Secure Network Connection
User Name
user_user@acme.com
Password
12345

5. Click **Save**.

Appendix A

Endeca Flag Reference

This appendix provides a description of the flags (options) used by the Dgraph program.

Dgraph flags

The Dgraph program starts the MDEX Engine.

You start the MDEX Engine by running a program called Dgraph, which you point at a set of indices loaded into the MDEX Engine by the Data Ingest Web Service. The Dgraph has a number of options that allow you to adjust the MDEX Engine.

The usage of Dgraph is as follows:

```
dgraph [-?Adv] [--flags] <db_prefix>
```

where `<db_prefix>` specifies the path to the directory, and the prefix used for the files in your Endeca application.

Flag	Description
?	Print the help message and exit.
`-v`	Verbose mode. Print information about each request to `stdout`.
`--ancestor_counts`	Compute counts for root managed attribute values and any intermediate managed attribute value selections. By default, the Dgraph only computes refinement counts for proper refinements (in other words, for actual managed attribute values). It does not compute counts for root managed attribute values or for any intermediate managed attribute value selections.
`--backlog-timeout` <*seconds*>	Specify the wait limit (in seconds) for a query that has been read and queued for processing. This is the maximum number of seconds that a query is allowed to spend waiting in the processing queue before the Dgraph responds with a timeout message. The default value is 0 seconds.

Flag	Description
`--bulk_load_port` <*num*>	Specify the port for bulk load ingest operations. This port number must be different from the port specified by the `--port` flag. If this flag is not used when starting the MDEX Engine, then the default bulk load port is either: • `5556` (if the `--port` flag is not used) • The number specified by the `--port` flag plus one
`--cmem` <*MB*>	Specify an absolute value in MB for the MDEX Engine cache. When an absolute value is not specified with the `--cmem` flag, the default Dgraph cache size is computed as 10% of the amount of RAM available in the system.
`--coordinator_host` <*host name*>	Specify the host name of the server on which the Cluster Coordinator service is running. You specify this flag along with the `--coordinator_port` flag when you start the MDEX Engine as one of the nodes in the cluster.
`--coordinator_port` <*num*>	Specify the port of the server on which the Cluster Coordinator service is running. The Cluster Coordinator expects that you specify the port 2181 (if you specify another port, changes to the Cluster Coordinator configuration file are required). You specify this flag along with the `--coordinator_host` flag when you start the MDEX Engine as one of the nodes in the cluster.
`--disable_fast_aspell`	Disable fast mode for the aspell spelling module. If you disable fast mode, it decreases the performance of the spelling correction, but may allow additional queries to be corrected. When the fast mode is enabled, it can significantly speed up applications that use spelling correction features with the aspell module. The fast mode is used by default.

Flag	Description
`--esampmin` <*num*>	Specify the minimum number of records to sample during refinement computation. The default is `0`. Tuning recommendations: • For most applications, larger values reduce performance without improving dynamic refinement ranking quality. • For some applications with extremely large, non-hierarchical managed attributes (if they cannot be avoided), larger values can meaningfully improve dynamic refinement ranking quality with minor performance cost.
`--follower` <*name*>	Specify the name of the MDEX Engine node that should serve as one of the follower nodes in the cluster. This name must be unique across the cluster, and must also be a valid directory name (characters such as slashes (/) are not allowed). You can start more than one node in the cluster with this command, thus designating more than one follower node. Before starting the MDEX Engine with this command flag, ensure that the Cluster Coordinator service is running on the server that serves as the leader node. All nodes must be able to connect to the Cluster Coordinator. Therefore, when you specify a follower node with the `--follower` flag, also specify for the follower node the host name and port of the Cluster Coordinator service using the `--coordinator_host` and `--coordinator_port` commands.  **Note:** If you start a node without the `--follower` flag, the Cluster Coordinator assumes this is the leader node. Since there could be one and only one leader node in the cluster, the MDEX Engine will not start if it is asked to be the leader node when a leader node already exists.
`--help`	Print the help message and exit.
`--implicit_exact`	Disable approximate computation of implicit refinements. Use of this option is not recommended. If this option is not enabled, managed attribute values without full coverage of the current result record set may sometimes be returned as implicit refinements, although the probability of such "false" implicit refinements is minuscule.

Flag	Description
`--implicit_sample` <*num*>	Set the maximum number of records to sample when computing implicit refinements (which are a performance tuning parameter). The default value is 1024.
`--latin1`	Ignore character accents when handling search requests, and use ISO Latin 1 character mappings when processing search requests.
`--log` <*path*>	Specify the path for the Dgraph request log file. The default log file is named `dgraph.reqlog`.
`--net-timeout` <*num*>	Specify the maximum number of seconds the Dgraph waits for the client to download data from queries across the network. The default network timeout value is `30` seconds.
`--out` <*stdout/stderr file*>	Specify file path to which stdout/stderr should be remapped. The default is to use default stdout/stderr for the process.
`--pidfile` <*pidfile-path*>	Specify the file to which to write the process ID (pid). If unspecified, the default name of the pid file depends on how the Dgraph starts. Running the Dgraph from the command line creates a default named `dgraph.pid`.
`--port` <*num*>	Specify the port to use in server (non-interactive) mode. The default is `5555`.
`--search_max` <*num*>	Specify the maximum number of terms for text search. Default is `10`.
`--snip_cutoff` <*num*>	Limit the number of words in an attribute that the MDEX Engine evaluates to identify the snippet. If a match is not found within <*num*> words, the MDEX Engine does not return a snippet, even if a match occurs later in the attribute value. If the flag is not specified, or <*num*> is not specified, the default is 500.
`--snip_disable`	Globally disable snippeting.

Flag	Description
`--sslcafile` <*CA-certfile-path*>	Specify the path of the `eneCA.pem` Certificate Authority file that the Dgraph will use to authenticate SSL communications with other Endeca components. If not given, SSL mutual authentication is not performed.
`--sslcertfile` <*certfile-path*>	Specify the path of the `eneCert.pem` certificate file that will be used by the Dgraph to present to any client for SSL communications. If not given, SSL is not enabled for Dgraph communications.
`--sslcipher` <*cipher-list*>	Set one or more cipher names (such as RC4-SHA) that specify the minimum cryptographic algorithm that the Dgraph will use during the SSL negotiation. If multiple ciphers are specified, the names must be separated by colons.
`--stat-all`	Enable all available dynamic attribute value characteristics. Note that this option has performance implications and is not intended for production use.
`--stat-brel`	Create dynamic record attributes indicating the relevance rank assigned to full-text search result records.
`--syslog`	Direct all output to syslog.
`--thesaurus_cutoff` <*limit*>	Set a limit on the number of words in a user's search query that are subject to thesaurus replacement. If more terms than this number match thesaurus entries, none of the terms are thesaurus expanded. The default value of <*limit*> is 3. This means that up to 3 words in a user's search query can be replaced with thesaurus entries. This option is intended as a performance guard against very expensive thesaurus queries. Lower values improve thesaurus engine performance.

Flag	Description
`--thesaurus_multiword_nostem`	Specify that words in a multiple-word thesaurus form should be treated like phrases and should not be stemmed, which increases performance for some query loads. Single-word terms are subject to stemming regardless of whether this flag is specified. This flag prevents the Dgraph from expanding multi-word thesaurus forms by stemming. Thesaurus entries continue to match any stemmed form in the query, but multi-word expansions only include explicitly listed forms. To get the multi-word stemmed thesaurus expansions, the various forms must be listed explicitly in the thesaurus.
`--threads` <*num*>	Specify the number of threads in the MDEX Engine threading pool. The value of <*num*> must be a positive integer (that is, 1 or greater). The default for *num* is 2. The recommended number of threads for the MDEX Engine is typically equal to the number of cores on the MDEX Engine server.
`--unctrct`	Specify to the Dgraph not to compute implicit managed attributes, and to only compute and present explicitly specified managed attributes, when displaying refinements in navigation results. Specifying this flag does not reduce the size of the resulting record set that is being displayed; however, it improves run-time performance of the MDEX Engine. Be aware that if you use this flag, in order to receive meaningful navigation refinements, you need to make top-level precedence rules work for ALL outbound queries.
`--validate_data`	Validate that all indexed data loads and then exit.
`--version`	Print version information and exit. This includes both the Latitude version and the internal MDEX Engine identifier and index format version.
`--wildcard_max` <*count*>	Specify the maximum number of terms that can match a wildcard term in a wildcard query that contains punctuation, such as `ab*c.def*`. The default is `100`.

Flag	Description
`--whymatch`	Enable computation of "Why Did It Match" dynamic record attributes returned as results of full-text search queries. These dynamic attributes contain a copy of the attribute key and value that caused the match, along with query interpretation notes (spelling, thesaurus, and so on).
`--whymatchConcise`	Similar to `--whymatch`, but produces more concise dynamic attribute values containing only the attribute key and query interpretation notes. This is useful when the attribute value might include large amounts of text, such as document contents.
`--wordinterp`	Enable computation of word interpretation dynamic supplement (or see-also) objects, which report on alternate forms of user query terms considered by the text search engine while processing full-text (record) search requests.
`--xquery_fndoc` <*mode*>	Specifies the handling of the `fn:doc()` function within XQuery. The following values are supported: • `none` causes all calls to `fn:doc()` to fail. • `sandbox` allows `fn:doc()`, but interprets its argument as a relative path within the XML subdirectory of the XQuery service directory. • `open` allows `fn:doc()` and interprets its argument as a URL. Note that `open` is not supported for use in deployed applications. If not specified, defaults to `sandbox`.
`--xquery_path` <*path*>	Specify the directory in which XQuery Web service resources are located. XQuery main modules and WSDL files are loaded from this directory. Library modules are loaded from the `lib` subdirectory. If not specified, a user XQuery path is not used.

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