

Hazelcast Management Center Reference Manual

Version 3.11.4

Table of Contents

1. Browser Compatibility	1
2. Upgrading Notes	1
3. Deploying and Starting	1
3.1. Starting with WAR File	2
3.2. Starting with a License	2
3.3. Configure Disk Usage Control	2
3.4. Enabling TLS/SSL When Starting with WAR File	3
3.5. Enabling HTTP Port	4
3.6. Mutual Authentication	4
3.7. Configuring Session Timeout	6
3.8. Enabling Multiple Simultaneous Login Attempts	6
3.9. Disable Login Configuration	6
3.10. Forcing Logout on Multiple Simultaneous Login Attempts	7
3.11. Using a Dictionary to Prevent Weak Passwords	7
3.12. Starting with an Extra Classpath	8
3.13. Starting with Scripts	8
3.14. Deploying to Application Server	8
3.15. Connecting Hazelcast members to Management Center	9
3.16. Managing TLS Enabled Clusters	11
3.17. Configuring Update Interval	12
3.18. Configuring Logging	12
4. Getting Started	13
5. Variable Replacers	15
5.1. EncryptionReplacer	15
5.2. PropertyReplacer	17
5.3. Implementing Custom Replacers	17
6. Using Management Center with TLS/SSL Only	17
7. Authentication Options	18
7.1. Active Directory Authentication	18
7.2. JAAS Authentication	20
7.3. LDAP Authentication	22
8. User Interface Overview	26
8.1. Toolbar	26
8.2. Menu	27
9. Status Page	29
9.1. Memory Utilization	29
9.2. Heap Memory Distribution	30
9.3. Map Memory Distribution	30

9.4. Cluster State/Health	30
9.5. Partition Distribution	31
9.6. CPU Utilization	31
10. Monitoring Caches	32
11. Managing Maps	34
11.1. Map Browser	35
11.2. Map Config	36
11.3. Map Monitoring	36
12. Monitoring Replicated Maps	38
13. Monitoring Queues	40
14. Monitoring Topics	42
15. Monitoring Reliable Topics	42
16. Monitoring Multimaps	43
17. Monitoring Executors	44
18. Monitoring WAN Replication	46
18.1. Changing WAN Publisher State	47
18.2. WAN Sync	47
18.3. WAN Consistency Check	49
18.4. Add Temporary WAN Replication Configuration	50
19. Monitoring Members	51
20. Monitoring Clients	54
21. Monitoring PN Counters	57
22. Monitoring Flake ID Generators	58
23. Scripting	60
24. Executing Console Commands	61
25. Creating Alerts	62
25.1. Creating Filters for Cluster Members	63
25.2. Creating Filters for Data Types	64
26. Administering Management Center	65
26.1. Cluster State	66
26.2. Manage License	67
26.3. Socket Interceptor	68
26.4. Change URL	70
26.5. Users	71
26.6. Rolling Upgrade	72
26.7. Hot Restart	72
27. License Information	78
28. Checking Past Status with Time Travel	79
29. Clustered REST via Management Center	80
29.1. Enabling Clustered REST	80
29.2. Clustered REST API Root	80

29.3. Clusters Resource	81
29.4. Cluster Resource	81
29.5. Members Resource	82
29.6. Member Resource	82
29.7. Client Endpoints Resource	86
29.8. Maps Resource	87
29.9. MultiMaps Resource	88
29.10. ReplicatedMaps Resource	89
29.11. Queues Resource	91
29.12. Topics Resource	92
29.13. Executors Resource	93
29.14. Client Statistics Resource	94
30. Clustered JMX via Management Center	97
30.1. Configuring Clustered JMX	97
30.2. Clustered JMX API	99
30.3. Integrating with New Relic	107
30.4. Integrating with AppDynamics	109
31. Management Center Documentation	110
32. Suggested Heap Size	110

Welcome to the Hazelcast IMDG Management Center Manual. This manual includes information on how to use Hazelcast Management Center.

Hazelcast Management Center enables you to monitor and manage your cluster members running Hazelcast. In addition to monitoring the overall state of your clusters, you can also analyze and browse your data structures in detail, update map configurations and take thread dumps from members. You can run scripts (JavaScript, Groovy, etc.) and commands on your members with its scripting and console modules.

1. Browser Compatibility

Hazelcast Management Center is tested and works on the following browsers:

- Chrome 65 and newer
- Firefox 57 and newer
- Safari 11 and newer
- Internet Explorer 11 and newer

2. Upgrading Notes

Upgrading to 3.10.x

Starting with Hazelcast Management Center 3.10:

- Hazelcast Management Center's default URL has been changed from `localhost:8080/mancenter` to `localhost:8080/hazelcast-mancenter`.
- Default home directory location has been changed from `<user-home>/mancenter-<version>` to `<user-home>/hazelcast-mancenter-<version>`.
- Name of the WAR file is named has been changed from `mancenter-{version}.war` to `hazelcast-mancenter-{version}.war`.

3. Deploying and Starting

You have two options to start Hazelcast Management Center:

1. Deploy the file `hazelcast-mancenter-3.11.4.war` on your Java application server/container.
2. Start Hazelcast Management Center from the command line. This means Hazelcast cluster members should know the URL of the `hazelcast-mancenter` application before they start.



Hazelcast Management Center is compatible with Hazelcast cluster members having the same or the previous minor version. For example, Hazelcast Management Center version 3.10.x works with Hazelcast cluster members having version 3.9.x or 3.10.x.



Starting with version 3.10, you need Java Runtime Environment 1.8 or later for running Hazelcast Management Center.

3.1. Starting with WAR File

Here are the steps.

- Download the latest Hazelcast Management Center ZIP from <http://www.hazelcast.org/download/> under Management Center section. The ZIP contains the `hazelcast-mancenter-3.11.4.war` file under the directory `hazelcast-management-center-3.11.4`.
- You can directly start `hazelcast-mancenter-3.11.4.war` file from the command line. The following command will start Hazelcast Management Center on port 8080 with context path 'hazelcast-mancenter' (<http://localhost:8080/hazelcast-mancenter>).

```
java -jar hazelcast-mancenter-3.11.4.war 8080 hazelcast-mancenter
```

3.2. Starting with a License

When starting Management Center from the command line, a license can be provided using the system property `hazelcast.mc.license`. For example by using the command line parameter:

```
java -Dhazelcast.mc.license=<key> -jar hazelcast-mancenter-3.11.4.war
```

When this option is used the license provided will take precedence over any license set and stored previously using the user interface. Previously stored licenses are not affected and will be used again when the Management Center is started without the `hazelcast.mc.license` property. This also means no new license can be stored when the property is used.

3.3. Configure Disk Usage Control

Starting with 3.10, the disk space used by Management Center is constrained to avoid exceeding available disk space. When the set limit is exceeded Management Center deals with this in two ways:

- persisted statistics data is removed, starting with oldest (one month at a time)
- persisted alerts are removed for filters that report further alerts

Usually, either of the above automatically resolves the situation and makes room for new data. Depending on the disk usage configuration and the kind of data that contributes to exceeding the limit it can occur that the limit continues to be exceeded. In this case Management Center will not store new alerts or metrics data. Other data (like configurations and account information) is still stored as they hardly cause larger data volumes.

An active blockage is reported in the UI as an error notification, as shown below:

However, storage operations will not explicitly fail or report errors since this would constantly cause interruptions and error logging - both in the UI and logs.

One way to resolve a blockage is deleting the data manually, e.g., deleting a filter that caused many alerts in the alerts view. Another way is to restart Management Center with a higher limit or in **purge** mode (if not used before).

You can use the following system properties to configure Management Center's disk usage control:

- **-Dhazelcast.mc.disk.usage.mode**: Available values are **purge** and **block**. If the mode is **purge**, persisted statistics data is removed (as stated in the beginning of this section). If it is **block**, persisted statistics data is not removed. Its default value is **purge**.
- **-Dhazelcast.mc.disk.usage.limit**: The *high water mark* in **KB**, **MB** or **GB**. Its default value adapts to the available disk space and the space already used by database files. At a maximum it will default to **512MB** unless existing data already exceeds this maximum. In that case the already used space is used as limit. The minimal allowed limit is **2MB**.
- **-Dhazelcast.mc.disk.usage.interval**: Specifies how often the disk usage is checked to see if it exceeds the limit (**hazelcast.mc.disk.usage.limit**). It is in milliseconds and its default value is **1000** milliseconds. Set values have to be in range of **50** to **5000** ms.

It is important to understand that the limit given is a *soft* limit, a *high water mark*. Management Center will act if it is exceeded but it might be exceeded by a margin between two measurements. Do not set it to the absolute maximum disk space available. A smaller interval increases accuracy but also performance overhead.

In case of a misconfiguration of any of the three properties Management Center will log the problem and abort startup immediately.

3.4. Enabling TLS/SSL When Starting with WAR File

When you start Management Center from the command line, it will serve the pages unencrypted by using "http", by default. To enable TLS/SSL, use the following command line parameters when starting the Management Center:

- **-Dhazelcast.mc.tls.enabled=true** (default is false)
- **-Dhazelcast.mc.tls.keyStore=path to your keyStore**
- **-Dhazelcast.mc.tls.keyStorePassword=password for your keyStore**
- **-Dhazelcast.mc.tls.trustStore=path to your trustStore**
- **-Dhazelcast.mc.tls.trustStorePassword=password for your trustStore**

You can leave trust store and trust store password values empty to use the system JVM's own trust store.

Following is an example on how to start Management Center with TLS/SSL enabled from the command line:

```
java -Dhazelcast.mc.tls.enabled=true -Dhazelcast.mc.tls.keyStore=/some/dir/selfsigned
.jks -Dhazelcast.mc.tls.keyStorePassword=yourpassword -jar hazelcast-mancenter-3.11.4
.war
```

You can access Management Center from the following HTTPS URL on port 8443: <https://localhost:8443/hazelcast-mancenter>

On the member side, you need to configure the Management Center URL as <https://localhost:8443/hazelcast-mancenter> and also set the following JVM arguments when starting the member:

```
-Djavax.net.ssl.trustStore=path to your trustStore -Djavax.net.ssl.trustStorePassword
=yourpassword
```



If you plan to use a self-signed certificate, make sure to create a certificate with the hostname of the machine you will deploy Management Center on. Otherwise, you will see a line similar to the following in the member logs:
`javax.net.ssl.SSLHandshakeException: java.security.cert.CertificateException: No subject alternative names matching IP address 127.0.0.1 found`

To override the HTTPS port, you can give it as the second argument when starting Management Center. For example:

```
java -Dhazelcast.mc.tls.enabled=true -Dhazelcast.mc.tls.keyStore=/dir/to/certificate
.jks -Dhazelcast.mc.tls.keyStorePassword=yourpassword -jar hazelcast-mancenter-3.11.4
.war 80 443 hazelcast-mancenter
```

This will start Management Center on HTTPS port 443 with context path `/hazelcast-mancenter`.



You can encrypt the keyStore/trustStore passwords and pass them as command line arguments in encrypted form for improved security. See [Variable Replacers](#) for more information.

3.5. Enabling HTTP Port

By default, HTTP port is disabled when you enable TLS. If you want to have an open HTTP port that redirects to the HTTPS port, use the following command line argument:

```
-Dhazelcast.mc.tls.enableHttpPort=true
```

3.6. Mutual Authentication

Mutual authentication allows cluster members to have their keyStores and Management Center to have its trustStore so that Management Center can know which members it can trust. To enable

mutual authentication, you need to use the following command line parameters when starting the Management Center:

```
-Dhazelcast.mc.tls.mutualAuthentication=REQUIRED
```

And on the member side, you need to set the following JVM arguments when starting the member:

```
-Djavax.net.ssl.keyStore=path to your keyStore -Djavax.net.ssl.keyStorePassword  
=yourpassword
```

Please see the below example snippet to see the full command to start Management Center:

```
java -Dhazelcast.mc.tls.enabled=true -Dhazelcast.mc.tls.keyStore=path to your keyStore  
-Dhazelcast.mc.tls.keyStorePassword=password for your keyStore -Dhazelcast.mc.tls  
.trustStore=path to your trustStore -Dhazelcast.mc.tls.trustStorePassword=password for  
your trustStore -Dhazelcast.mc.tls.mutualAuthentication=REQUIRED -jar hazelcast-  
mancenter-3.11.4.war
```

And the full command to start the cluster member:

```
java -Djavax.net.ssl.keyStore=path to your keyStore -Djavax.net.ssl.keyStorePassword  
=yourpassword -Djavax.net.ssl.trustStore=path to your trustStore -Djavax.net.ssl  
.trustStorePassword=yourpassword -jar hazelcast.jar
```

The parameter `-Dhazelcast.mc.tls.mutualAuthentication` has two options:

- **REQUIRED**: If the cluster member does not provide a keystore or the provided keys are not included in Management Center's truststore, the cluster member will not be authenticated.
- **OPTIONAL**: If the cluster member does not provide a keystore, it will be authenticated. But if the cluster member provides keys that are not included in Management Center's truststore, the cluster member will not be authenticated.

3.6.1. Excluding Specific TLS/SSL Protocols

When you enable TLS on the Management Center, it will support the clients connecting with any of the TLS/SSL protocols that the JVM supports by default. In order to disable specific protocols, you need to set the `-Dhazelcast.mc.tls.excludeProtocols` command line argument to a comma separated list of protocols to be excluded from the list of supported protocols. For example, to allow only TLSv1.2, you need to add the following command line argument when starting the Management Center:

```
-Dhazelcast.mc.tls.excludeProtocols=SSLv3,SSLv2Hello,TLSv1,TLSv1.1
```

When you specify the above argument, you should see a line similar to the following in the

Management Center log:

```
2017-06-21 12:35:54.856:INFO:oejus.SslContextFactory:Enabled Protocols [TLSv1.2] of [SSLv2Hello, SSLv3, TLSv1, TLSv1.1, TLSv1.2]
```

3.7. Configuring Session Timeout

If you have started Management Center from the command line by using the WAR file, by default, sessions that are inactive for 30 minutes are invalidated. To change this, you can use the `-Dhazelcast.mc.session.timeout.seconds` command line parameter.

For example, the following command starts Management Center with a session timeout period of 1 minute:

```
java -Dhazelcast.mc.session.timeout.seconds=60 -jar hazelcast-mancenter-3.11.4.war
```

If you have deployed Management Center on an application server/container, you can configure the default session timeout period of the application server/container to change the session timeout period for Management Center. If your server/container allows application specific configuration, you can use it to configure the session timeout period for Management Center.

3.8. Enabling Multiple Simultaneous Login Attempts

Normally, a user account on Management Center can't be used from multiple locations at the same time. If you want to allow others to log in, when there's already someone logged in with the same username, you can start Management Center with the `-Dhazelcast.mc.allowMultipleLogin=true` command line parameter.

3.9. Disable Login Configuration

In order to prevent password guessing attacks, logging in is disabled temporarily after a number of failed login attempts. When not configured explicitly, default values are used, i.e., logging in is disabled for 5 seconds when a username is failed to log in consecutively 3 times. During this 5 seconds of period, logging in will not be allowed even when the correct credentials are used. After 5 seconds, the user will be able to log in using the correct credentials.

Assuming the configuration with the default values, if the failed attempts continue (consecutively 3 times) after the period of disabled login passes, this time the disable period will be multiplied by 10 and logging in will be disabled for 50 seconds; the whole process repeats itself until the user logs in successfully. By default, there's no upper limit to the disable period, but can be configured by using the `-Dhazelcast.mc.maxDisableLoginPeriod` parameter.

Here is a scenario, in the given order, with the default values:

1. You try to login with your credentials consecutively 3 times but failed.

2. Logging in is disabled and you have to wait for 5 seconds.
3. After 5 seconds have passed, logging in is enabled.
4. You try to login with your credentials consecutively 3 times but again failed.
5. Logging in is disabled again and this time you have to wait for 50 seconds until your next login attempt.
6. And so on; each 3 consecutive login failures will cause the disable period to be multiplied by 10.

You can configure the number of failed login attempts, initial and maximum duration of the disabled login and the multiplier using the following command line parameters:

- `-Dhazelcast.mc.failedAttemptsBeforeDisableLogin`: Number of failed login attempts that cause the logging in to be disabled temporarily. Default value is **3**.
- `-Dhazelcast.mc.initialDisableLoginPeriod`: Initial duration for the disabled login in seconds. Default value is **5**.
- `-Dhazelcast.mc.disableLoginPeriodMultiplier`: Multiplier used for extending the disable period in case the failed login attempts continue after disable period passes. Default value is **10**.
- `-Dhazelcast.mc.maxDisableLoginPeriod`: Maximum amount of time for the disable login period. This parameter does not have a default value. By default, disabled login period is not limited.

3.10. Forcing Logout on Multiple Simultaneous Login Attempts

If you haven't allowed multiple simultaneous login attempts explicitly, the first user to login with a username stays logged in until that username explicitly logs out or its session expires. In the meantime, no one else can login with the same username. If you want to force logout for the first user and let the newcomer login, you need to start Management Center with the `-Dhazelcast.mc.forceLogoutOnMultipleLogin=true` command line parameter.

3.11. Using a Dictionary to Prevent Weak Passwords

In order to prevent certain words from being included in the user passwords, you can start the Management Center with `-Dhazelcast.mc.security.dictionary.path` command line parameter which points to a text file that contains a word on each line. As a result, the user passwords will not contain any dictionary words, making them harder to guess.

The words in the dictionary need to be at least 3 characters long in order to be used for checking the passwords. The shorter words will be ignored to prevent them from blocking the usage of many password combinations. You can configure the minimum length of words by starting the Management Center with `-Dhazelcast.mc.security.dictionary.minWordLength` command line parameter and setting it to a number.

An example to start the Management Center using the aforementioned parameters is shown below:

```
java -Dhazelcast.mc.security.dictionary.path=/usr/MCtext/pwd.txt -Dhazelcast.mc
.security.dictionary.minWordLength=3 -jar hazelcast-mancenter-3.11.4.war
```

3.12. Starting with an Extra Classpath

You can also start the Management Center with an extra classpath entry (for example, when using JAAS authentication) by using the following command:

```
java -cp "hazelcast-mancenter-3.11.4.war:/path/to/an/extra.jar" Launcher 8080
hazelcast-mancenter
```

On Windows, the command becomes as follows (semicolon instead of colon):

```
java -cp "hazelcast-mancenter-3.11.4.war;/path/to/an/extra.jar" Launcher 8080
hazelcast-mancenter
```

3.13. Starting with Scripts

Optionally, you can use the scripts `start.bat` or `start.sh` to start the Management Center.

3.14. Deploying to Application Server

Or, instead of starting at the command line, you can deploy it to your application server (Tomcat, Jetty, etc.).

If you have deployed `hazelcast-mancenter-3.11.4.war` in your already-SSL-enabled web container, configure `hazelcast.xml` as follows.

```
<management-center enabled="true">
  https://localhost:sslPortNumber/hazelcast-mancenter
</management-center>
```

If you are using an untrusted certificate for your container, which you created yourself, you need to add that certificate to your JVM first. Download the certificate from the browser, after this you can add it to JVM as follows.

```
keytool -import -noprompt -trustcacerts -alias <AliasName> -file <certificateFile> -
keystore $JAVA_HOME/jre/lib/security/cacerts -storepass <Password>
```

3.15. Connecting Hazelcast members to Management Center

After you perform the above steps, make sure that <http://localhost:8080/hazelcast-mancenter> is up.

Configure your Hazelcast members by adding the URL of your web application to your `hazelcast.xml`. Hazelcast members will send their states to this URL.

```
<management-center enabled="true">
  http://localhost:8080/hazelcast-mancenter
</management-center>
```

You can configure it programmatically as follows.

```
Config config = new Config();
config.getManagementCenterConfig().setEnabled(true);
config.getManagementCenterConfig().setUrl("http://localhost:8080/hazelcast-mancenter");

HazelcastInstance hz = Hazelcast.newHazelcastInstance(config);
```

If you enabled TLS/SSL on Management Center, then you will need to configure the members with the relevant keystore & trustore. In that case you expand the above configuration as follows.

```
<management-center enabled="true">
  <url>https://localhost:sslPortNumber/hazelcast-mancenter</url>
  <mutual-auth enabled="true">
    <factory-class-name>
      com.hazelcast.nio.ssl.BasicSSLContextFactory
    </factory-class-name>
    <properties>
      <property name="keyStore">keyStore</property>
      <property name="keyStorePassword">keyStorePassword</property>
      <property name="trustStore">trustStore</property>
      <property name="trustStorePassword">trustStorePassword</property>
      <property name="protocol">TLS</property>
    </properties>
  </mutual-auth>
</management-center>
```

In the example above, Hazelcast's default SSL context factory (`BasicSSLContextFactory`) is used; you can also provide your own implementation of this factory.

Here are the descriptions for the properties:

- **keystore:** Path of your keystore file. Note that your keystore's type must be JKS.

- **keyStorePassword:** Password to access the key from your keystore file.
- **keyManagerAlgorithm:** Name of the algorithm based on which the authentication keys are provided.
- **keyStoreType:** The type of the keystore. Its default value is JKS.
- **truststore:** Path of your truststore file. The file truststore is a keystore file that contains a collection of certificates trusted by your application. Its type should be JKS.
- **trustStorePassword:** Password to unlock the truststore file.
- **trustManagerAlgorithm:** Name of the algorithm based on which the trust managers are provided.
- **trustStoreType:** The type of the truststore. Its default value is JKS.
- **protocol:** Name of the algorithm which is used in your TLS/SSL. Its default value is TLS. Available values are:
 - SSL
 - SSLv2
 - SSLv3
 - TLS
 - TLSv1
 - TLSv1.1
 - TLSv1.2

See the programmatic configuration example below:

```
Config config = new Config();
SSLContextFactory factory = new BasicSSLContextFactory();

MCMutualAuthConfig mcMutualAuthConfig = new MCMutualAuthConfig().setEnabled(true)
    .setFactoryImplementation(factory)
        .setProperty("keyStore", "/path/to/keyStore")
        .setProperty("keyStorePassword", "password")
        .setProperty("keyManagerAlgorithm", "SunX509")
        .setProperty("trustStore", "/path/to/truststore")
        .setProperty("trustStorePassword", "password")
        .setProperty("trustManagerAlgorithm", "SunX509");

ManagementCenterConfig mcc = new ManagementCenterConfig()
    .setEnabled(true)
    .setMutualAuthConfig(mcMutualAuthConfig)
    .setUrl("https://localhost:8443/hazelcast-mancenter");

config.setManagementCenterConfig(mcc);

HazelcastInstance hz = Hazelcast.newHazelcastInstance(config);
```



For the protocol property, we recommend you to provide SSL or TLS with its version information, e.g., TLSv1.2. Note that if you write only SSL or TLS, your application will choose the SSL or TLS version according to your Java version.

Now you can start your Hazelcast cluster, browse to <http://localhost:8080/hazelcast-mancenter> or <https://localhost:sslPortNumber/hazelcast-mancenter> (depending on installation) and setup your [administrator account](#) explained in the next section.

3.16. Managing TLS Enabled Clusters

If a Hazelcast cluster is configured to use TLS for communication between its members using a self-signed certificate, Management Center will not be able to perform some of the operations that use the cluster's HTTP endpoints (such as shutting down a member or getting the thread dump of a member). This is so because self-signed certificates are not trusted by default by the JVM. For these operations to work, you need to configure a `truststore` containing the public key of the self-signed certificate when starting the JVM of Management Center using the following command line parameters:

- `-Dhazelcast.mc.httpClient.tls.trustStore=path to your trust store`
- `-Dhazelcast.mc.httpClient.tls.trustStorePassword=password for your trust store`
- `-Dhazelcast.mc.httpClient.tls.trustStoreType`: Type of the trust store. Its default value is JKS.
- `-Dhazelcast.mc.httpClient.tls.trustManagerAlgorithm`: Name of the algorithm based on which the authentication keys are provided. System default will be used if none provided. You can find out the default by calling `javax.net.ssl.TrustManagerFactory#getDefaultAlgorithm` method.



You can encrypt the `trustStore` password and pass it as a command line argument in encrypted form for improved security. See [Variable Replacers](#) for more information.

By default, JVM also checks for the validity of the hostname of the certificate. If this test fails, you will see a line similar to the following in the Management Center logs:

```
javax.net.ssl.SSLHandshakeException: java.security.cert.CertificateException: No
subject alternative names matching IP address 127.0.0.1 found
```

If you want to disable this check, you will need to start Management Center with the following command line parameter:

```
-Dhazelcast.mc.disableHostnameVerification=true
```

3.16.1. Managing Mutual Authentication Enabled Clusters

If mutual authentication is enabled for the cluster (as described [here](#)), Management Center needs to have a `keyStore` to identify itself. For this, you need to start Management Center with the following command line parameters:

- `-Dhazelcast.mc.httpClient.tls.keyStore=path` to your key store
- `-Dhazelcast.mc.httpClient.tls.keyStorePassword=password` for your key store
- `-Dhazelcast.mc.httpClient.tls.keyStoreType`: Type of the key store. Its default value is JKS.
- `-Dhazelcast.mc.httpClient.tls.keyManagerAlgorithm`: Name of the algorithm based on which the authentication keys are provided. System default will be used if none provided. You can find out the default by calling `javax.net.ssl.KeyManagerFactory#getDefaultAlgorithm` method.

3.17. Configuring Update Interval

You can set a frequency (in seconds) for which Management Center will take information from the Hazelcast cluster, using the element `update-interval` as shown below. `update-interval` is optional and its default value is 3 seconds.

```
<management-center enabled="true" update-interval="3">
  http://localhost:8080/hazelcast-mancenter
</management-center>
```

3.18. Configuring Logging

Management Center uses [Logback](#) for its logging. By default, it uses the following configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>

  <appender name="STDOUT" class="ch.qos.logback.core.ConsoleAppender">
    <layout class="ch.qos.logback.classic.PatternLayout">
      <Pattern>
        %d{yyyy-MM-dd HH:mm:ss} [%thread] %-5level %logger{36} - %msg%n
      </Pattern>
    </layout>
  </appender>

  <root level="INFO">
    <appender-ref ref="STDOUT"/>
  </root>
</configuration>
```

To change the logging configuration, you can create a custom Logback configuration file and start Management Center with the `-Dlogback.configurationFile` option pointing to your configuration file.

For example, you can create a file named `logback-custom.xml` with the following content and set logging level to `DEBUG`. To use this file as the logging configuration, you need to start Management Center with `-Dlogback.configurationFile=/path/to/your/logback-custom.xml` command line parameter:


```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>

    <appender name="STDOUT" class="ch.qos.logback.core.ConsoleAppender">
        <layout class="ch.qos.logback.classic.PatternLayout">
            <Pattern>
                %d{yyyy-MM-dd HH:mm:ss} [%thread] %-5level %logger{36} - %msg%n
            </Pattern>
        </layout>
    </appender>

    <root level="DEBUG">
        <appender-ref ref="STDOUT"/>
    </root>
</configuration>
```

4. Getting Started

If you have the open source edition of Hazelcast, Management Center can be used for at most 2 members in the cluster. To use it for more members, you need to have either a Management Center license, Hazelcast IMDG Enterprise license or Hazelcast IMDG Enterprise HD license. This license should be entered within the Management Center as described in the following paragraphs.



Even if you have a Hazelcast IMDG Enterprise or Enterprise HD license key and you set it as explained in the [Setting the License Key](#) section, you still need to enter this same license within the Management Center. Please see the following paragraphs to learn how you can enter your license.

Once you browse to <http://localhost:8080/hazelcast-mancenter> and since you are going to use Management Center for the first time, the following dialog box appears.



If you already configured security before, a login dialog box appears instead.

It asks you to choose your security provider and create a username and password. Available

security providers are Active Directory, LDAP and JAAS, which are described in the following sections.

Once you press the **Save** button, your administrator account credentials are created and you can log in with your credentials.

If you have more than one cluster that send statistics to Management Center, you can select a cluster to connect by clicking on its name from the list. Otherwise, you will connect to the only cluster that sends statistics automatically upon logging in.

Select cluster

- > Cluster A
- > Cluster B



Management Center can be used without a license if the cluster that you want to monitor has at most 2 members.

If you have a Management Center license or Hazelcast IMDG Enterprise license, you can enter it by clicking the **Administration** button on the left menu and opening the **Manage License** tab. Here you can enter your license key and press the **Update License** button, as shown below.

The screenshot shows the Hazelcast Management Center web interface. On the left is a sidebar with the Hazelcast logo and a menu under 'CLUSTER' including Status, Clients [0], Members [0], Administration (highlighted), Alerts, WAN Rep [0], Scripting, and Console. The main area has a breadcrumb trail: Dev > Administration > Manage License. Below this is a tab bar with Cluster State, Manage License (active), Socket Interceptor, Change Url, Users, Rolling Upgrade, and Hot Restart. The 'Manage License' section contains the text 'Please enter your new license key:' followed by a text input field and a green 'Update License' button.

Note that a license can likewise be provided using the system property `hazelcast.mc.license` (see [Starting with a License](#) for details).

When you try to connect to a cluster that has more than 2 members without entering a license key or if your license key is expired, the following warning message is shown at the top.

Node Limit Exceeded ! Have you entered your license key? If not [click here](#) to enter license details or [click here](#) to apply for a trial.

If you choose to continue without a license, please remember that Management Center works if your cluster has **at most** two members.

Management Center creates a folder with the name `hazelcast-mancenter` under your `user/home` folder to save data files and above settings/license information. You can change the data folder by

setting the `hazelcast.mancenter.home` system property. Please see the [System Properties](#) section to see the description of this property and to learn how to set a system property.

5. Variable Replacers

Variable replacers are used to replace custom strings during loading the configuration, either passed as command line arguments or as part of a configuration file, such as `ldap.properties` or `jaas.properties`. They can be used to mask sensitive information such as usernames and passwords. Of course their usage is not limited to security related information.

Variable replacers implement the interface `com.hazelcast.webmonitor.configreplacer.spi.ConfigReplacer` and they are configured via the following command line arguments:

- `-Dhazelcast.mc.configReplacer.class`: Full class name of the replacer.
- `-Dhazelcast.mc.configReplacer.failIfValueMissing`: Specifies whether the loading configuration process stops when a replacement value is missing. It is an optional attribute and its default value is true.
- Additional command line arguments specific to each replacer implementation. All of the properties for the built-in replacers are explained in the upcoming sections.

The following replacer classes are provided by Hazelcast as example implementations of the `ConfigReplacer` interface. Note that you can also implement your own replacers.

- `EncryptionReplacer`
- `PropertyReplacer`

Each example replacer is explained in the below sections.

5.1. EncryptionReplacer

This example `EncryptionReplacer` replaces encrypted variables by its plain form. The secret key for encryption/decryption is generated from a password which can be a value in a file and/or environment specific values, such as MAC address and actual user data.

Its full class name is `com.hazelcast.webmonitor.configreplacer.EncryptionReplacer` and the replacer prefix is `ENC`. Here are the properties used to configure this example replacer:

- `hazelcast.mc.configReplacer.prop.cipherAlgorithm`: Cipher algorithm used for the encryption/decryption. Its default value is AES.
- `hazelcast.mc.configReplacer.prop.keyLengthBits`: Length (in bits) of the secret key to be generated. Its default value is 128.
- `hazelcast.mc.configReplacer.prop.passwordFile`: Path to a file whose content should be used as a part of the encryption password. When the property is not provided no file is used as a part of the password. Its default value is null.
- `hazelcast.mc.configReplacer.prop.passwordNetworkInterface`: Name of network interface whose MAC address should be used as a part of the encryption password. When the property is not

provided no network interface property is used as a part of the password. Its default value is null.

- `hazelcast.mc.configReplacer.prop.passwordUserProperties`: Specifies whether the current user properties (`user.name` and `user.home`) should be used as a part of the encryption password. Its default value is true.
- `hazelcast.mc.configReplacer.prop.saltLengthBytes`: Length (in bytes) of a random password salt. Its default value is 8.
- `hazelcast.mc.configReplacer.prop.secretKeyAlgorithm`: Name of the secret-key algorithm to be associated with the generated secret key. Its default value is AES.
- `hazelcast.mc.configReplacer.prop.secretKeyFactoryAlgorithm`: Algorithm used to generate a secret key from a password. Its default value is PBKDF2WithHmacSHA256.
- `hazelcast.mc.configReplacer.prop.securityProvider`: Name of a Java Security Provider to be used for retrieving the configured secret key factory and the cipher. Its default value is null.



Older Java versions may not support all the algorithms used as defaults. Please use the property values supported your Java version.

As a usage example, let's create a password file and generate the encrypted strings out of this file.

1 - Create the password file: `echo '/Za-uG3dDfPd,5.-' > /opt/master-password`

2 - Define the encrypted variables:

```
java -cp hazelcast-mancenter-3.11.4.war \  
-Dhazelcast.mc.configReplacer.prop.passwordFile=/opt/master-password \  
-Dhazelcast.mc.configReplacer.prop.passwordUserProperties=false \  
com.hazelcast.webmonitor.configreplacer.EncryptionReplacer \  
"aPasswordToEncrypt" \  

```

Output:

```
$ENC{wJxe1vfHTgg=:531:WkAEdSi//YWEbvvVNoU9mUyZ0DE49acJeaJmGalHHfA=}
```

3 - Configure the replacer and provide the encrypted variables as command line arguments while starting Management Center:

```
java \
  -Dhazelcast.mc.configReplacer.class=com.hazelcast.webmonitor.configreplacer
  .EncryptionReplacer \
    -Dhazelcast.mc.configReplacer.prop.passwordFile=/opt/master-password \
    -Dhazelcast.mc.configReplacer.prop.passwordUserProperties=false \
    -Dhazelcast.mc.tls.enabled=true \
    -Dhazelcast.mc.tls.keyStore=/opt/mancenter.keystore \
    -Dhazelcast.mc.tls.keyStorePassword=
    '$ENC{wJxe1vfHTgg=:531:WkAEdSi//YWEbvvVNoU9mUyZ0DE49acJeaJmGalHHfA=}' \
    -jar hazelcast-mancenter-3.11.4.war
```

5.2. PropertyReplacer

The `PropertyReplacer` replaces variables by properties with the given name. Usually the system properties are used, e.g., `${user.name}`.

Its full class name is `com.hazelcast.webmonitor.configreplacer.PropertyReplacer` and the replacer prefix is empty string (`""`).

5.3. Implementing Custom Replacers

You can also provide your own replacer implementations. All replacers have to implement the three methods that have the same signatures as the methods of the following interface:

```
import java.util.Properties;

public interface ConfigReplacer {
    void init(Properties properties);
    String getPrefix();
    String getReplacement(String maskedValue);
}
```

6. Using Management Center with TLS/SSL Only

To encrypt data transmitted over all channels of Management Center using TLS/SSL, make sure you do all of the following:

- Deploy Management Center on a TLS/SSL enabled container or start it from the command line with TLS/SSL enabled. See [Installing Management Center](#).
 - Another option is to place Management Center behind a TLS-enabled reverse proxy. In that case, make sure your reverse proxy sets the necessary HTTP header (`X-Forwarded-Proto`) for resolving the correct protocol.
- Enable TLS/SSL communication to Management Center for your Hazelcast cluster. See

[Connecting Hazelcast members to Management Center.](#)

- If you're using Clustered JMX on Management center, enable TLS/SSL for it. See [Enabling TLS/SSL for Clustered JMX](#).
- If you're using LDAP authentication, make sure you use LDAPS or enable the "Start TLS" field. See [LDAP Authentication](#).

7. Authentication Options

7.1. Active Directory Authentication

You can use your existing Active Directory server for authentication/authorization on Management Center. In the "Configure Security" page, select **Active Directory** from the "Security Provider" combo, and the following form page appears:

Configure security

Security Provider:	Active Directory
URL	ldap://localhost:10389
Domain	example.com
User Search Filter	(&(objectClass=user)(userPrincipalName
Admin Group Name	MancenterAdmin
User Group Name	MancenterUser
Read-only User Group Name	MancenterReadonlyUser
Metrics-only Group Name	MancenterMetricsOnlyUser

Save

Provide the details in this form for your Active Directory server:

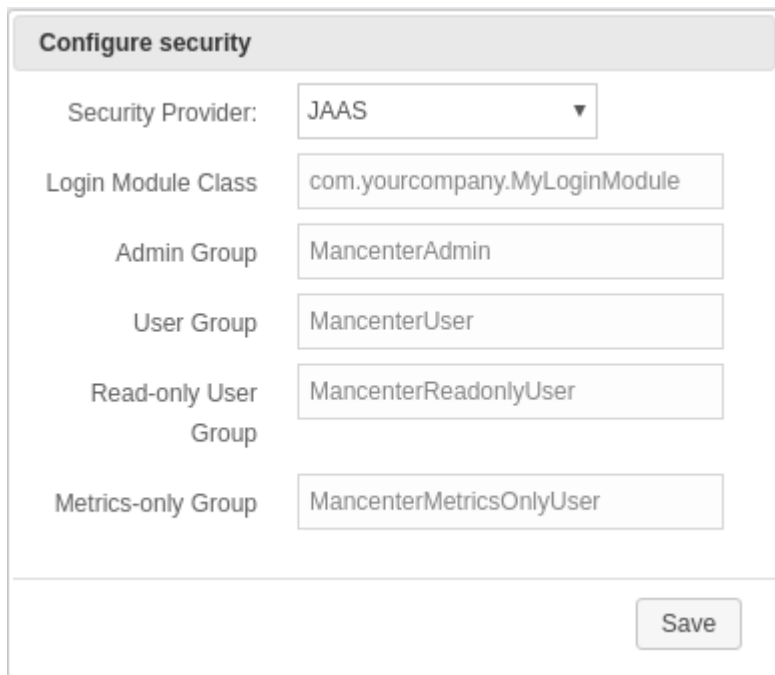
- **URL:** URL of your Active Directory server, including schema (**ldap://** or **ldaps://**) and port.
- **Domain:** Domain of your organization on Active Directory.
- **User Search Filter:** LDAP search filter expression to search for the users. **{0}** will be replaced with **username@domain** and **{1}** will be replaced with only the **username**. You can use both placeholders, only one of them or none in your search filter. For example, **(&(objectClass=user)(userPrincipalName={0}))** searches for a username that matches with the **userPrincipalName** attribute and member of the object class **user**.
- **Admin Group Name:** Members of this group will have admin privileges on the Management Center.

- **User Group Name:** Members of this group will have read and write privileges on the Management Center.
- **Read-only User Group Name:** Members of this group will have only read privilege on the Management Center.
- **Metrics-only Group Name:** Members of this group will have the privilege to see only the metrics on the Management Center.

Once configured, Active Directory settings are saved in a file named `ldap.properties` under the `hazelcast-mancenter3.11.4` folder mentioned in the previous section. If you want to update your settings afterwards, you need to update `ldap.properties` file and click "Reload Security Config" button on the login page.

7.2. JAAS Authentication

You can use your own `javax.security.auth.spi.LoginModule` implementation for authentication/authorization on Management Center. In the "Configure Security" page, select **JAAS** from the "Security Provider" combo box, and the following page appears:



The screenshot shows a web form titled "Configure security". It contains the following fields:

- Security Provider:** A dropdown menu with "JAAS" selected.
- Login Module Class:** A text input field containing "com.yourcompany.MyLoginModule".
- Admin Group:** A text input field containing "MancenterAdmin".
- User Group:** A text input field containing "MancenterUser".
- Read-only User Group:** A text input field containing "MancenterReadonlyUser".
- Metrics-only Group:** A text input field containing "MancenterMetricsOnlyUser".

At the bottom right of the form is a "Save" button.

Provide the details in this form for your JAAS `LoginModule` implementation:

- **Login Module Class:** Fully qualified class name of your `javax.security.auth.spi.LoginModule` implementation
- **Admin Group:** Members of this group will have admin privileges on the Management Center.
- **User Group:** Members of this group will have read and write privileges on the Management Center.
- **Read-only User Group:** Members of this group will have only read privilege on the Management Center.
- **Metrics-only Group:** Members of this group will have the privilege to see only the metrics on the Management Center.

Following is an example implementation. Note that we return two `java.security.Principal` instances; one of them is the username and the other one is a group name, which you will use when configuring JAAS security as described above.

```
import javax.security.auth.Subject;
import javax.security.auth.callback.Callback;
import javax.security.auth.callback.CallbackHandler;
import javax.security.auth.callback.NameCallback;
import javax.security.auth.callback.PasswordCallback;
import javax.security.auth.login.LoginException;
import javax.security.auth.spi.LoginModule;
import java.security.Principal;
import java.util.Map;

public class SampleLoginModule implements LoginModule {
    private Subject subject;
    private String password;
    private String username;

    @Override
    public void initialize(Subject subject, CallbackHandler callbackHandler, Map
<String, ?> sharedState, Map<String, ?> options) {
        this.subject = subject;

        try {
            NameCallback nameCallback = new NameCallback("prompt");
            PasswordCallback passwordCallback = new PasswordCallback("prompt", false);

            callbackHandler.handle(new Callback[] {nameCallback, passwordCallback });

            password = new String(passwordCallback.getPassword());
            username = nameCallback.getName();
        } catch (Exception e) {
            throw new RuntimeException(e);
        }
    }

    @Override
    public boolean login() throws LoginException {
        if (!username.equals("emre")) {
            throw new LoginException("Bad User");
        }

        if (!password.equals("pass1234")) {
            throw new LoginException("Bad Password");
        }

        subject.getPrincipals().add(new Principal() {
            public String getName() {
                return "emre";
            }
        });
    }
}
```

```

    }
    });

    subject.getPrincipals().add(new Principal() {
        public String getName() {
            return "MancenterAdmin";
        }
    });

    return true;
}

@Override
public boolean commit() throws LoginException {
    return true;
}

@Override
public boolean abort() throws LoginException {
    return true;
}

@Override
public boolean logout() throws LoginException {
    return true;
}
}

```

7.3. LDAP Authentication

You can use your existing LDAP server for authentication/authorization on Management Center. In the "Configure Security" page, select **LDAP** from the "Security Provider" combo box, and the following form page appears:

Configure security

Security Provider:

LDAP

URL

ldap://localhost:10389

Distinguished name (DN) of user

cn=Some User,cn=users,dc=example,c

Password

Search Base DN

o=yourorg

Additional User DN

ou=users

Additional Group DN

ou=groups

Admin Group Name

MancenterAdmin

User Group Name

MancenterUser

Read-only User Group Name

MancenterReadonlyUser

Metrics-only Group Name

MancenterMetricsOnlyUser

Start TLS

☐

User Search Filter

uid={0}

Group Search Filter

uniquemember={0}

Save

Provide the details in this form for your LDAP server:

- **URL:** URL of your LDAP server, including schema (**ldap://** or **ldaps://**) and port.
- **Distinguished name (DN) of user:** DN of a user that has admin privileges on the LDAP server. It is used to connect to the server when authenticating users.
- **Search base DN:** Base DN to use for searching users/groups.
- **Additional user DN:** Appended to "Search base DN" and used for finding users.
- **Additional group DN:** Appended to "Search base DN" and used for finding groups.
- **Admin Group Name:** Members of this group will have admin privileges on the Management Center.
- **User Group Name:** Members of this group will have read and write privileges on the Management Center.

- **Read-only User Group Name:** Members of this group will have only read privilege on the Management Center.
- **Metrics-only Group Name:** Members of this group will have the privilege to see only the metrics on the Management Center.
- **Start TLS:** Enable if your LDAP server uses Start TLS.
- **User Search Filter:** LDAP search filter expression to search for users. For example, `uid={0}` searches for a username that matches with the `uid` attribute.
- **Group Search Filter:** LDAP search filter expression to search for groups. For example, `uniquemember={0}` searches for a group that matches with the `uniquemember` attribute.



Values for Admin, User, Read-only and Metrics-Only Group Names must be given as plain names. They should not contain any LDAP attributes such as `CN`, `OU` and `DC`.

Once configured, LDAP settings are saved in a file named `ldap.properties` under the `hazelcast-mancenter3.11.4` folder mentioned in the previous section. If you want to update your settings afterwards, you need to update `ldap.properties` file and click "Reload Security Config" button on the login page.

7.3.1. Enabling TLS/SSL for LDAP

If your LDAP server is using `ldaps` (LDAP over SSL) protocol or Start TLS operation, use the following command line parameters for your Management Center deployment:

- `-Dhazelcast.mc.ldap.ssl.trustStore=path to your truststore`: This truststore needs to contain the public key of your LDAP server.
- `-Dhazelcast.mc.ldap.ssl.trustStorePassword=password for your truststore`
- `-Dhazelcast.mc.ldap.ssl.trustStoreType`: Type of the trust store. Its default value is `JKS`.
- `-Dhazelcast.mc.ldap.ssl.trustManagerAlgorithm`: Name of the algorithm based on which the authentication keys are provided. System default will be used if none provided. You can find out the default by calling `javax.net.ssl.TrustManagerFactory#getDefaultAlgorithm` method.

7.3.2. Password Encryption

By default, the password that you use in LDAP configuration is saved on the `ldap.properties` file in clear text. This might pose a security risk. To store the LDAP password in encrypted form, we offer the following two options:

- **Provide a KeyStore password:** This will create and manage a Java KeyStore under the Management Center home directory. The LDAP password will be stored in this KeyStore in encrypted form.
- **Configure an external Java KeyStore:** This will use an existing Java KeyStore. This option might also be used to store the password in an HSM that provides a Java KeyStore API.

When you do either, the LDAP password you enter on the initial configuration UI dialog will be stored in encrypted form in a Java KeyStore instead of the `ldap.properties` file.



You can also encrypt the password before saving it on `ldap.properties`. See [Variable Replacers](#) for more information.

Providing a Master Key for Encryption

There are two ways to provide a master key for encryption:

- If you deploy Management Center on an application server, you need to set `MC_KEYSTORE_PASS` environment variable before starting Management Center. This option is less secure. You should clear the environment variable once you make sure you can log in with your LDAP credentials to minimize the security risk.
- If you're starting Management Center from the command line, you can start it with `-Dhazelcast.mc.askKeyStorePassword`. Management Center will ask for the KeyStore password upon start and use it as a password for the KeyStore it creates. This option is more secure as it only stores the KeyStore password in the memory.

By default, Management Center will create a Java KeyStore file under the Management Center home directory with the name `mancenter.jceks`. You can change the location of this file by using the `-Dhazelcast.mc.keyStore.path=/path/to/keyStore.jceks` JVM argument.

Configuring an External Java KeyStore

If you don't want Management Center to create a KeyStore for you and use an existing one that you've created before (or an HSM), set the following JVM arguments when starting Management Center:

- `-Dhazelcast.mc.useExistingKeyStore=true`: Enables use of an existing KeyStore.
- `-Dhazelcast.mc.existingKeyStore.path=/path/to/existing/keyStore.jceks`: Path to the KeyStore. You do not have to set it if you use an HSM.
- `-Dhazelcast.mc.existingKeyStore.pass=somepass`: Password for the KeyStore. You do not have to set it if HSM provides another means to unlock HSM.
- `-Dhazelcast.mc.existingKeyStore.type=JCEKS`: Type of the KeyStore.
- `-Dhazelcast.mc.existingKeyStore.provider=com.yourprovider.MyProvider`: Provider of the KeyStore. Leave empty to use the system provider. Specify the class name of your HSM's `java.security.Provider` implementation if you use an HSM.



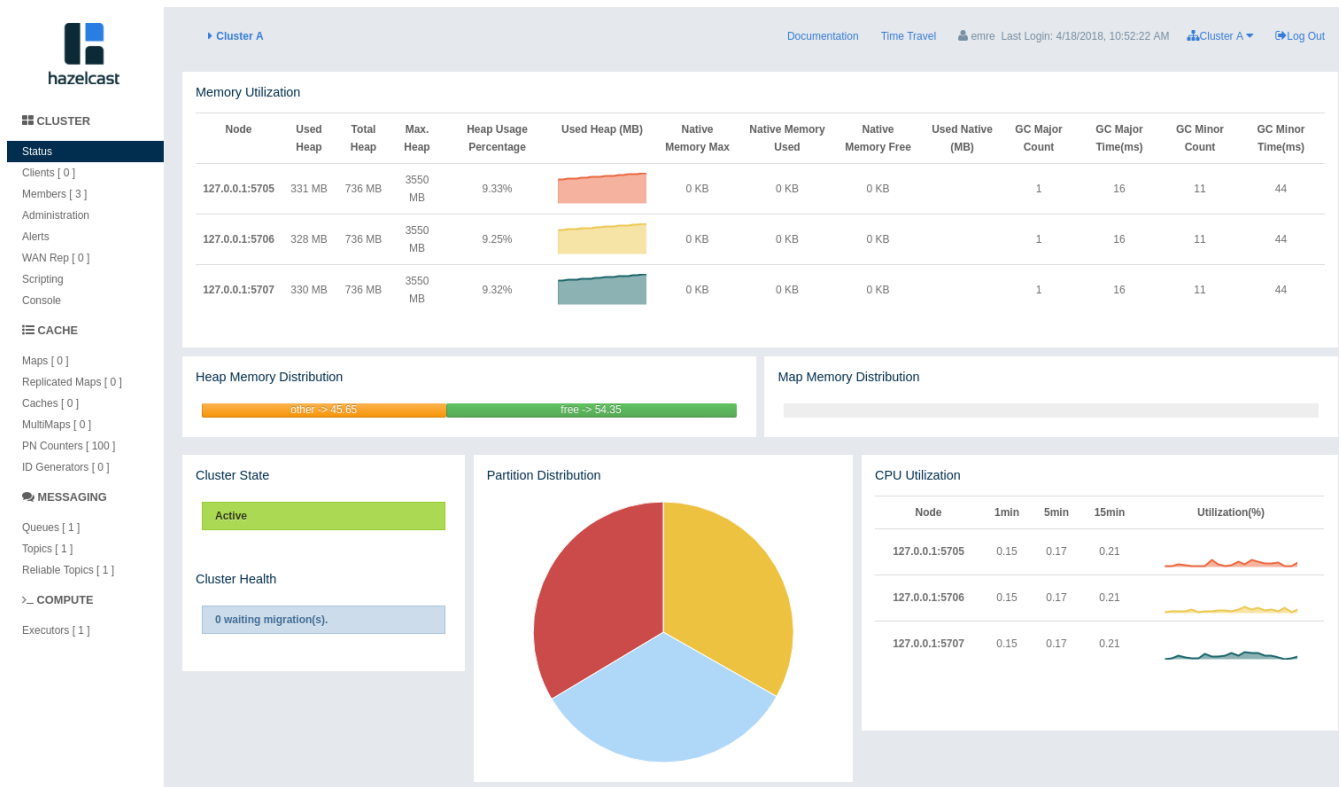
Make sure your KeyStore supports storing ``SecretKey`s`.

7.3.3. Updating Encrypted Passwords

You can use one of the `updateLdapPassword.sh` or `updateLdapPassword.bat` scripts to update the encrypted LDAP password stored in the KeyStore. It will ask for information about the KeyStore such as its location and password. It will then ask for the new LDAP password that you want to use. After updating the LDAP password, you'll need to click **Reload Security Configuration** button on the main screen.

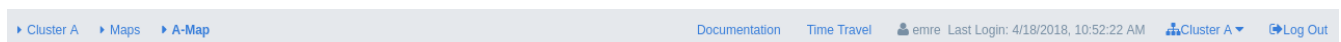
8. User Interface Overview

Once the page is loaded after selecting a cluster, [Status Page](#) appears as shown below.



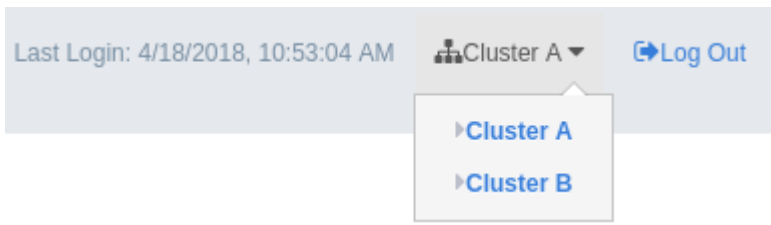
This page provides the fundamental properties of the selected cluster which are explained in the [Status Page](#) section. The page has a toolbar on the top and a menu on the left.

8.1. Toolbar



The toolbar has the following elements:

- **Navigation Breadcrumb:** The leftmost element is the navigation breadcrumb that you can use to navigate to the previously opened pages. For example, while you're on the page where you're viewing a Map, you can click the **Maps** link to go back to the page where all Map instances are listed.
- **Documentation:** Opens the Management Center documentation in a new browser tab.
- **Time Travel:** Sees the cluster's situation at a time in the past. Please see the [Time Travel](#) section.
- **User name and last login time:** The current user's name and last login time is shown for security purposes.
- **Cluster Selector:** Switches between clusters. When clicked, a drop down list of clusters appears.



The user can select any cluster and once selected, the page immediately loads with the selected cluster's information.

- **Logout:** Closes the current user's session.

8.2. Menu

The Home Page includes a menu on the left which lists the distributed data structures in the cluster, cluster members and clients connected to the cluster (numbers in square brackets show the instance count for each entity), as shown below. You can also see an overview state of your cluster, create alerts, execute codes and perform user/license operations using this menu:



■ CLUSTER

Status

Clients [0]
Members [2]
Administration
Alerts
WAN Replication [2]
Scripting
Console

☰ CACHE

Maps [3]
Replicated Maps [0]
Caches [0]
MultiMaps [0]
PN Counters [0]
ID Generators [0]

💬 MESSAGING

Queues [0]
Topics [0]
Reliable Topics [0]

>_ COMPUTE

Executors [0]



Distributed data structures will be shown there when the proxies are created for them.



WAN Replication button is only visible with Hazelcast IMDG Enterprise license.

Below is the list of menu items with links to their explanations.

- [Status](#)
- [Clients](#)
- [Members](#)
- [Administration](#)



- [License Screen](#)
- [Alerts](#)
- [WAN Replication](#)
- [Scripting](#)
- [Console](#)
- [Maps](#)
- [Replicated Maps](#)
- [Caches](#)
- [MultiMaps](#)
- [PN Counters](#)
- [ID Generators](#)
- [Queues](#)
- [Topics](#)
- [Reliable Topics](#)
- [Executors](#)

9. Status Page

This is the first page appearing after logging in. It gives an overview of the connected cluster. The following subsections describe each portion of the page.

9.1. Memory Utilization

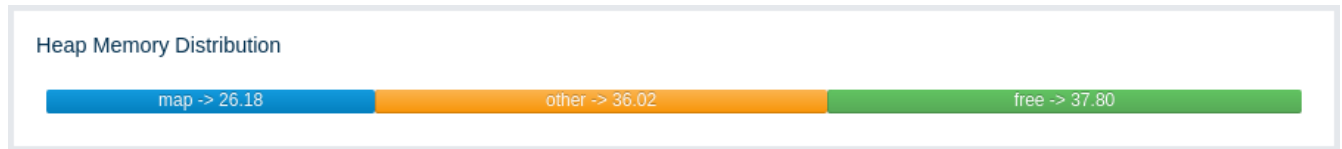
This part of the page provides information related to memory usages for each member, as shown below.

Node	Used Heap	Total Heap	Max. Heap	Heap Usage Percentage	Used Heap	Native Memory Max	Native Memory Used	Native Memory Free	Used Native (MB)	GC Major Count	GC Major Time(ms)	GC Minor Count	GC Minor Time(ms)
127.0.0.1:5701	250 MB	374 MB	3550 MB	7.05%		0 KB	0 KB	0 KB		1	41	17	87
127.0.0.1:5702	250 MB	374 MB	3550 MB	7.05%		0 KB	0 KB	0 KB		1	41	17	87

The first column lists the members with their IPs and ports. The next columns show the used and free memories out of the total memory reserved for Hazelcast usage, in real-time. The **Max. Heap** column lists the maximum memory capacity of each member and the **Heap Usage Percentage** column lists the percentage value of used memory out of the maximum memory. The **Used Heap** column shows the memory usage of members graphically. When you move the mouse cursor on a desired graph, you can see the memory usage at the time where the cursor is placed. Graphs under this column shows the memory usages approximately for the last 2 minutes.

9.2. Heap Memory Distribution

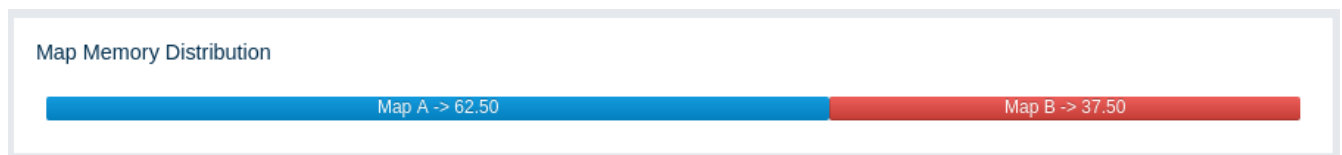
This part of the page graphically provides the cluster wise breakdown of heap memory, as shown below. The blue area is the heap memory used by maps (including all owned/backup entires and any near cache usage). The dark yellow area is the heap memory used by both non-Hazelcast entities and all Hazelcast entities except the map (i.e. the heap memory used by all entities subtracted by the heap memory used by map). The green area is the free heap memory out of the whole cluster's total committed heap memory.



In the above example, you can see 26.18% of the total heap memory is used by Hazelcast maps, 36.02% is used by both non-Hazelcast entities and all Hazelcast entities except the map and 37.80% of the total heap memory is free.

9.3. Map Memory Distribution

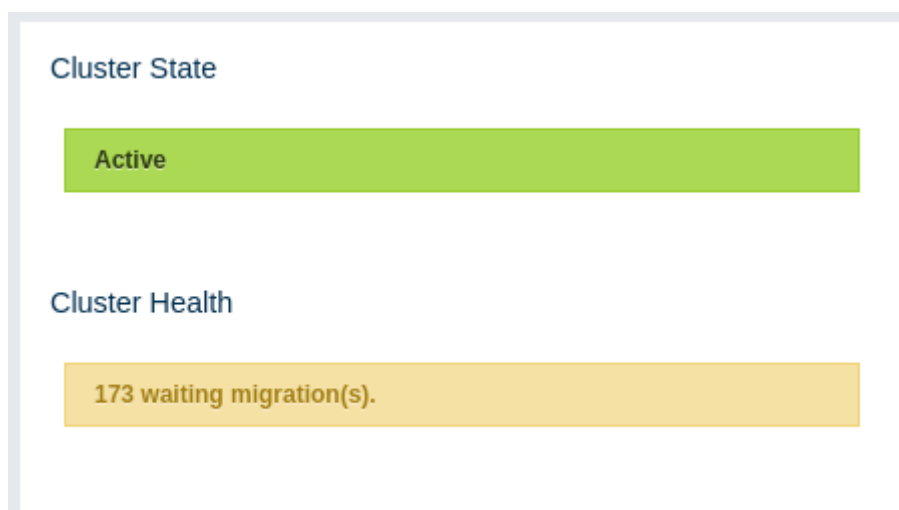
This part provides the percentage values of the memories used by each map, out of the total cluster memory reserved for all Hazelcast maps.



In the above example, you can see 62.50% of the total map memory is used by **Map A** and 37.50% is used by **Map B**.

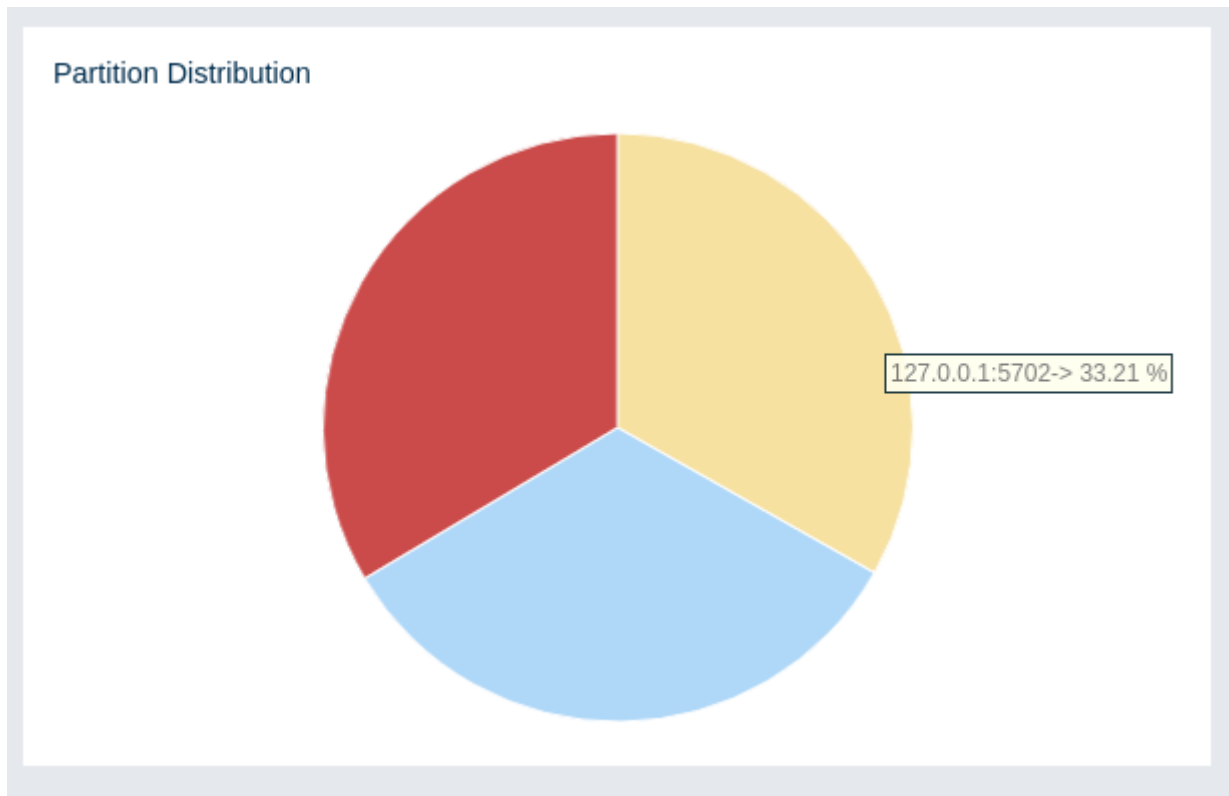
9.4. Cluster State/Health

This part shows the current cluster state and the cluster's health. For more information on cluster states, see [Cluster State](#). Cluster health shows how many migrations are taking place currently.



9.5. Partition Distribution

This pie chart shows what percentage of partitions each cluster member has, as shown below.



You can see each member's partition percentages by placing the mouse cursor on the chart. In the above example, you can see the member "127.0.0.1:5702" has 33.21% of the total partition count (which is 271 by default and configurable, please see the `hazelcast.partition.count` property explained in the [System Properties](#) section).



The partition distribution pie chart will show no information until you create your distributed objects. When you add new members to your cluster, there will be no partition migration since partitions do not exist yet. Once you connect to your cluster and, for example, create a map (using `hazelcastInstance.getMap()`), only then this pie chart starts to show partition distribution information.

9.6. CPU Utilization

This part of the page provides load and utilization information for the CPUs for each cluster member, as shown below.



The first column lists the members with their IPs and ports. The next columns list the system load averages on each member for the last 1, 5 and 15 minutes. These average values are calculated as the sum of the count of runnable entities running on and queued to the available CPUs averaged over the last 1, 5 and 15 minutes. This calculation is operating system specific, typically a damped time-dependent average. If system load average is not available, these columns show negative values.

The last column (**Utilization(%)**) graphically shows the recent load on the CPUs. When you move the mouse cursor on a chart, you can see the CPU load at the time where the cursor is placed. Charts under this column shows the CPU loads approximately for the last 2 minutes. If recent CPU load is not available, you will see a negative value.

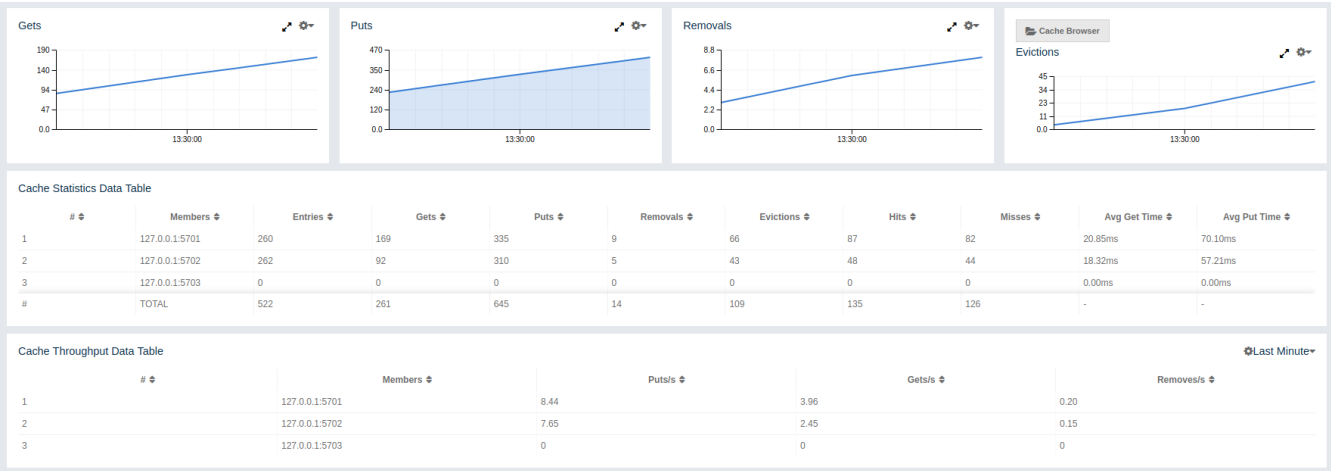
10. Monitoring Caches

You can see a list of all the caches in your cluster by clicking on the **Caches** menu item on the left panel. A new page is opened on the right, as shown below.

Name ↕	Entries ↕	Hits ↕	Misses ↕
<input type="text"/>			
🔗 cache-42	19	0	0
🔗 cache-43	17	0	0
🔗 cache-44	7	0	0
🔗 cache-45	18	0	0
🔗 cache-46	14	0	0
🔗 cache-47	12	0	0
🔗 cache-48	8	0	0
🔗 cache-49	31	0	0
🔗 cache-5	6	0	0
🔗 cache-50	15	0	0
🔗 cache-51	13	0	0
🔗 cache-52	24	0	0
🔗 cache-53	12	0	0
🔗 cache-54	8	0	0
🔗 cache-55	15	0	0
🔗 cache-56	29	0	0
🔗 cache-57	12	0	0
🔗 cache-58	6	0	0
🔗 cache-59	13	0	0
🔗 cache-6	7	0	0

« < 1 2 3 4 5 6 > »

You can filter the caches shown and you can also sort the table by clicking on the column headers. Clicking on the cache name will open a new page for monitoring that cache instance on the right, as shown below.



On top of the page, four charts monitor the **Gets**, **Puts**, **Removals** and **Evictions** in real-time. The X-axis of all the charts show the current system time. To open a chart as a separate dialog, click on the button placed at the top right of each chart.

Under these charts is the Cache Statistics Data Table. From left to right, this table lists the IP addresses and ports of each member, and the entry, get, put, removal, eviction, and hit and miss counts per second in real-time.

You can ascend or descend the order of the listings in each column by clicking on column headings.

Under the Cache Statistics Data Table, there is Cache Throughput Data Table.

From left to right, this table lists:

- the IP address and port of each member,
- the put/s, get/s and remove/s operation rates on each member.

You can select the period in the combo box placed at the top right corner of the window, for which the table data will be shown. Available values are **Since Beginning**, **Last Minute**, **Last 10 Minutes** and **Last 1 Hour**.



You need to enable the statistics for caches to monitor them in the Management Center. Use the `<statistics-enabled>` element or `setStatisticsEnabled()` method in declarative or programmatic configuration, respectively, to enable the statistics. Please refer to the [JCache Declarative Configuration](#) section for more information.

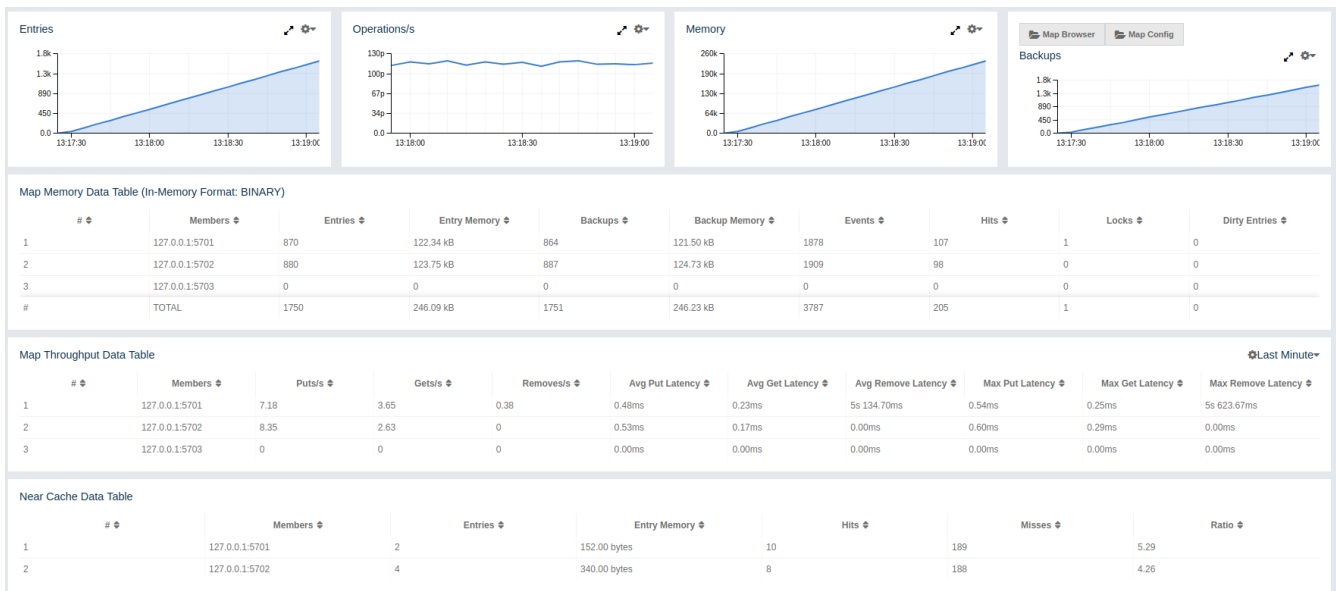
11. Managing Maps

You can see a list of all the maps in your cluster by clicking on the **Maps** menu item on the left panel. A new page is opened on the right, as shown below.

Name ↕	Entries ↕	EntryMemory ↕	BackupMemory ↕	Events ↕	Hits ↕	Locks ↕	DirtyEntries ↕
<input type="text"/>							
map-45	50	7.62 kB	7.62 kB	0	0	0	0
map-46	50	7.62 kB	7.62 kB	0	0	0	0
map-47	50	7.62 kB	7.62 kB	0	0	0	0
map-48	50	7.62 kB	7.62 kB	0	0	0	0
map-49	50	7.62 kB	7.62 kB	0	0	0	0
map-5	50	7.62 kB	7.62 kB	0	0	0	0
map-50	50	7.62 kB	7.62 kB	0	0	0	0
map-51	50	7.62 kB	7.62 kB	0	0	0	0
map-52	50	7.62 kB	7.62 kB	0	0	0	0
map-53	50	7.62 kB	7.62 kB	0	0	0	0
map-54	50	7.62 kB	7.62 kB	0	0	0	0
map-55	50	7.62 kB	7.62 kB	0	0	0	0
map-56	50	7.62 kB	7.62 kB	0	0	0	0
map-57	50	7.62 kB	7.62 kB	0	0	0	0
map-58	50	7.62 kB	7.62 kB	0	0	0	0
map-59	50	7.62 kB	7.62 kB	0	0	0	0
map-6	50	7.62 kB	7.62 kB	0	0	0	0
map-60	50	7.62 kB	7.62 kB	0	0	0	0
map-61	50	7.62 kB	7.62 kB	0	0	0	0
map-62	50	7.62 kB	7.62 kB	0	0	0	0

« < 1 2 3 4 5 6 > »

You can filter the maps shown and you can also sort the table by clicking on the column headers. Clicking on a map name will open a new page for monitoring that map instance on the right, as shown below.



The below subsections explain the portions of this window.

11.1. Map Browser

Use the Map Browser tool to retrieve properties of the entries stored in the selected map. To open the Map Browser tool, click on the **Map Browser** button, located at the top right of the window. Once opened, the tool appears as a dialog, as shown below.

Map Browser

Value:

2

Class:

Cost:

0.11 KB

Creation Time:

Thu Apr 19 16:56:33 MSK 2018

Expiration Time:

NOT_AVAILABLE

Hits:

0

Access Time:

NOT_AVAILABLE

Update Time:

Thu Apr 19 16:56:33 MSK 2018

Version:

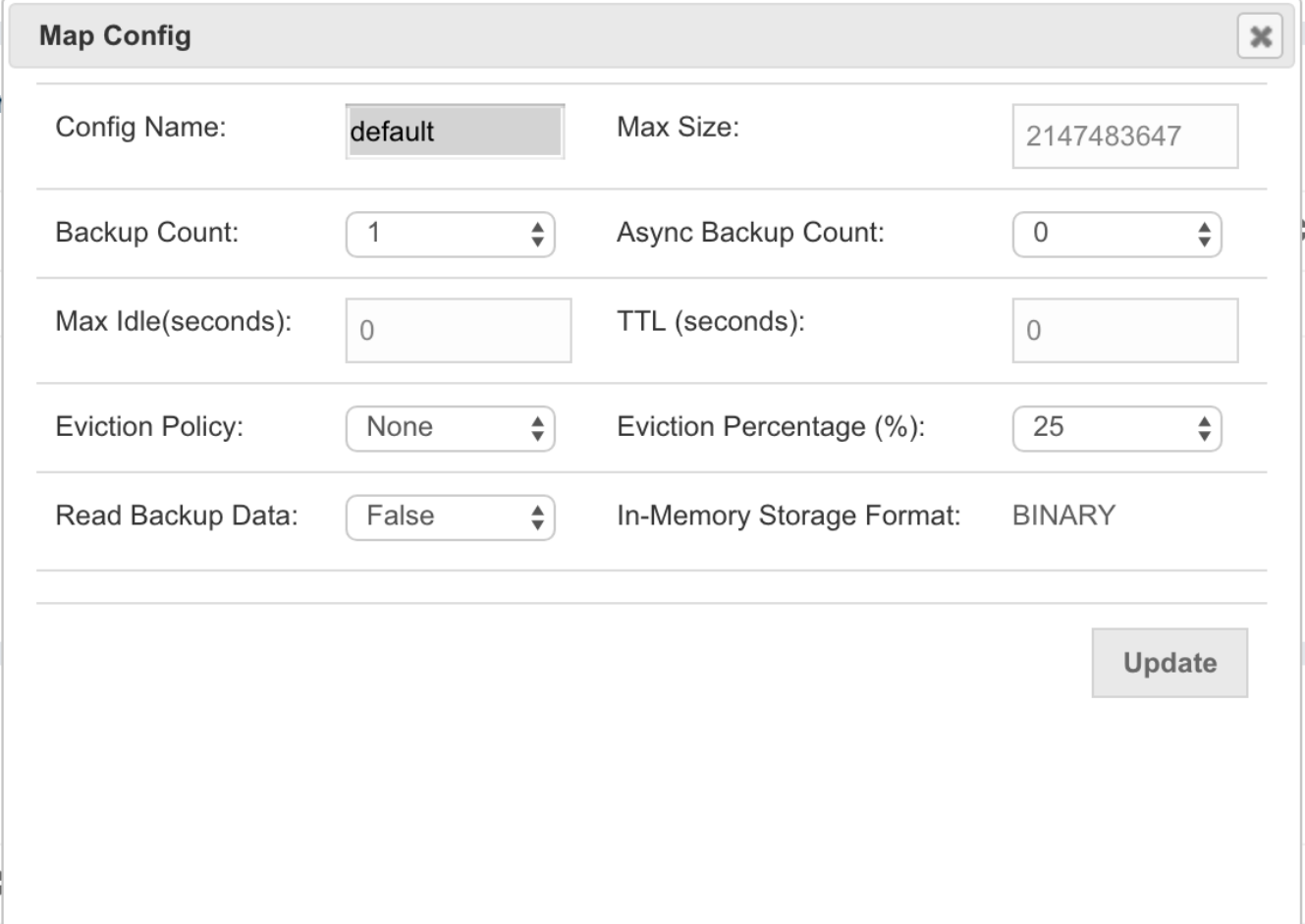
0

Once the key and the key's type are specified and the **Browse** button is clicked, the key's properties

along with its value are listed.

11.2. Map Config

Use the Map Config tool to set the selected map's attributes, such as the backup count, TTL, and eviction policy. To open the Map Config tool, click on the **Map Config** button, located at the top right of the window. Once opened, the tool appears as a dialog, as shown below.

A screenshot of the 'Map Config' dialog box. The dialog has a title bar with the text 'Map Config' and a close button (X). The main area contains several configuration fields arranged in two columns. The first row has 'Config Name:' with a text box containing 'default' and 'Max Size:' with a text box containing '2147483647'. The second row has 'Backup Count:' with a spinner box set to '1' and 'Async Backup Count:' with a spinner box set to '0'. The third row has 'Max Idle(seconds):' with a text box containing '0' and 'TTL (seconds):' with a text box containing '0'. The fourth row has 'Eviction Policy:' with a dropdown menu set to 'None' and 'Eviction Percentage (%)' with a spinner box set to '25'. The fifth row has 'Read Backup Data:' with a dropdown menu set to 'False' and 'In-Memory Storage Format:' with a text box containing 'BINARY'. At the bottom right of the dialog is an 'Update' button.


Config Name:	default	Max Size:	2147483647
Backup Count:	1	Async Backup Count:	0
Max Idle(seconds):	0	TTL (seconds):	0
Eviction Policy:	None	Eviction Percentage (%):	25
Read Backup Data:	False	In-Memory Storage Format:	BINARY

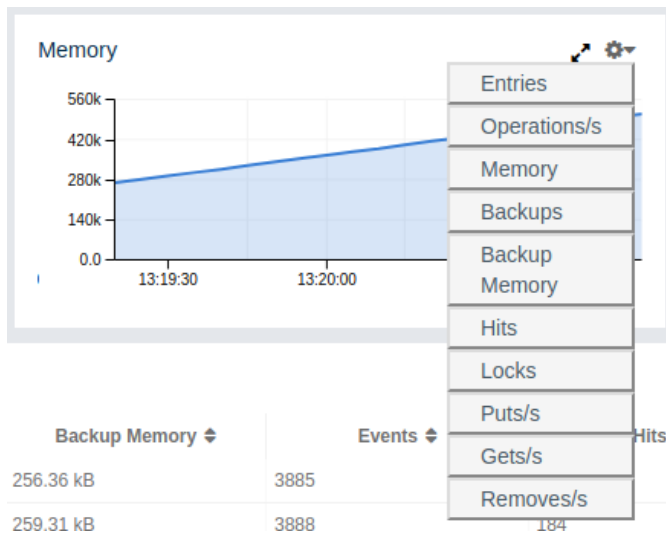
Update


You can change any attribute and click the **Update** button to save your changes.

11.3. Map Monitoring

Besides the Map Browser and Map Config tools, the map monitoring page has monitoring options that are explained below. All of these options perform real-time monitoring.

On top of the page, small charts monitor the entries, operations per second, memory usage, backup size, etc. of the selected map in real-time. The X-axis of all the charts show the current system time. You can select other small monitoring charts using the  button at the top right of each chart. When you click the button, the monitoring options are listed, as shown below.



When you click on a desired monitoring, the chart is loaded with the selected option. To open a chart as a separate dialog, click on the  button placed at the top right of each chart. The monitoring charts below are available:

- **Entries:** Monitors number of locally owned entries.
- **Memory:** Monitors the total memory cost of locally owned entries.
- **Backups:** Monitors number of backup entries.
- **Backup Memory:** Monitors the total memory cost of backup entries.
- **Hits:** Monitors number of hits (reads) of locally owned entries, including those which are no longer in the map (for example, may have been evicted). The number of hits may be inaccurate after a partition is migrated to a new owner member.
- **Locks:** Monitors number of locally owned entries that are locked.
- **Operations/s:** Monitors the total number of all operations performed on the map per second.
- **Puts/s, Gets/s, Removes/s:** These three charts monitor the put, get and remove operations performed on the map per second.

Under these charts are **Map Memory** and **Map Throughput** data tables. The Map Memory data table provides memory metrics distributed over members, as shown below.

#	Members	Entries	Entry Memory	Backups	Backup Memory	Events	Hits	Locks	Dirty Entries
1	127.0.0.1:5701	11517	1.58 MB	11518	1.58 MB	23830	1258	1	0
2	127.0.0.1:5702	11538	1.58 MB	11530	1.58 MB	23862	1201	1	0
3	127.0.0.1:5703	0	0	0	0	0	0	0	0
#	TOTAL	23055	3.17 MB	23048	3.17 MB	47692	2459	2	0

From left to right, this table lists:

- **Members:** The IP address and port of the member.
- **Entries:** Number of entries owned by the member.
- **Entry Memory:** Memory cost of owned entries in the member.
- **Backups:** Number of backup entries held by the member.

- **Backup Memory:** Memory cost of backup entries held by the member.
- **Events:** Number of events received by the member.
- **Hits:** Number of hits (reads) of the entries that are owned by the member, including those which are no longer in the map (for example, may have been evicted). The number of hits may be inaccurate after a partition is migrated to a new owner member.
- **Locks:** Number of currently locked entries owned by the member.
- **Dirty Entries:** Number of entries that the member owns and are dirty (updated but not persisted yet). In the cases where **MapStore** is enabled, these are the entries that are put to/removed from the map but not written to/removed from a database yet.

You can ascend or descend the order of the listings by clicking on the column headings.

Map Throughput data table provides information about the operations (get, put, remove) performed on each member in the map, as shown below.

#	Members	Puts/s	Gets/s	Removes/s	Avg Put Latency	Avg Get Latency	Avg Remove Latency	Max Put Latency	Max Get Latency	Max Remove Latency
1	127.0.0.1:5701	6.32	3.12	0.47	0.96ms	0.12ms	7s 153.43ms	0.38ms	0.13ms	7s 610.55ms
2	127.0.0.1:5702	9.28	3.18	0	0.53ms	0.16ms	0.00ms	0.62ms	0.42ms	0.00ms
3	127.0.0.1:5703	0	0	0	0.00ms	0.00ms	0.00ms	0.00ms	0.00ms	0.00ms

From left to right, this table lists:

- **Members:** The IP address and port of the member.
- **Puts/s:** Number of put operations per second on the member.
- **Gets/s:** Number of get operations per second on the member.
- **Removes/s:** Number of remove operations per second on the member.
- **Avg Put Latency:** Average latency of put operations on the member.
- **Avg Get Latency:** Average latency of get operations on the member.
- **Avg Remove Latency:** Average latency of remove operations on the member.
- **Max Put Latency:** Maximum latency of put operations on the member.
- **Max Get Latency:** Maximum latency of get operations on the member.
- **Max Remove Latency:** Maximum latency of remove operations on the member.

You can select the time period in the combo box placed at the top right corner of the window, for which the table data will be shown. Available values are **Since Beginning**, **Last Minute**, **Last 10 Minutes** and **Last 1 Hour**.

To ascend or descent the order of the listings, click on the column headings.

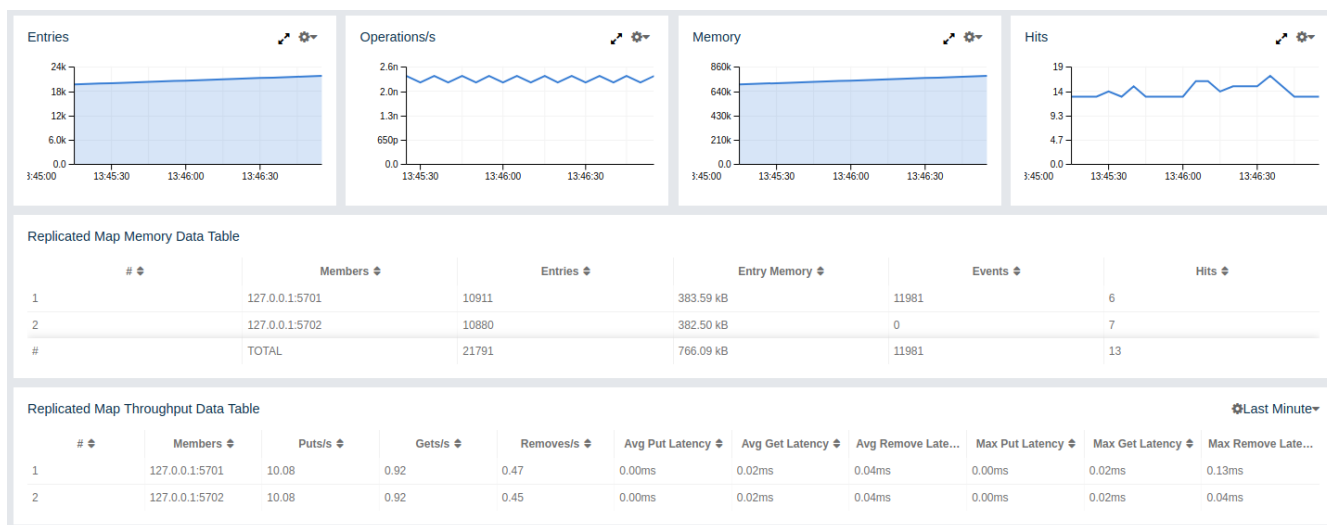
12. Monitoring Replicated Maps

You can see a list of all the Replicated Maps in your cluster by clicking on the **Replicated Maps** menu item on the left panel. A new page is opened on the right, as shown below.

Name ↕	Entries ↕	Entry Memory ↕	Events ↕	Hits ↕
<input type="text"/>				
🔗 Replicated Map 28	16	0	0	0
🔗 Replicated Map 29	16	0	0	0
🔗 Replicated Map 3	18	0	0	0
🔗 Replicated Map 30	32	0	0	0
🔗 Replicated Map 31	48	0	0	0
🔗 Replicated Map 32	12	0	0	0
🔗 Replicated Map 33	14	0	0	0
🔗 Replicated Map 34	40	0	0	0
🔗 Replicated Map 35	4	0	0	0
🔗 Replicated Map 36	20	0	0	0
🔗 Replicated Map 37	6	0	0	0
🔗 Replicated Map 38	16	0	0	0
🔗 Replicated Map 39	16	0	0	0
🔗 Replicated Map 4	50	0	0	0
🔗 Replicated Map 40	44	0	0	0
🔗 Replicated Map 41	42	0	0	0
🔗 Replicated Map 42	4	0	0	0
🔗 Replicated Map 43	16	0	0	0
🔗 Replicated Map 44	26	0	0	0
🔗 Replicated Map 45	34	0	0	0

« < 1 2 3 4 5 > »

You can filter the Replicated Maps shown and you can also sort the table by clicking on the column headers. Clicking on a Replicated Map name will open a new page for monitoring that Replicate Map instance on the right, as shown below.



In this page, you can monitor metrics and also re-configure the selected Replicated Map. All of the statistics are real-time monitoring statistics.

When you click on a desired monitoring, the chart is loaded with the selected option. Also you can open the chart in new window.

- **Entries:** Monitors number of entries of the Replicated Map.
- **Operations/s:** Monitors number of all operations performed on the Replicated Map per second.
- **Memory:** Monitors memory usage of the Replicated Map.
- **Hits:** Monitors hit count of the Replicated Map.

- **Puts/s, Gets/s, Removes/s:** These three charts monitor the put, get and remove operations performed on the selected Replicated Map per second.

The Replicated Map Throughput Data Table provides information about operations (get, put, remove) performed on each member in the selected Replicated Map.

#	Members	Puts/s	Gets/s	Removes/s	Avg Put Latency	Avg Get Latency	Avg Remove Late...	Max Put Latency	Max Get Latency	Max Remove Late...
1	127.0.0.1:5701	10.08	0.92	0.47	0.00ms	0.02ms	0.00ms	0.01ms	0.20ms	0.00ms
2	127.0.0.1:5702	10.08	0.92	0.45	0.00ms	0.00ms	0.04ms	0.01ms	0.00ms	0.50ms

From left to right, this table lists:

- the IP address and port of each member,
- the put, get, and remove operations on each member,
- the average put, get, and remove latencies,
- and the maximum put, get, and remove latencies on each member.

You can select the period from the combo box placed at the top right corner of the window, in which the table data is shown. Available values are **Since Beginning**, **Last Minute**, **Last 10 Minutes** and **Last 1 Hour**.

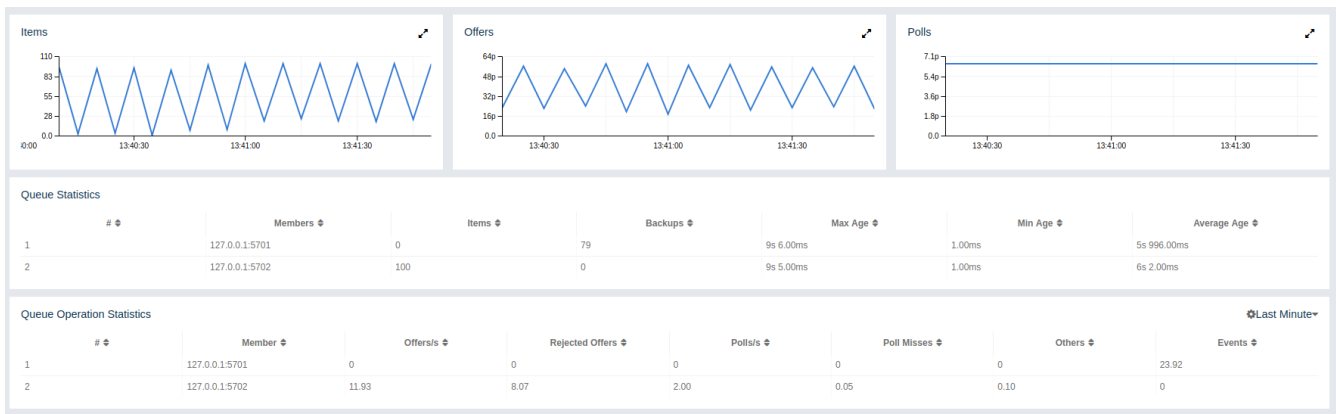
To ascend or descent the order of the listings, click on the column headings.


13. Monitoring Queues

You can see a list of all the queues in your cluster by clicking on the **Queues** menu item on the left panel. A new page is opened on the right, as shown below.

Name	Items	Backups	Max age	Min age	Average age
<input type="text"/>					
Queue - 0	17	17	0s	0s	0s
Queue - 1	5	5	0s	0s	0s
Queue - 2	1	1	0s	0s	0s
Queue - 3	16	16	0s	0s	0s
Queue - 4	16	16	0s	0s	0s
Queue - 5	11	11	0s	0s	0s
Queue - 6	10	10	0s	0s	0s
Queue - 7	9	9	0s	0s	0s
Queue - 8	14	13	0s	0s	0s
Queue - 9	5	0	0s	0s	0s

You can filter the queues shown and you can also sort the table by clicking on the column headers. Clicking on a queue name will open a new page for monitoring that queue instance on the right, as shown below.



On top of the page, small charts monitor the size, offers and polls of the selected queue in real-time. The X-axis of all the charts shows the current system time. To open a chart as a separate dialog, click on the  button placed at the top right of each chart. The monitoring charts below are available:

- **Items:** Monitors the size of the queue. Y-axis is the entry count.
- **Offers:** Monitors the offers sent to the selected queue. Y-axis is the offer count.
- **Polls:** Monitors the polls sent to the selected queue. Y-axis is the poll count.

Under these charts are **Queue Statistics** and **Queue Operation Statistics** tables. The Queue Statistics table provides item and backup item counts in the queue and age statistics of items and backup items at each member, as shown below.

#	Members	Items	Backups	Max Age	Min Age	Average Age
1	127.0.0.1:5701	0	100	9s 6.00ms	1.00ms	5s 994.00ms
2	127.0.0.1:5702	22	0	9s 5.00ms	1.00ms	6s 1.00ms

From left to right, this table lists the IP address and port, items and backup items on the queue of each member, and maximum, minimum and average age of items in the queue. The order of the listings in each column can be ascended or descended by clicking on column headings.

Queue Operations Statistics table provides information about the operations (offers, polls, events) performed on the queues, as shown below.

#	Member	Offers/s	Rejected Offers	Polls/s	Poll Misses	Others	Events
1	127.0.0.1:5701	0	0	0	0	0	23.87
2	127.0.0.1:5702	11.87	8.13	2.00	0.05	0.10	0

From left to right, this table lists the IP address and port of each member, and counts of offers, rejected offers, polls, poll misses and events.

You can select the period in the combo box placed at the top right corner of the window to show the table data. Available values are **Since Beginning**, **Last Minute**, **Last 10 Minutes** and **Last 1 Hour**.

Click on the column headings to ascend or descend the order of the listings.

14. Monitoring Topics

You can see a list of all the topics in your cluster by clicking on the **Topics** menu item on the left panel. A new page is opened on the right, as shown below.

Name ↕	Member ↕	Publishes ↕	Receives ↕
► Topic - 0 (2)	127.0.0.1:5706, 127.0.0.1:5705	5	0
► Topic - 1 (2)	127.0.0.1:5706, 127.0.0.1:5705	8	0
▼ Topic - 2 (2)	127.0.0.1:5706, 127.0.0.1:5705	7	0
	🔗 127.0.0.1:5706	0	0
	🔗 127.0.0.1:5705	7	0
► Topic - 3 (2)	127.0.0.1:5706, 127.0.0.1:5705	23	0
► Topic - 4 (2)	127.0.0.1:5706, 127.0.0.1:5705	20	0

You can filter the topics shown and you can also sort the table by clicking on the column headers. Clicking on a topic name will open a new page for monitoring that topic instance on the right, as shown below.



On top of the page, two charts monitor the **Publishes** and **Receives** in real-time. They show the published and received message counts of the cluster, the members of which are subscribed to the selected topic. The X-axis of both charts show the current system time. To open a chart as a separate dialog, click on the 📊 button placed at the top right of each chart.

Under these charts is the Topic Operation Statistics table. From left to right, this table lists the IP addresses and ports of each member, and counts of the messages published and received per second in real-time. You can select the period in the combo box placed at top right corner of the table to show the table data. The available values are **Since Beginning**, **Last Minute**, **Last 10 Minutes** and **Last 1 Hour**.

Click on the column heading to ascend or descend the order of the listings.

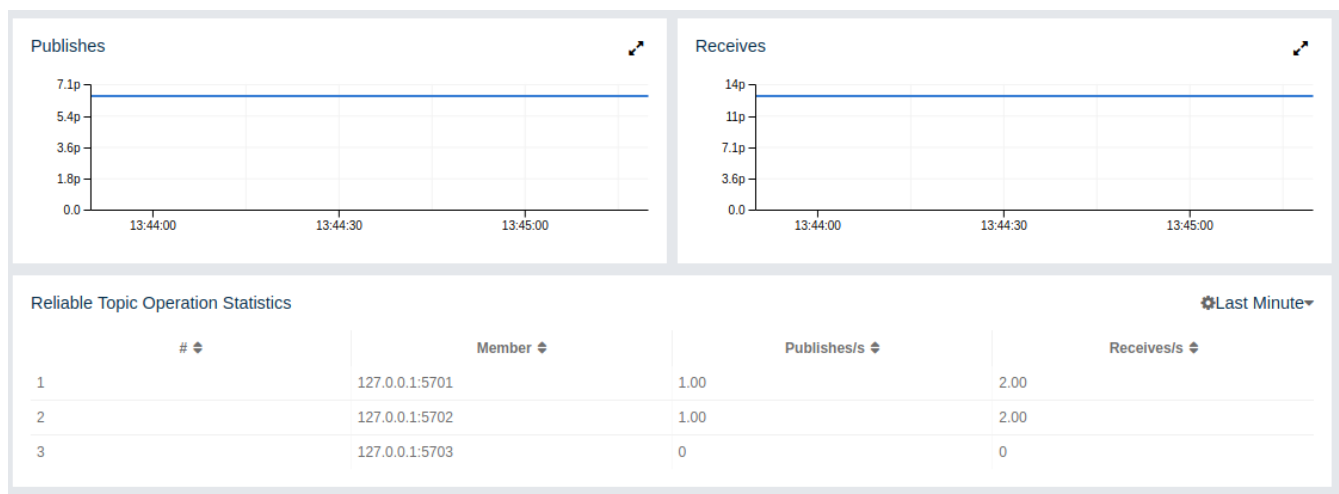
15. Monitoring Reliable Topics

You can see a list of all the Reliable Topics in your cluster by clicking on the **Reliable Topics** menu

item on the left panel. A new page is opened on the right, as shown below.

Name ↕	Member ↕	Publishes ↕	Receives ↕
▶ Reliable Topic - 0 (2)	127.0.0.1:5706, 127.0.0.1:5705	6	0
▼ Reliable Topic - 1 (2)	127.0.0.1:5706, 127.0.0.1:5705	14	0
	🔗 127.0.0.1:5706	7	0
	🔗 127.0.0.1:5705	7	0
▶ Reliable Topic - 2 (2)	127.0.0.1:5706, 127.0.0.1:5705	18	0

You can filter the Reliable Topics shown and you can also sort the table by clicking on the column headers. Clicking on a Reliable Topic name will open a new page for monitoring that Reliable Topic instance on the right, as shown below.



On top of the page, two charts monitor the **Publishes** and **Receives** in real-time. They show the published and received message counts of the cluster, the members of which are subscribed to the selected reliable topic. The X-axis of both charts show the current system time. To open a chart as a separate dialog, click on the 🗨 button placed at the top right of each chart.

Under these charts is the Reliable Topic Operation Statistics table. From left to right, this table lists the IP addresses and ports of each member, and counts of the messages published and received per second in real-time. You can select the period in the combo box placed at top right corner of the table to show the table data. The available values are **Since Beginning**, **Last Minute**, **Last 10 Minutes** and **Last 1 Hour**.

Click on the column heading to ascend or descend the order of the listings.

16. Monitoring Multimaps

You can see a list of all the MultiMaps in your cluster by clicking on the **MultiMaps** menu item on the left panel. A new page is opened on the right, as shown below.

Name ↕	Entries ↕	Backups ↕	Events ↕	Hits ↕	Locks ↕	DirtyEntries ↕
<input type="text"/>						
🔗 Multi Map - 0	4	4	0	0	0	0
🔗 Multi Map - 1	16	16	0	0	0	0
🔗 Multi Map - 2	9	9	0	0	0	0
🔗 Multi Map - 3	15	14	0	0	0	0

You can filter the MultiMaps shown and you can also sort the table by clicking on the column headers. Clicking on a MultiMap name will open a new page for monitoring that MultiMap instance on the right.

MultiMap is a specialized map where you can associate a key with multiple values. This monitoring option is similar to the **Maps** option: the same monitoring charts and data tables monitor MultiMaps. The differences are that you cannot browse the MultiMaps and re-configure it. Please see the [Managing Maps](#).

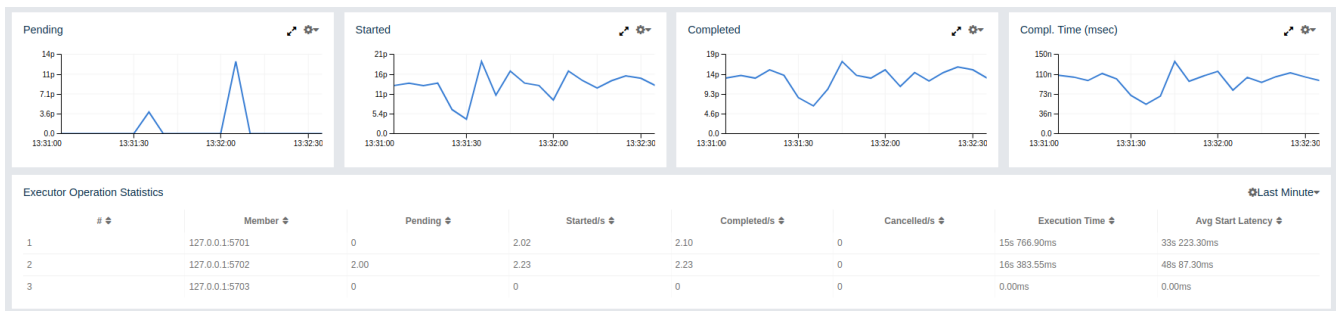
17. Monitoring Executors

You can see a list of all the Executors in your cluster by clicking on the **Executors** menu item on the left panel. A new page is opened on the right, as shown below.

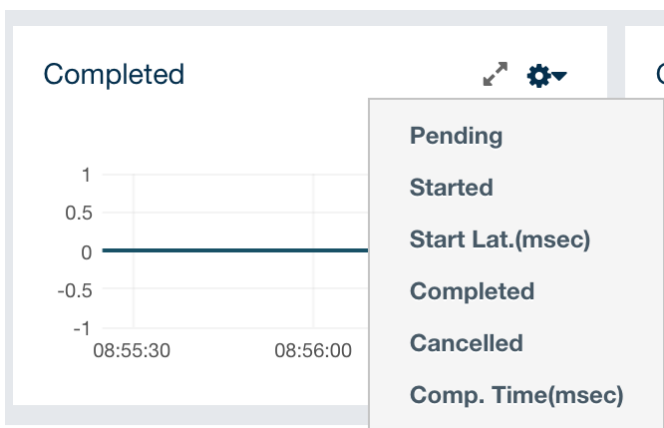
Name ↕	Member ↕	Pending ↕	Started ↕	Completed ↕	Cancelled ↕	Execution Time ↕	Avg Start Latency ↕
<input type="text"/>	<input type="text"/>						
▶ Executor - 0 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		0, 0
▶ Executor - 1 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		1, 0
▶ Executor - 10 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		1, 2
▶ Executor - 11 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		1, 1
▶ Executor - 12 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		1, 1
▶ Executor - 13 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		0, 0
▶ Executor - 14 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		5, 5
▶ Executor - 15 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		5, 5
▼ Executor - 16 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		4, 0
	🔗 127.0.0.1:5706	0	1	1	0	1m 30s	4
	🔗 127.0.0.1:5705	0	1	1	0	28m 51s	0
▶ Executor - 17 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		4, 4
▶ Executor - 18 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		3, 4
▶ Executor - 19 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		3, 3
▶ Executor - 2 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		0, 1
▶ Executor - 20 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		3, 3
▶ Executor - 21 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		2, 2
▶ Executor - 22 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		1, 1
▶ Executor - 23 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		0, 1
▶ Executor - 24 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		1, 0
▶ Executor - 25 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		5, 6
▶ Executor - 26 (2)	127.0.0.1:5706, 127.0.0.1:5706	0, 0	1, 1	1, 1	0, 0		5, 5

« < 1 2 3 4 5 > »

You can filter the Executors shown and you can also sort the table by clicking on the column headers. Clicking on an Executor name will open a new page for monitoring that Executor instance on the right, as shown below.



On top of the page, small charts monitor the pending, started, completed, etc. executors in real-time. The X-axis of all the charts shows the current system time. You can select other small monitoring charts using the button placed at the top right of each chart. Click the button to list the monitoring options, as shown below.



When you click on a desired monitoring, the chart loads with the selected option. To open a chart as a separate dialog, click on the button placed at top right of each chart. The below monitoring charts are available:

- **Pending:** Monitors the pending executors. Y-axis is the executor count.
- **Started:** Monitors the started executors. Y-axis is the executor count.
- **Start Lat. (msec.):** Shows the latency when executors are started. Y-axis is the duration in milliseconds.
- **Completed:** Monitors the completed executors. Y-axis is the executor count.
- **Comp. Time (msec.):** Shows the completion period of executors. Y-axis is the duration in milliseconds.

Under these charts is the **Executor Operation Statistics** table, as shown below.

Executor Operation Statistics							Last Minute
#	Member	Pending	Started/s	Completed/s	Cancelled/s	Execution Time	Avg Start Latency
1	127.0.0.1:5701	0	1.38	1.65	0	12s 466.80ms	20s 429.78ms
2	127.0.0.1:5702	0	1.78	2.05	0	15s 266.95ms	24s 545.33ms
3	127.0.0.1:5703	0	0	0	0	0.00ms	0.00ms

From left to right, this table lists the IP address and port of members, the counts of pending, started and completed executors per second, and the execution time and average start latency of executors on each member. Click on the column heading to ascend or descend the order of the listings.

18. Monitoring WAN Replication

WAN Replication schemes are listed under the **WAN Replication** menu item on the left. When you click on a scheme, a new page for monitoring the targets which that scheme has appears on the right, as shown below.

[illegible]

In this page, you see **WAN Replication Operations Table** for each target which belongs to this scheme. One of the example tables is shown below.

Cluster-2						Change State
Members	Connected	Events Published per Second	Average Event Latency	Outbound Queue Size	Action	State
127.0.0.1:5702	✓	7	1s 130.00ms	13	Pause Clear Queues	REPLICATING
127.0.0.1:5701	✓	7	944.00ms	6	Pause Clear Queues	REPLICATING
127.0.0.1:5703	✗	0	0.00ms	0	Pause Clear Queues	REPLICATING

- **Connected:** Status of the member connection to the target.
- **Events Published per Second:** Number of published events per second. Please see the paragraph below.
- **Average Event Latency:** Average latency of sending a record to the target from this member. Please see the paragraph below.
- **Outbound Queue Size:** Number of records waiting in the queue to be sent to the target.
- **Action:** Pause, stop or resume replication of a member's records. You can also clear the event queues in a member using the "Clear Queues" action. For instance, if you know that the target cluster is being shut down, decommissioned, put out of use and it will never come back, you may additionally clear the WAN queues to release the consumed heap after the publisher has been switched. Or, when a failure happens and queues are not replicated anymore, you could manually clear the queues using, again the "Clear Queues" action.
- **State:** Shows current state of the WAN publisher on a member. See [Changing WAN Publisher](#)

[State](#) for the list of possible WAN publisher states.

Events Published per Second and **Average Event Latency** are based on the following internal statistics:

- Total published event count (TBEC): Total number of events that are successfully sent to the target cluster since the start-up of the member.
- Total latency (TL): Grand total of each event's waiting time in the queue, including network transmit and receiving ACK from the target.

Each member sends these two statistics to the Management Center at intervals of 3 seconds (update interval). Management Center derives **Events Published per Second** and **Average Event Latency** from these statistics as formulated below:

Events Published per Second = (Current TBEC - Previous TBEC) / Update Interval

Average Event Latency = (Current TL - Previous TL) / (Current TBEC - Previous TBEC)

18.1. Changing WAN Publisher State

A WAN publisher can be in one of the following states:

- **REPLICATING** (default): State where both enqueueing new events is allowed, enqueued events are replicated to the target cluster.
- **PAUSED**: State where new events are enqueued but they are dequeued. Some events which have been dequeued before the state was switched may still be replicated to the target cluster but further events will not be replicated.
- **STOPPED**: State where neither new events are enqueued nor dequeued. As with the **PAUSED** state, some events might still be replicated after the publisher has switched to this state.

You can change a WAN publisher's state by clicking the **Change State** dropdown button on top right hand corner of the WAN Replication Operations Table.

Cluster-2							Change State
Members	Connected	Events Published per Second	Average Event Latency	Outbound Queue Size	Action		
127.0.0.1:5702	✓	7	688.00ms	5	Pause Clear Queues	REPLICATING	REPLICATING
127.0.0.1:5701	✓	7	769.00ms	4	Pause Clear Queues	REPLICATING	REPLICATING
127.0.0.1:5703	✗	0	0.00ms	0	Pause Clear Queues	REPLICATING	REPLICATING

18.2. WAN Sync

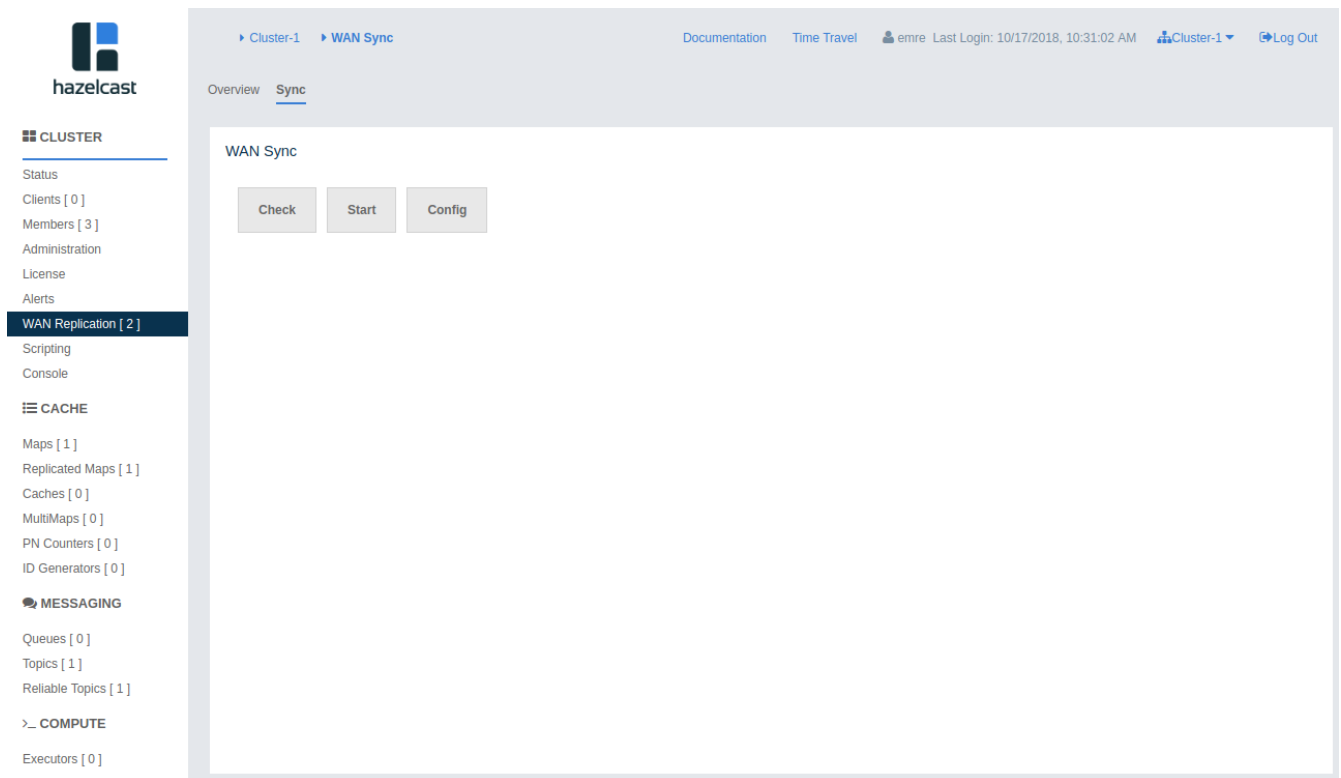
You can initiate a synchronization operation on an IMap for a specific target cluster. This operation is useful if two remote clusters lost their synchronization due to WAN queue overflow or in restart scenarios.

Hazelcast provides the following synchronization options:

1. Default WAN synchronization operation: It sends all the data of an IMap to a target cluster to align the state of target IMap with the source IMap. See [here](#) for more information.

2. WAN synchronization using [Merkle trees](#): To initiate this type of synchronization, you need to configure the cluster members. See the [Delta WAN Synchronization section](#) in Hazelcast IMDG Reference Manual for details about configuring them. Make sure you meet [all the requirements](#) to use Delta WAN Synchronization and do the configuration on both the source and target clusters.

To initiate WAN Sync, open the **WAN Replication** menu item on the left and navigate to the **Sync** tab.



Click **Start** button to open the dialog, enter the target details for the sync operation and click **Sync** to start the operation.

Start WAN Sync ✕

Select WAN Configuration

my-wan-cluster ▼

Select Target

Cluster-2 ▼

Select Map

map-1 ▼

Sync

You can also use the "All Maps" option in the above dialog if you want to synchronize all the maps in source and target cluster.

You can see the progress of the operation once you initiate it.

WAN Sync

Check

Start

Config

Time ▾	Member ↕	Description ↕
October 17th 2018, 13:02:20	127.0.0.1:5702	Completed WAN sync between Cluster-1 and Cluster-2 for map map-1 using Merkle trees. Partitions synced: 136 Records synced: 5000 Duration (seconds): 0
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 136 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 135 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 134 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 133 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 132 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Completed WAN sync between Cluster-1 and Cluster-2 for map map-1 using Merkle trees. Partitions synced: 135 Records synced: 5000 Duration (seconds): 0
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 135 partitions out of 135 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 134 partitions out of 135 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 131 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 130 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 129 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 128 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 127 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5702	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 126 partitions out of 136 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 133 partitions out of 135 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 132 partitions out of 135 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 131 partitions out of 135 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 130 partitions out of 135 are synced.
October 17th 2018, 13:02:20	127.0.0.1:5701	Progress update for WAN sync between Cluster-1 and Cluster-2 for map map-1: 129 partitions out of 135 are synced.

<<

<

1

2

3

4

5

6

>

>>

18.3. WAN Consistency Check

You can check if an IMap is in sync with a specific target cluster. Click **Check** button to open the dialog, enter the target details for the consistency check operation and click **Check Consistency** to start the operation.

Start WAN Consistency Check

Select WAN Configuration

my-wan-cluster

Select Target

Cluster-3

Select Map

map-1

Check Consistency

You can see the progress of the operation once you initiate it.

Overview Sync

WAN Sync

Check

Start

Config

Time ▼	Member ↕	Description ↕
October 17th 2018, 13:19:52	127.0.0.1:5701	Completed consistency check between Cluster-1 and Cluster-2 for map map-1. 135 partitions out of 135 are in need of sync.
October 17th 2018, 13:19:52	127.0.0.1:5702	Completed consistency check between Cluster-1 and Cluster-2 for map map-1. 136 partitions out of 136 are in need of sync.
October 17th 2018, 13:19:52	127.0.0.1:5701	Started consistency check between Cluster-1 and Cluster-2 for map map-1
October 17th 2018, 13:19:52	127.0.0.1:5702	Started consistency check between Cluster-1 and Cluster-2 for map map-1
October 17th 2018, 13:19:51	127.0.0.1:5703	Completed consistency check between Cluster-1 and Cluster-2 for map map-1. 0 partitions out of 0 are in need of sync.
October 17th 2018, 13:19:51	127.0.0.1:5703	Started consistency check between Cluster-1 and Cluster-2 for map map-1



You need to use Merkle trees for WAN synchronization to be able to check for the consistency between two clusters. You need to configure the Merkle trees on both the source and target clusters. If you do not configure it for the source cluster, consistency check will be ignored. If it's enabled for the source cluster but not for the target cluster, all entries will be reported as if they need a sync because a sync operation will be a full sync in the absence of Merkle trees.

Overview Sync

WAN Sync

Check

Start

Config

Time ▼	Member ↕	Description ↕
October 17th 2018, 13:24:39	127.0.0.1:5702	Consistency check request for WAN replication 'my-wan-cluster', target group name 'Cluster-2' and map 'map-1' ignored. Reason: Map has merkle trees disabled.

18.4. Add Temporary WAN Replication Configuration

You can add a temporary WAN replication configuration dynamically to a cluster. It is useful for having one-off WAN sync operations. The added configuration has two caveats:

- It is not persistent, so it will not survive a member restart.
- It cannot be used as a target for regular WAN replication. It can only be used for WAN sync.

Add WAN Replication Configuration

Config Name:

the-wan-cluster

Class Name:

com.hazelcast.enterprise.wan.replication.WanBatch

Target Group Name:

Cluster-2

Group Password:

Queue Capacity:

10000

Endpoints:

127.0.0.1:5715

Batch Max Delay(ms):

2000

Batch Size:

500

Response Timeout(ms):

60000

Acknowledge Type:

ACK_ON_RECEIPT

Full Queue Behavior:

DISCARD_AFTER_MUTATION

+ Add Configuration

See the [WAN Replication section](#) in Hazelcast IMDG Reference Manual for details about the fields and their possible values.

After clicking the **Add Configuration** button, the new WAN replication configuration is added to the cluster. You can see the new configuration when you try to initiate a WAN sync operation as described in the previous section.

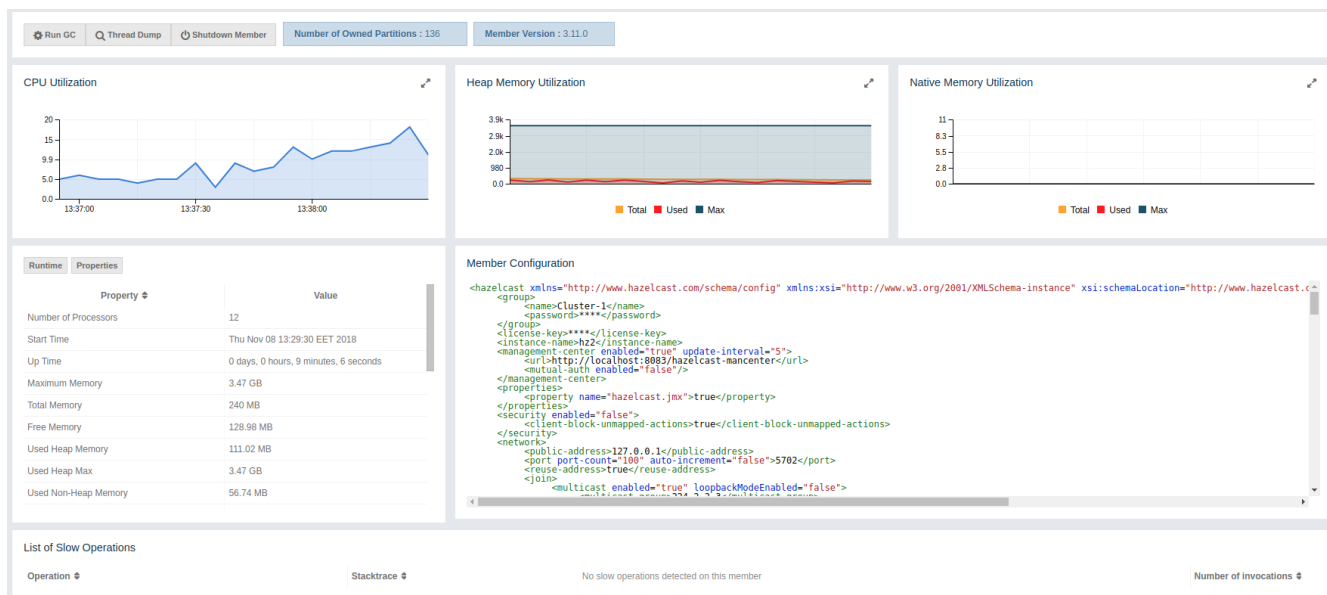
19. Monitoring Members


Use this menu item to monitor each cluster member and perform operations like running garbage collection (GC) and taking a thread dump.

You can see a list of all the members in your cluster by clicking on the **Members** menu item on the left panel. A new page is opened on the right, as shown below.

Member	Scripting Enabled	Slow Operations	Owned Partitions	Version	OS Total Physical ...	OS Committed Virtu...	OS Free Physical ...	OS System CPU L...	OS Max File Desc	OS Open File Des...
127.0.0.1:5702	No	No	136	3.11.1	15.60 GB	12.14 GB	503.20 MB	27%	1048576	272
127.0.0.1:5701	No	Yes	135	3.11.1	15.60 GB	12.14 GB	548.07 MB	37%	1048576	272
127.0.0.1:5703	No	No	0	3.11.1	15.60 GB	12.14 GB	551.60 MB	11%	1048576	272

You can filter the members shown and you can also sort the table by clicking on the column headers. Clicking on a member name will open a new page for monitoring that member on the right, as shown below.



The **CPU Utilization** chart shows the percentage of CPU usage on the selected member. The **Memory Utilization** chart shows the memory usage on the selected member with three different metrics (maximum, used and total memory). You can open both of these charts as separate windows using the  button placed at top right of each chart; this gives you a clearer view of the chart.

The window titled **Partitions** shows which partitions are assigned to the selected member. **Runtime** is a dynamically updated window tab showing the processor number, the start and up times, and the maximum, total and free memory sizes of the selected member. These values are collected from the default MXBeans provided by the Java Virtual Machine (JVM). Descriptions from the Javadocs and some explanations are below:

- **Number of Processors:** Number of processors available to the member (JVM).
- **Start Time:** Start time of the member (JVM) in milliseconds.
- **Up Time:** Uptime of the member (JVM) in milliseconds
- **Maximum Memory:** Maximum amount of memory that the member (JVM) will attempt to use.
- **Free Memory:** Amount of free memory in the member (JVM).
- **Used Heap Memory:** Amount of used memory in bytes.
- **Max Heap Memory:** Maximum amount of memory in bytes that can be used for memory management.
- **Used Non-Heap Memory:** Amount of used memory in bytes.
- **Max Non-Heap Memory:** Maximum amount of memory in bytes that can be used for memory management.
- **Total Loaded Classes:** Total number of classes that have been loaded since the member (JVM) has started execution.
- **Current Loaded Classes:** Number of classes that are currently loaded in the member (JVM).
- **Total Unloaded Classes:** Total number of classes unloaded since the member (JVM) has started execution.
- **Total Thread Count:** Total number of threads created and also started since the member (JVM)

started.

- **Active Thread Count:** Current number of live threads including both daemon and non-daemon threads.
- **Peak Thread Count:** Peak live thread count since the member (JVM) started or peak was reset.
- **Daemon Thread Count:** Current number of live daemon threads.
- **OS: Free Physical Memory:** Amount of free physical memory in bytes.
- **OS: Committed Virtual Memory:** Amount of virtual memory that is guaranteed to be available to the running process in bytes.
- **OS: Total Physical Memory:** Total amount of physical memory in bytes.
- **OS: Free Swap Space:** Amount of free swap space in bytes. Swap space is used when the amount of physical memory (RAM) is full. If the system needs more memory resources and the RAM is full, inactive pages in memory are moved to the swap space.
- **OS: Total Swap Space:** Total amount of swap space in bytes.
- **OS: Maximum File Descriptor Count:** Maximum number of file descriptors. File descriptor is an integer number that uniquely represents an opened file in the operating system.
- **OS: Open File Descriptor Count:** Number of open file descriptors.
- **OS: Process CPU Time:** CPU time used by the process on which the member (JVM) is running in nanoseconds.
- **OS: Process CPU Load:** Recent CPU usage for the member (JVM) process. This is a double with a value from 0.0 to 1.0. A value of 0.0 means that none of the CPUs were running threads from the member (JVM) process during the recent period of time observed, while a value of 1.0 means that all CPUs were actively running threads from the member (JVM) 100% of the time during the recent period being observed. Threads from the member (JVM) include the application threads as well as the member (JVM) internal threads.
- **OS: System Load Average:** System load average for the last minute. The system load average is the average over a period of time of this sum: (the number of runnable entities queued to the available processors) + (the number of runnable entities running on the available processors). The way in which the load average is calculated is operating system specific but it is typically a damped time-dependent average.
- **OS: System CPU Load:** Recent CPU usage for the whole system. This is a double with a value from 0.0 to 1.0. A value of 0.0 means that all CPUs were idle during the recent period of time observed, while a value of 1.0 means that all CPUs were actively running 100% of the time during the recent period being observed.



These descriptions may vary according to the JVM version or vendor.

Next to the **Runtime** tab, the **Properties** tab shows the system properties. The **Member Configuration** window shows the XML configuration of the connected Hazelcast cluster.

The **List of Slow Operations** gives an overview of detected slow operations which occurred on that member. The data is collected by the [SlowOperationDetector](#).

List of Slow Operations		
Operation	Stacktrace	Number of Invocations
com.hazelcast.webscope.HzStarter\$1	java.lang.Thread.sleep(Native Method) com.hazelcast.webscope.HzStarter\$1.run(HzStarter.java:148) com.hazelcast.spi.impl.operationsexecutor.impl.OperationThread.run(OperationThread.java:110)	1

Click on an entry to open a dialog which shows the stacktrace and detailed information about each slow invocation of this operation.

Slow Operation Details

Stacktrace

java.lang.Thread.sleep(Native Method) com.hazelcast.webscope.HzStarter\$1.run(HzStarter.java:148)
 com.hazelcast.spi.impl.operationsexecutor.impl.OperationThread.run(OperationThread.java:110)
 com.hazelcast.spi.impl.operationsexecutor.impl.OperationThread.process(OperationThread.java:159)
 com.hazelcast.spi.impl.operationsexecutor.impl.OperationThread.run(OperationThread.java:110)

Operation

com.hazelcast.webscope.HzStarter\$1@340ea292

Start Time

Thursday, November 8th 2018, 1:33:25 pm

Duration

99010 ms

Besides the aforementioned monitoring charts and windows, you can also perform operations on the selected member through this page. The operation buttons are located at the top right of the page, as explained below:

- **Run GC:** Press this button to execute garbage collection on the selected member. A notification stating that the GC execution was successful will be shown.
- **Thread Dump:** Press this button to take a thread dump of the selected member and show it as a separate dialog to the user.
- **Shutdown Node:** Press this button to shutdown the selected member.
- **Promote Member:** Only shown for lite members. Press this button to promote a lite member to a data member.

20. Monitoring Clients

You can use the **Clients** menu item to monitor all the clients that are connected to your Hazelcast cluster.

As a prerequisite, you need to enable the client statistics before starting your clients. This can be done by setting the `hazelcast.client.statistics.enabled` system property to `true` on the **client**. Please see the [Client System Properties section](#) in the Hazelcast IMDG Reference Manual for more information. After you enable the client statistics, you can monitor your clients using Hazelcast Management Center.

You can see a list of all the clients in your cluster by clicking on the **Clients** menu item on the left panel. A new page is opened on the right, as shown below.

Cluster A Clients Documentation Time Travel puzpuzpuz Last Login: 1/22/2019, 11:05:24 AM Cluster A Log Out

Name	Address	Enterprise	Type	Member Connection	Version	UUID
hz.client_4	127.0.0.1:39399	Yes	JAVA	ALL	3.11.1	5b9d9eeb-871e-4606-bd7...
hz.client_9	127.0.0.1:50639	Yes	JAVA	127.0.0.1:5701	3.11.1	ba4065d4-9a60-4223-950...
hz.client_1	127.0.0.1:50305	Yes	JAVA	ALL	3.11.1	df02d41c-5c0b-443d-ba55...
hz.client_0	127.0.0.1:58895	Yes	JAVA	127.0.0.1:5702	3.11.1	8a3cf0d8-587f-4c54-8add...
hz.client_7	127.0.0.1:59479	Yes	JAVA	127.0.0.1:5702	3.11.1	b7556ef4-573d-4cef-9689...
hz.client_2	127.0.0.1:43501	Yes	JAVA	127.0.0.1:5702	3.11.1	e48ef350-c056-4317-99a3...
hz.client_5	127.0.0.1:56151	Yes	JAVA	127.0.0.1:5702	3.11.1	ca3062e5-2fa3-49bc-9e12...
hz.client_3	127.0.0.1:55863	Yes	JAVA	127.0.0.1:5701	3.11.1	65eb9e42-90c5-4ade-a35f...
hz.client_8	127.0.0.1:52715	Yes	JAVA	ALL	3.11.1	42737046-e43a-458c-aa24...
hz.client_6	127.0.0.1:41189	Yes	JAVA	127.0.0.1:5702	3.11.1	6e908d44-4f7b-437d-928a...

20 rows

You can filter the clients shown and you can also sort the table by clicking on the column headers. Clicking on a client name will open a new page for monitoring that client on the right, as shown below.



The **Heap Memory Utilization** chart shows the memory usage on the selected client with three different metrics (maximum, used and total memory). You can open both of these charts as separate windows using the button placed at top right of each chart; this gives you a clearer view of the chart.

General is a dynamically updated window tab showing general information about the client. Below are brief explanations for each piece of information:

- **Name:** Name of the client instance.
- **Address:** Local address of the client that is used for connecting to client's owner member, shown as **<IP>:<port>**.
- **Type:** Type of the client. Java client is the only supported client type at the moment.
- **Enterprise:** Yes, if the client is an Hazelcast IMDG Enterprise client.
- **Member Connection:** Shows to which member a client is currently connected to. Please note

that **ALL** means a client is configured so that it **might** connect to all members of a cluster, i.e., it might not have a connection to all members all the time.

- **Version:** Version of the client.
- **Last Connection to Cluster:** Time that the client connected to the cluster. It is reset on each reconnection.
- **Last Statistics Collection:** Time when the latest update for the statistics is collected from the client.
- **User Executor Queue Size:** Number of waiting tasks in the client user executor.

Next to the **General** tab, the **Runtime** tab shows the processor number, uptime, and maximum, total and free memory sizes of the selected client. These values are collected from the default MXBeans provided by the Java Virtual Machine (JVM). Descriptions from the Javadocs and some explanations are below:

- **Number of Processors:** Number of processors available to the client (JVM).
- **Up Time:** Uptime of the client (JVM).
- **Maximum Memory:** Maximum amount of memory that the client (JVM) will attempt to use.
- **Total Memory:** Amount of total heap memory currently available for current and future objects in the client (JVM).
- **Free Memory:** Amount of free heap memory in the client (JVM).
- **Used Memory:** Amount of used heap memory in the client (JVM).

Next to the **Runtime** tab, the **OS** tab shows statistics about the operating system of the client. These values are collected from the default MXBeans provided by the Java Virtual Machine (JVM). Descriptions from the Javadocs and some explanations are below:

- **Free Physical Memory:** Amount of free physical memory.
- **Committed Virtual Memory:** Amount of virtual memory that is guaranteed to be available to the running process.
- **Total Physical Memory:** Total amount of physical memory.
- **Free Swap Space:** Amount of free swap space. Swap space is used when the amount of physical memory (RAM) is full. If the system needs more memory resources and the RAM is full, inactive pages in memory are moved to the swap space.
- **Total Swap Space:** Total amount of swap space.
- **Maximum File Descriptor Count:** Maximum number of file descriptors. File descriptor is an integer number that uniquely represents an opened file in the operating system.
- **Open File Descriptor Count:** Number of open file descriptors.
- **Process CPU Time:** CPU time used by the process on which the member (JVM) is running.
- **System Load Average:** System load average for the last minute. The system load average is the average over a period of time of this sum: (the number of runnable entities queued to the available processors) + (the number of runnable entities running on the available processors). The way in which the load average is calculated is operating system specific but it is typically a

damped time-dependent average.



Some of the Runtime/OS statistics may not be available for your client's JVM implementation/operating system. **UNKNOWN** is shown for these types of statistics. Please refer to your JVM/operating system documentation for further details.

The **Client Near Cache Statistics** table shows statistics related to Near Cache of a client. There are two separate tables; one for maps and one for caches.

- **Map/Cache Name:** Name of the map or cache.
- **Creation Time:** Creation time of this Near Cache on the client.
- **Evictions:** Number of evictions of Near Cache entries owned by the client.
- **Expirations:** Number of TTL and max-idle expirations of Near Cache entries owned by the client.
- **Hits:** Number of hits (reads) of Near Cache entries owned by the client.
- **Misses:** Number of misses of Near Cache entries owned by the client.
- **Owned Entry Count:** Number of Near Cache entries owned by the client.
- **Owned Entry Memory Cost:** Memory cost of Near Cache entries owned by the client.
- **LP Duration:** Duration of the last Near Cache key persistence (when the pre-load feature is enabled).
- **LP Key Count:** Number of Near Cache key persistences (when the pre-load feature is enabled).
- **LP Time:** Time of the last Near Cache key persistence (when the pre-load feature is enabled).
- **LP Written Bytes:** Written number of bytes of the last Near Cache key persistence (when the pre-load feature is enabled).
- **LP Failure:** Failure reason of the last Near Cache persistence (when the pre-load feature is enabled).



Please note that you can configure the time interval for which the client statistics are collected and sent to the cluster, using the system property `hazelcast.client.statistics.period.seconds`. Please see the [System Properties section](<http://docs.hazelcast.org/docs/latest/manual/html-single/index.html#client-system-properties>) in the Hazelcast IMDG Reference Manual for more information.

21. Monitoring PN Counters

You can see a list of all the PN counters in your cluster by clicking on the **Counters** menu item on the left panel. A new page is opened on the right, as shown below.

Cluster A > PN Counters		Documentation	Time Travel	emre Last Login: 4/20/2018, 11:57:49 AM	Cluster A ▾	Log Out
Name ↕	Operations per second INC ↕	Operations per second DEC ↕	Number of Replicas ↕			
<input type="text"/>						
🔗 PN Counter - 0	6.549	3.699	2			
🔗 PN Counter - 1	7.399	0	1			
🔗 PN Counter - 2	6.549	0	2			
🔗 PN Counter - 3	7.399	7.399	1			
🔗 PN Counter - 4	6.549	0	2			
🔗 PN Counter - 5	7.399	0	1			
🔗 PN Counter - 6	6.549	3.699	2			
🔗 PN Counter - 7	7.399	0	1			
🔗 PN Counter - 8	6.549	0	2			
🔗 PN Counter - 9	7.399	7.399	1			

You can filter the counters shown and you can also sort the table by clicking on the column headers. The monitoring data available are:

- **Operations per second INC:** Average number of times the counter was incremented per second during the last timeslice
- **Operations per second DEC:** Average number of times the counter was decremented per second during the last timeslice
- **Number of Replicas:** The number of member instances that have a state for the counter

Clicking on a counter name will open a new page for monitoring that specific counter instance, as shown below.

Cluster A > PN Counters > PN Counter - 2		Documentation	Time Travel	emre Last Login: 4/20/2018, 11:57:49 AM	Cluster A ▾	Log Out
Member ↕	Operations per second INC ↕	Operations per second DEC ↕	Value ↕			
<input type="text"/>						
127.0.0.1:5706	0	0	200			
127.0.0.1:5705	0	0	200			

The table can likewise be sorted by clicking the column headers. It shows IP and port of the members that have a state for the specific counter named in the page's title. The monitoring data available are:

- **Operations per second INC:** Average number of times the counter was incremented on that member per second during the last timeslice
- **Operations per second DEC:** Average number of times the counter was decremented on that member per second during the last timeslice
- **Value:** The current value of the counter on that member

22. Monitoring Flake ID Generators

You can see a list of all Flake ID Generators in your cluster by clicking on the **ID Generators** menu

item on the left panel. A new page is opened on the right, as shown below.

Cluster A ID Generators			Documentation	Time Travel	emre Last Login: 4/20/2018, 11:57:49 AM	Cluster A	Log Out
Name	Avg. Batch Requests	Avg. Batch Size					
<input type="text"/>							
Flake ID Generator - 0	1	100					
Flake ID Generator - 1	1	100					
Flake ID Generator - 2	1	100					
Flake ID Generator - 3	1	100					
Flake ID Generator - 4	1	100					
Flake ID Generator - 5	1	100					
Flake ID Generator - 6	1	100					
Flake ID Generator - 7	1	100					
Flake ID Generator - 8	1	100					
Flake ID Generator - 9	1	100					

You can filter the generators shown and you can also sort the table by clicking on the column headers. The monitoring data available are:

- **Operations per second:** Average number of times per second the generator created a batch of new IDs during the last timeslice

Clicking on a generator name will open a new page for monitoring that specific generator instance, as shown below.

Cluster A ID Generators Flake ID Generator - 3			Documentation	Time Travel	emre Last Login: 4/20/2018, 11:57:49 AM	Cluster A	Log Out
Member	Batch Requests	Avg. Batch Size					
<input type="text"/>							
127.0.0.1:5710	2	100					
127.0.0.1:5709	2	100					
127.0.0.1:5706	2	100					
127.0.0.1:5708	2	100					
127.0.0.1:5707	2	100					

The table can likewise be sorted by clicking the column headers. It shows IP and port of the members that have a state for the specific generator named in the page's title. The monitoring data available are:

- **Operations per second:** Average number of times per second the generator created a batch of new IDs on that member during the last timeslice



The operations per second is not the number of new IDs generated or used but the number of ID batches. The batch size is configurable, usually it contains hundreds or thousands of IDs. A client uses all IDs from a batch before a new batch is requested.

23. Scripting

You can use the scripting feature of this tool to execute codes on the cluster. To use this feature, click the **Scripting** menu item on the left panel. Once selected, the scripting feature opens as shown below.

The screenshot displays the Scripting interface. On the left, the 'Scripting' tab is active, showing a code editor with a JavaScript function:

```
1 function echo() {
2   var name = hazelcast.getName();
3   var node = hazelcast.getCluster().getLocalMember();
4   return name + ' => ' + node;
5 }
6 echo();
7
```

 Above the editor is a 'Script Name' input field and 'Save' and 'Delete' buttons. On the right, the 'Members' list shows six cluster members, all selected with checkboxes. Below the list is a language dropdown menu set to 'Javascript' and an 'Execute' button. At the bottom, the 'Result' pane shows the output of the script execution, displaying responses from four members (5705, 5707, 5710, 5709) with their respective IDs and the string 'this'.

In this window, the **Scripting** part is the actual coding editor. You can select the members on which the code will execute from the **Members** list shown at the right side of the window. Below the members list, a combo box enables you to select a scripting language: currently, JavaScript, Ruby, Groovy and Python languages are supported. After you write your script and press the **Execute** button, you can see the execution result in the **Result** part of the window.



To use the scripting languages other than JavaScript on a member, the libraries for those languages should be placed in the classpath of that member.

There are **Save** and **Delete** buttons on the top right of the scripting editor. To save your scripts, press the **Save** button after you type a name for your script into the field next to this button. The scripts you saved are listed in the **Saved Scripts** part of the window, located at the bottom right of the page. Click on a saved script from this list to execute or edit it. If you want to remove a script that you wrote and saved before, select it from this list and press the **Delete** button.

In the scripting engine you have a **HazelcastInstance** bonded to a variable named **hazelcast**. You can invoke any method that **HazelcastInstance** has via the **hazelcast** variable. You can see example usage for JavaScript below.


```
var name = hazelcast.getName();
var node = hazelcast.getCluster().getLocalMember();
var employees = hazelcast.getMap("employees");
employees.put("1", "John Doe");
employees.get("1"); // will return "John Doe"
```



Starting with Hazelcast 3.11.1, you have the option to disable scripting on the Hazelcast members. The support for script execution is enabled in the Hazelcast IMDG Open Source edition and disabled in the Hazelcast IMDG Enterprise edition by default. Members list shows whether scripting is enabled or disabled for each member. Please see the [Toggle Scripting Support](#) section in the Hazelcast IMDG Reference Manual for details.

Member	Scripting Enabled	Slow Operations	Owned Partitions	Version	OS Total Physical ...	OS Committed Virtu...	OS Free Physical ...	OS System CPU L...	OS Max File Desc	OS Open File Des...
127.0.0.1:5702	No	No	136	3.11.1	15.60 GB	12.14 GB	503.20 MB	27%	1048576	272
127.0.0.1:5701	No	Yes	135	3.11.1	15.60 GB	12.14 GB	548.07 MB	37%	1048576	272
127.0.0.1:5703	No	No	0	3.11.1	15.60 GB	12.14 GB	551.60 MB	11%	1048576	272

24. Executing Console Commands

The Management Center has a console feature that enables you to execute commands on the cluster. For example, you can perform `put's` and `'get's` on a map, after you set the namespace with the command `'ns <name of your map>`. The same is valid for queues, topics, etc. To execute your command, type it into the field below the console and press **Enter**. Type `help` to see all the commands that you can use.

Open a console window by clicking on the **Console** button located on the left panel. Below is a sample view with some executed commands.

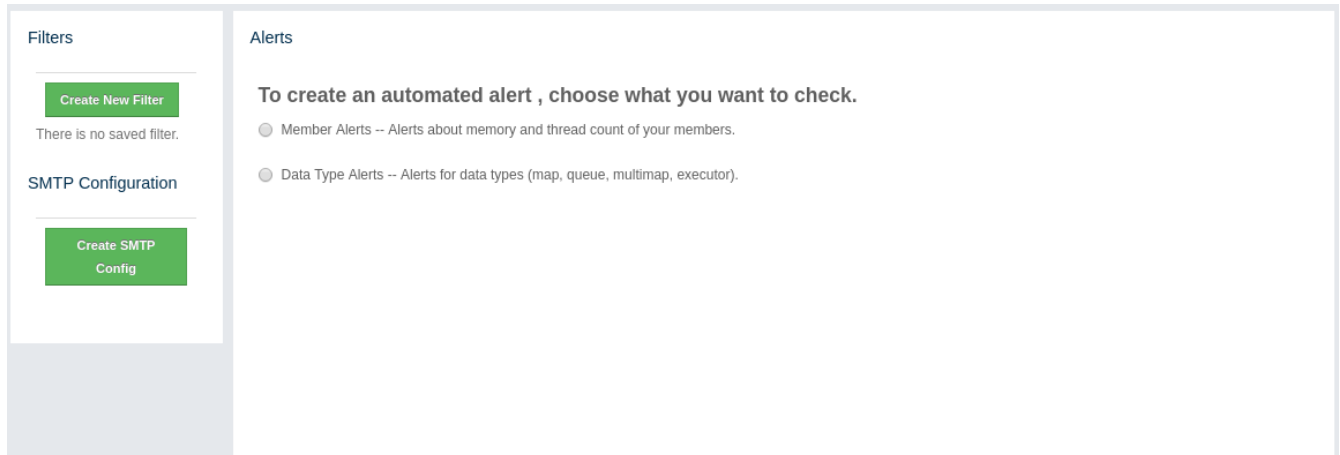
```
> Type help for command list If you'd like to connect specific member on the cluster please enter the command 'connect ip:port'.default> ns a-map
> Current Namespace:a-map
a-map> namespace: a-map
a-map> m.size
a-map> Size: 1
```

[Type your command here, type 'help' to see list of commands.]

25. Creating Alerts

You can use the alerts feature of this tool to receive alerts and/or e-mail notifications by creating filters. In these filters, you can specify criteria for cluster members or data structures. When the specified criteria are met for a filter, the related alert is shown as a pop-up message on the top right of the page or sent as an e-mail.

Once you click the **Alerts** button located on the left panel, the page shown below appears.



Filters

Create New Filter

There is no saved filter.

SMTP Configuration

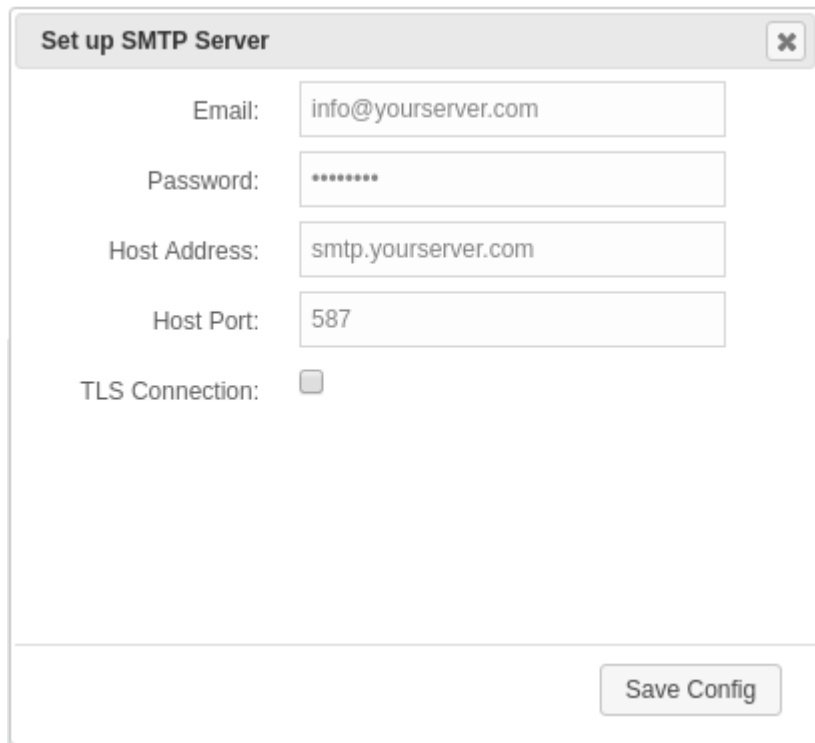
Create SMTP Config

Alerts

To create an automated alert , choose what you want to check.

- ☒ Member Alerts -- Alerts about memory and thread count of your members.
- ☐ Data Type Alerts -- Alerts for data types (map, queue, multimap, executor).

If you want to enable the Management Center to send e-mail notifications to the Management Center Admin users, you need to configure the SMTP server. To do this, click on the **Create STMP Config** shown above. The form shown below appears.



Set up SMTP Server

Email: info@yourserver.com

Password:

Host Address: smtp.yourserver.com

Host Port: 587

TLS Connection: ☐

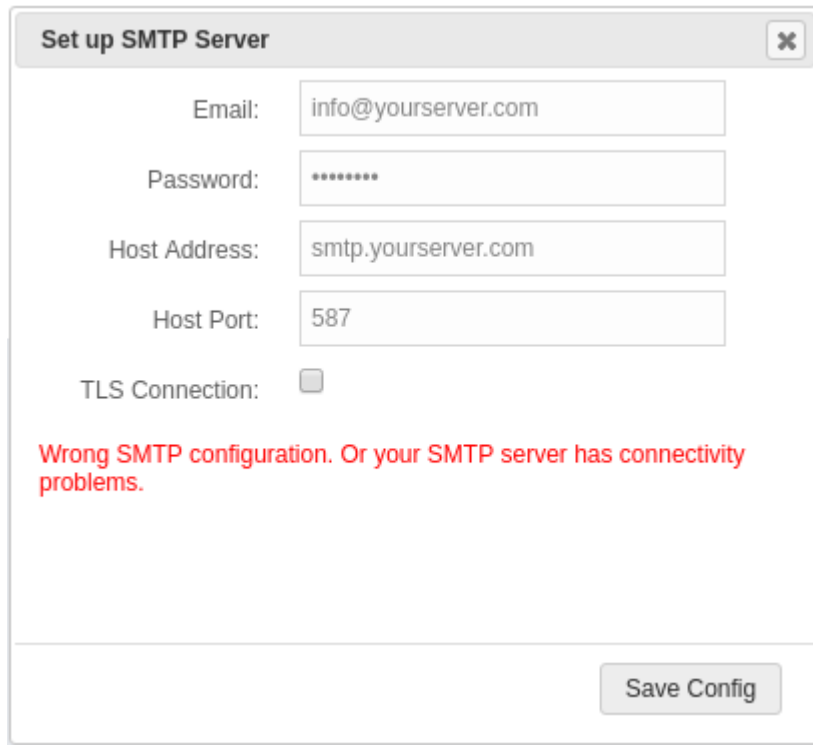
Save Config

In this form, specify the e-mail address from which the notifications will be sent and also its password. Then, provide the SMTP server host address and port. Finally, check the **TLS Connection** checkbox if the connection is secured by TLS (Transport Layer Security).

After you provide the required information, click on the **Save Config** button. After a processing

period (for a couple of seconds), the form will be closed if the configuration is created successfully. In this case, an e-mail will be sent to the e-mail address you provided in the form stating that the SMTP configuration is successful and e-mail alert system is created.

If not, you will see an error message at the bottom of this form as shown below.



The screenshot shows a web form titled "Set up SMTP Server" with a close button (X) in the top right corner. The form contains the following fields and controls:

- Email:
- Password:
- Host Address:
- Host Port:
- TLS Connection: ☐

Below the fields, there is a red error message: "Wrong SMTP configuration. Or your SMTP server has connectivity problems."

At the bottom right of the form, there is a "Save Config" button.

As you can see, the reasons can be wrong SMTP configuration or connectivity problems. In this case, please check the form fields and check for any causes for the connections issues with your server.

25.1. Creating Filters for Cluster Members

Select **Member Alerts** check box to create filters for some or all members in the cluster. Once selected, the next screen asks for which members the alert will be created. Select the desired members and click on the **Next** button. On the next page (shown below), specify the criteria.

Alerts

Alert Criteria

☒ Free Memory is less than MB

☒ Used Heap Memory is larger than MB

☐ # of Active Threads are less than


☐ # of Daemon Threads are larger than

You can create alerts when:

- free memory on the selected members is less than the specified number.
- used heap memory is larger than the specified number.
- the number of active threads are less than the specified count.
- the number of daemon threads are larger than the specified count.

When two or more criteria is specified they will be bound with the logical operator **AND**.

On the next page, give a name for the filter. Then, select whether notification e-mails will be sent to the Management Center Admins using the **Send Email Alert** checkbox. Then, provide a time interval (in seconds) for which the e-mails with the **same notification content** will be sent using the **Email Interval (secs)** field. Finally, select whether the alert data will be written to the disk (if checked, you can see the alert log at the folder `/users/<your user>/hazelcast-mancenter3.11.4`).

Click on the **Save** button; your filter will be saved and put into the **Filters** part of the page. To edit the filter, click on the  icon. To delete it, click on the  icon.

25.2. Creating Filters for Data Types

Select the **Data Type Alerts** check box to create filters for data structures. The next screen asks for which data structure (maps, queues, multimaps, executors) the alert will be created. Once a structure is selected, the next screen immediately loads and you then select the data structure instances (i.e. if you selected **Maps**, it will list all the maps defined in the cluster, you can select one map or more). Select as desired, click on the **Next** button, and select the members on which the selected data structure instances will run.

The next screen, as shown below, is the one where you specify the criteria for the selected data structure.

Data Type Filter

Data Type Settings



You will be alerted, when :

# of Entries	>	1200	Add
# of Locks	>	1199	X
# of Entries	>	1200	X

Cancel
Next

As the screen shown above shows, you will select an item from the left combo box, select the operator in the middle one, specify a value in the input field, and click on the **Add** button. You can create more than one criteria in this page; those will be bound by the logical operator **AND**.


After you specify the criteria, click the **Next** button. On the next page, give a name for the filter. Then, select whether notification e-mails will be sent to the Management Center Admins using the **Send Email Alert** checkbox. Then, provide a time interval (in seconds) for which the e-mails with the **same notification content** will be sent using the **Email Interval (secs)** field. Finally, select whether the alert data will be written to the disk (if checked, you can see the alert log at the folder `/users/<your user>/hazelcast-mancenter3.11.4`).

Click on the **Save** button; your filter will be saved and put into the **Filters** part of the page. To edit the filter, click on the  icon. To delete it, click on the  icon.

26. Administering Management Center

Using the "Administration" menu item, you can change the state of your cluster, shut down it, update your Management Center license, add or edit users, and perform Rolling Upgrade or Hot Restart on your cluster. You can also update the URL of your Management Center, in case it is changed for any reason.

When you click on the "Administration" menu item, the following page shows up:



hazelcast

- CLUSTER
 - Status
 - Clients [0]
 - Members [2]
 - Administration
 - Alerts
 - WAN Replication [0]
 - Scripting
 - Console
 - CACHE

TestCluster
Administration
Cluster State
Log Out

Documentation
Time Travel
serdaro Last Login: 7/16/2018, 2:27:08 PM
TestCluster

Cluster State
Manage License
Socket Interceptor
Change URL
Users
Rolling Upgrade
Hot Restart

Cluster State

Cluster Name : TestCluster

Current Cluster State : Active

Change Cluster State : Change State

Shutdown Cluster : Shutdown

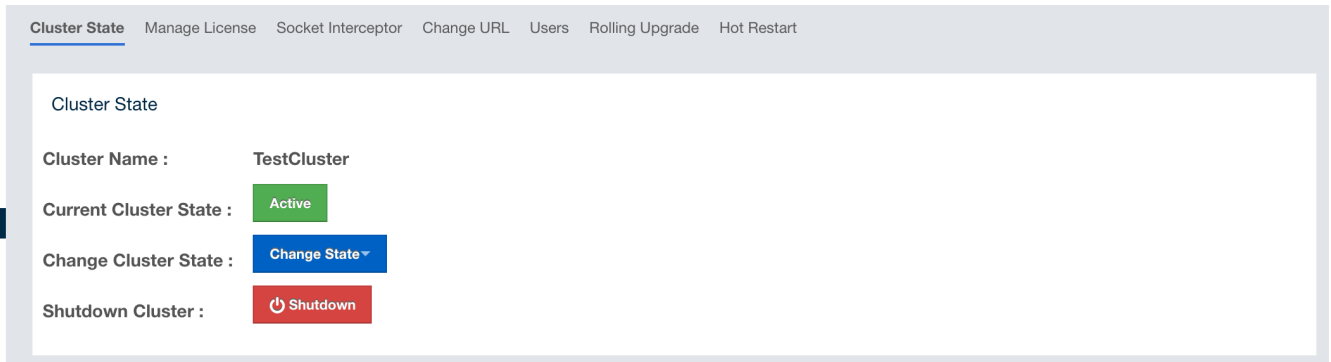


This menu item is available only to admin users.

You can perform the aforementioned administrative tasks using the tabs on this page. Below sections explain each tab.

26.1. Cluster State

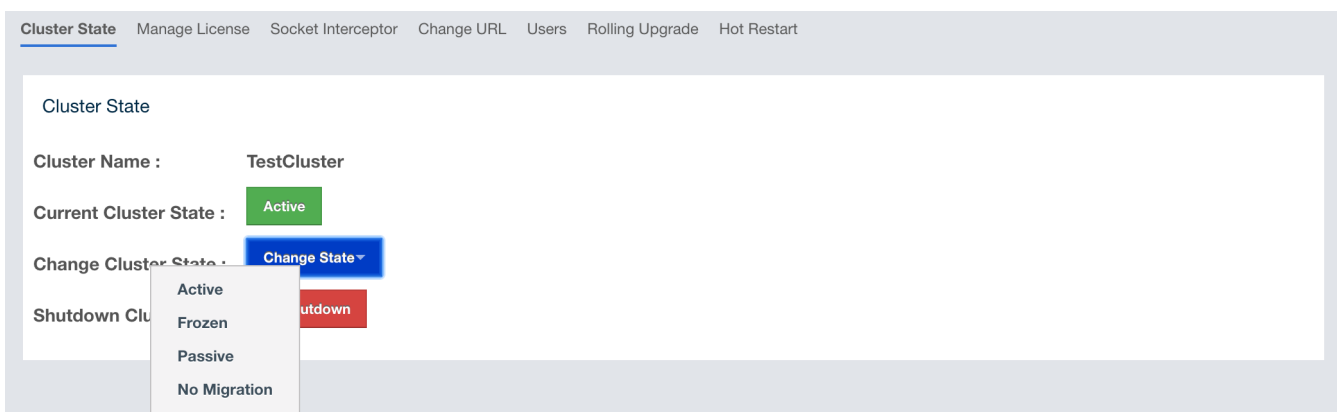
The admin user can see and change the cluster state and shut down the cluster using the buttons listed in this page as shown below.



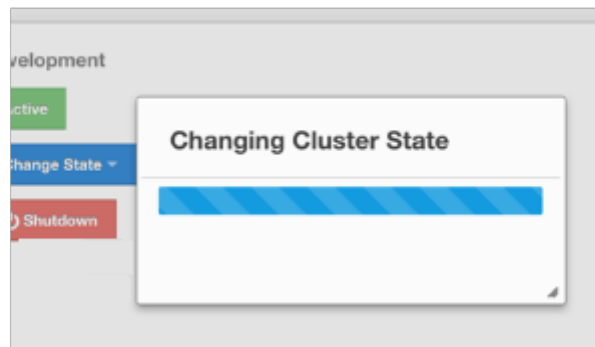
Cluster States:

- **Active:** Cluster will continue to operate without any restriction. All operations are allowed. This is the default state of a cluster.
- **No Migration:** Migrations (partition rebalancing) and backup replications are not allowed. Cluster will continue to operate without any restriction. All other operations are allowed.
- **Frozen:** New members are not allowed to join, except the members left in **this** state or **Passive** state. All other operations except migrations are allowed and will operate without any restriction.
- **Passive:** New members are not allowed to join, except the members left in **this** state or **Frozen** state. All operations, except the ones marked with **AllowedDuringPassiveState**, will be rejected immediately.
- **In Transition:** Shows that the cluster state is in transition. This is a temporary and intermediate state. It is not allowed to set it explicitly.

Changing Cluster State

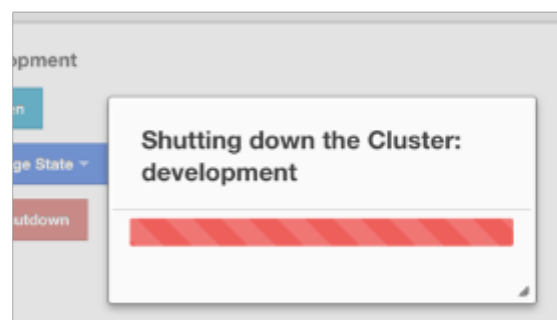


- Click the dropdown menu and choose the state to which you want your cluster to change. A pop-up will appear and stay on the screen until the state is successfully changed.



Shutting Down the Cluster

- Click the **Shutdown** button. A pop-up will appear and stay on screen until the cluster is successfully shutdown.



If an exception occurs during the state change or shutdown operation on the cluster, this exception message will be shown on the screen as a notification.

26.2. Manage License

To update the Management Center license, you can open the **Manage License** tab and click **Update License** button and enter the new license code.

Manage License

Please enter your new license key:

Update License

Alternatively a license can be provided using the system property `hazelcast.mc.license` (see [Starting with a License](#) for details).

26.3. Socket Interceptor

If the Hazelcast cluster is configured to use a socket interceptor, you need to configure a socket interceptor for Management Center as well. Enter the name of your socket interceptor class and the configuration parameters. Then click on the **Configure Socket Interceptor** button to save your configuration and enable the socket interceptor. The class whose name you entered into the "Class Name" field needs to be on your classpath when you are starting Management Center. The configuration parameters you provide will be used to invoke the `init` method of your socket interceptor implementation if it has such a method.

Cluster State Manage License Socket Interceptor Change Url Users Rolling Upgrade Hot Restart

Socket Interceptor

Please enter the class name of your socket interceptor (make sure that you have the class on the classpath):

Class Name

List of configuration parameters.

Each line should have a key-value pair separated by an equals sign (=).

Example:

param1=value1

param2=value2

Parameters

Configure Socket Interceptor

Following is a sample socket interceptor class implementation:


```

package com.example;

import java.io.IOException;
import java.io.InputStream;
import java.io.OutputStream;
import java.net.Socket;

public class SampleSocketInterceptor {
    // this method is optional
    public void init(Map<String, String> parameters) {
        // here goes the initialization logic for your socket interceptor
    }

    public void onConnect(Socket connectedSocket) throws IOException {
        // socket interceptor logic
        try {
            OutputStream out = connectedSocket.getOutputStream();
            InputStream in = connectedSocket.getInputStream();
            int multiplyBy = 2;
            while (true) {
                int read = in.read();
                if (read == 0) {
                    break;
                }
                out.write(read * multiplyBy);
                out.flush();
            }
        } catch (IOException e) {
            throw e;
        }
    }
}

```

A socket interceptor implementation needs to satisfy the following two conditions:

1. Have a no-argument constructor
2. Have a public `onConnect` method with the following signature:

```
void onConnect(Socket connectedSocket) throws IOException
```

26.3.1. Disabling Socket Interceptor

To disable the socket interceptor, you need to click the **Configure Socket Interceptor** button first and then click the **Disable** button on the dialog.

26.4. Change URL

Hazelcast cluster members need to be configured with Management Center's URL before they are started. If Management Center's URL is changed for some reason, you can use this page to make Hazelcast members send their statistics to the new Management Center URL. However, this has the following caveats:

1. This configuration change is not persistent. If a member is restarted without any updates to its configuration, it will go back to sending its statistics to the original URL
2. If a new member joins the cluster, it will not know of the URL change, and will send its statistics to the URL that it's configured with.

Change Server URL

Cluster Name:

Password:

Member IP:

Member Port:

Server URL:

SSL:

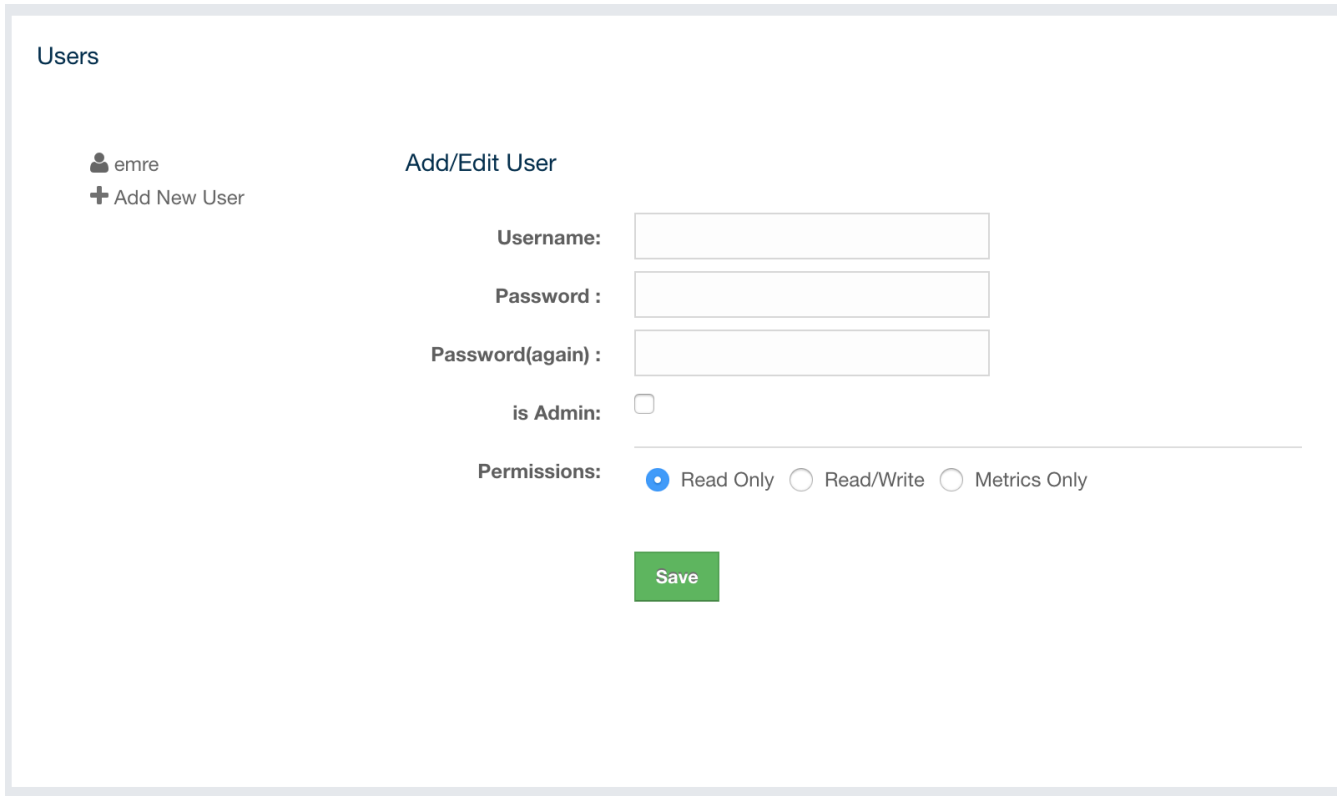
☐

Set URL

To change the URL, enter the **Cluster Name** and **Password**, provide the IP address and port for one of the members, and specify the new Management Center URL in the **Server URL** field. If the cluster members are configured to use TLS/SSL for communicating between themselves, check the

SSL box. Clicking the **Set URL** button will update the Management Center URL.

26.5. Users



To add a user to the system, specify the username, e-mail and password in the **Add/Edit User** part of the page. If the user to be added will have administrator privileges, select **isAdmin** checkbox. **Permissions** field has the following checkboxes:

- **Metrics Only:** If this permission is given to the user, only **Home**, **Documentation** and **Time Travel** items will be visible at the toolbar on that user's session. Also, the users with this permission cannot [browse a map](#) or a cache to see their contents, cannot update a [map configuration](#), run a garbage collection and take a thread dump on a cluster member, or shutdown a member (please see [Monitoring Members](#)).
- **Read Only:** If this permission is given to the user, only **Home**, **Documentation** and **Time Travel** items will be visible at the toolbar at that user's session. Also, users with this permission cannot update a [map configuration](#), run a garbage collection and take a thread dump on a cluster member, or shutdown a member (please see [Monitoring Members](#)).
- **Read/Write:** If this permission is given to the user, **Home**, **Scripting**, **Console**, **Documentation** and **Time Travel** items will be visible. The users with this permission can update a map configuration and perform operations on the members.

After you enter/select all fields, click **Save** button to create the user. You will see the newly created user's username on the left side, in the **Users** part of the page.

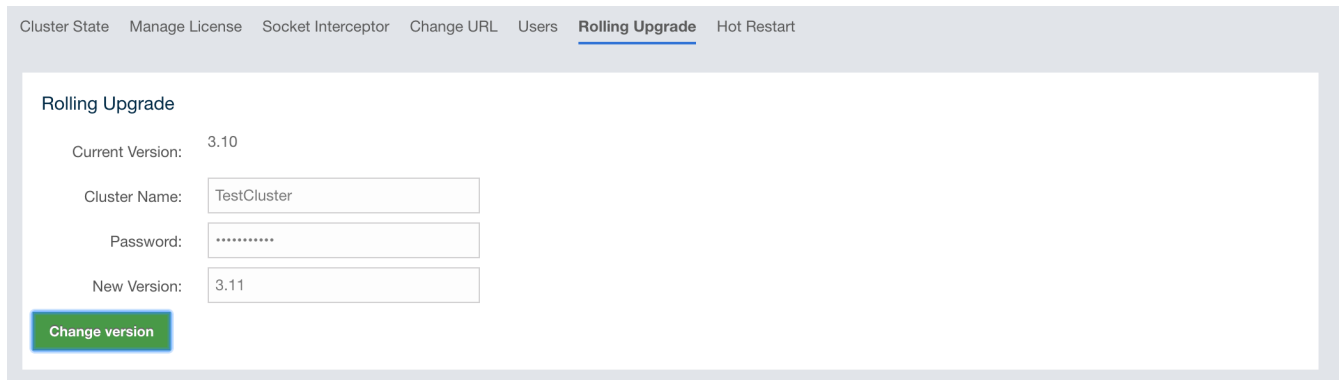
To edit or delete a user, select a username listed in the **Users**. Selected user information appears on the right side of the page. To update the user information, change the fields as desired and click the **Save** button. You can also change a user's password or delete the user account. To change the user's password, click the **Change Password** button. To delete the user from the system, click the **Delete**

button. Note that changing the password of a user and deleting the user account both require you to enter your own password.

26.6. Rolling Upgrade

The admin user can upgrade the cluster version once all members of the cluster have been upgraded to the intended codebase version as described in the Rolling Upgrade Procedure section of the [Hazelcast IMDG Reference Manual](#).

Open the **Rolling Upgrade** tab to perform a Rolling Upgrade and change the cluster's version.



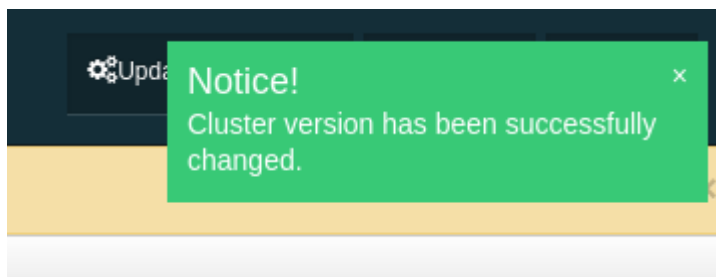
The screenshot shows the 'Rolling Upgrade' tab in the Hazelcast management console. The top navigation bar includes 'Cluster State', 'Manage License', 'Socket Interceptor', 'Change URL', 'Users', 'Rolling Upgrade' (which is underlined), and 'Hot Restart'. The main content area is titled 'Rolling Upgrade' and contains the following fields:

- Current Version:** 3.10
- Cluster Name:** TestCluster
- Password:** A text box with masked characters (dots).
- New Version:** 3.11

At the bottom left of the form is a green button labeled 'Change version'.

Enter the group name/password of the cluster and the version you want to upgrade the cluster to, and click on the **Change Version** button.

Once the operation succeeds, you will see the following notification:



26.7. Hot Restart

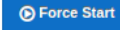
Using the Hot Restart tab, you can perform force and partial start of the cluster and see the Hot Restart status of the cluster members. You can also take snapshots of the Hot Restart Store (Hot Backup). When you click on this tab, the following page is shown:

Hot Restart

Cluster Status: SUCCEEDED


Data Recovery Policy:

PARTIAL_RECOVERY_MOST_RECENT

Force-Start Cluster: 

Remaining Data Load Time:

13m 29s 846.00ms

Partial-Start Cluster: 

Remaining Validation Time:

29s 845.00ms

Hot Backup: 

Hot Restart Status

Member ↕	Status ↕
127.0.0.1:5702	SUCCESSFUL
127.0.0.1:5701	SUCCESSFUL
127.0.0.1:5703	SUCCESSFUL

Last Hot Backup Task Status

Member ↕	Backup Directory ↕	Status ↕	Progress ↕
127.0.0.1:5702	/home/emre/hazelcast-hot-backup-5702	NO_TASK	<div></div>
127.0.0.1:5701	/home/emre/hazelcast-hot-backup-5701	NO_TASK	<div></div>
127.0.0.1:5703	/home/emre/hazelcast-hot-backup-5703	NO_TASK	<div></div>

Below sections explain each operation.

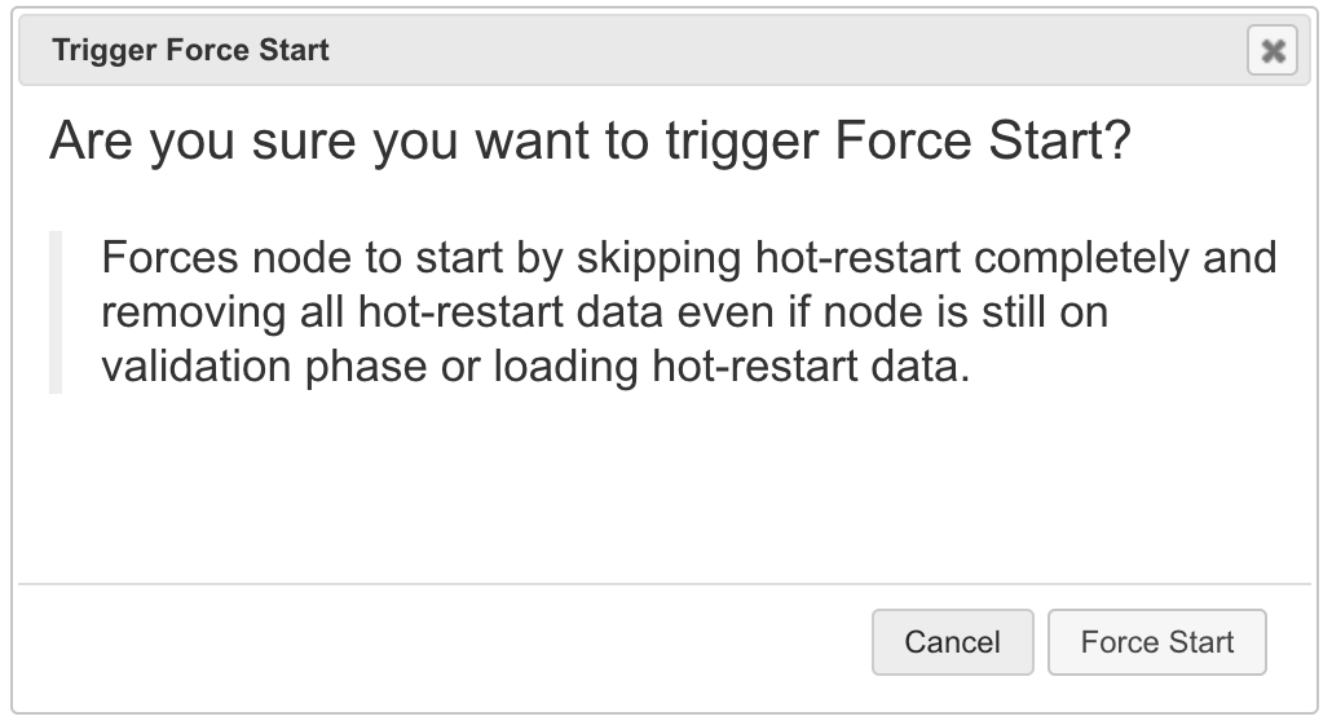
26.7.1. Force Start

Restart process cannot be completed if a member crashes permanently and cannot recover from the failure since it cannot start or it fails to load its own data. In that case, you can force the cluster to clean its persisted data and make a fresh start. This process is called **force start**.

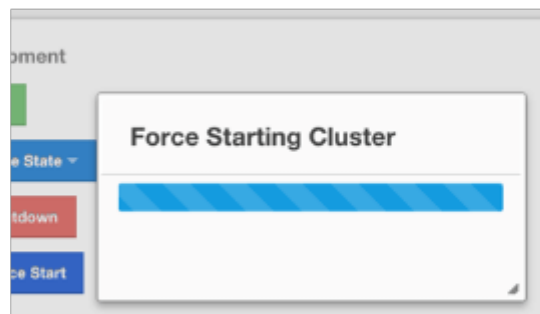


Please see the [Force Start](#) section in Hazelcast IMDG Reference Manual for more information on this operation.

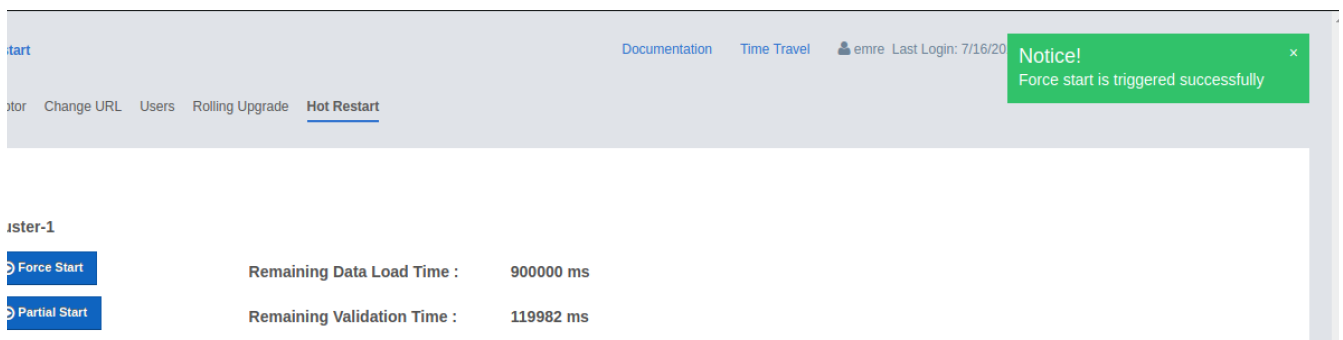
To perform a force start on the cluster, click on the **Force Start** button. A confirmation dialog appears as shown below.



Once you click on the "Force Start" button on this dialog, the cluster starts the force start process and the following progress dialog shows up while doing so.



This dialog stays on the screen until the operation is triggered. Once it is done, the success of force start operation is shown as a notice dialog, as shown below.



If an exception occurs, this exception message will be showed on the screen as a notification.

26.7.2. Partial Start

When one or more members fail to start or have incorrect Hot Restart data (stale or corrupted data) or fail to load their Hot Restart data, cluster will become incomplete and restart mechanism cannot proceed. One solution is to use Force Start and make a fresh start with existing members, as explained above. Another solution is to do a partial start.

Partial start means that the cluster will start with an incomplete set of members. Data belonging to the missing members will be assumed lost and Management Center will try to recover missing data using the restored backups. For example, if you have minimum two backups configured for all maps and caches, then a partial start up to two missing members will be safe against data loss. If there are more than two missing members or there are maps/caches with less than two backups, then data loss is expected.



Please see the [Partial Start](#) section in Hazelcast IMDG Reference Manual for more information on this operation and how to enable it.

To perform a partial start on the cluster, click on the **Partial Start** button. A notice dialog appears as shown below.

teststart Documentation Time Travel emre Last Login: 7/16/20

ceptor Change URL Users Rolling Upgrade Hot Restart

Cluster-1

Force Start Partial Start

Remaining Data Load Time : 900000 ms

Remaining Validation Time : 119986 ms

Notice! Partial Start triggered

You can also see two fields related to Partial Start operation: "Remaining Data Load Time" and "Remaining Validation Time", as shown in the above screenshot.

- **Remaining Validation Time:** When partial start is enabled, Hazelcast can perform a partial start automatically or manually, in case of some members are unable to restart successfully. Partial start proceeds automatically when some members fail to start and join to the cluster in **validation-timeout-seconds**, which you can configure. After this duration is passed, Hot Restart chooses to perform a partial start with the members present in the cluster. This field, i.e., "Remaining Validation Time" shows how much time is left to the automatic partial start, in seconds. You can always request a manual partial start, by clicking on the **Partial Start** button, before this duration passes.
- **Remaining Data Load Time:** The other situation to decide to perform a partial start is failures during the data load phase. When Hazelcast learns the data loading result of all members which have passed the validation step, it automatically performs a partial start with the ones which have successfully restored their Hot Restart data. Please note that partial start does not expect every member to succeed in the data load step. It completes the process when it learns the data loading result for every member and there is at least one member which has successfully restored its Hot Restart data. Relatedly, if it cannot learn the data loading result of all members before **data-load-timeout-seconds** duration, it proceeds with the ones which have already

completed the data load process. This field, i.e., "Remaining Data Load Time" shows how much time (in seconds) is left for Hazelcast to know at least one member has successfully restored its Hot Restart data and perform an automatic partial start.



Please see [Configuring Hot Restart](#) for more information on the configuration elements `validation-timeout-seconds` and `data-load-timeout-seconds` mentioned above and how to configure them.



Force and partial start operations can also be performed using REST API and the script `cluster.sh`. Please refer to the [Using REST API for Cluster Management section](#) and [Using the Script cluster.sh section](#) in Hazelcast IMDG Reference Manual.

26.7.3. Hot Backup

During Hot Restart operations you can take a snapshot of the Hot Restart data at a certain point in time. This is useful when you wish to bring up a new cluster with the same data or parts of the data. The new cluster can then be used to share load with the original cluster, to perform testing, quality assurance or reproduce an issue on the production data.

Note that you must first configure the Hot Backup directory programmatically (using the method `setBackupDir()`) or declaratively (using the element `backup-dir`) to be able to take a backup of the Hot Restart data. Please see [Configuring Hot Backup](#) section in Hazelcast IMDG Reference Manual.

If the backup directory is configured, you can start to perform the backup by clicking on the **Hot Backup** button. Management Center will first ask you the cluster password as shown in the following dialog.

Trigger Hot Backup

Please Enter Cluster Password:

.....

Cancel Start

Once you entered the password correctly and click on the "Start" button on this dialog, you will see a notification dialog stating that the backup process starts. You can see the progress of the backup

operation under the "Last Hot Backup Task Status" part of the page, as shown below.

Hot Restart

Cluster Status: SUCCEEDED

Force-Start Cluster: Force Start

Partial-Start Cluster: Partial Start

Hot Backup: Hot Backup

Data Recovery Policy: PARTIAL_RECOVERY_MOST_RECENT

Remaining Data Load Time: 9m 24s 536.00ms

Remaining Validation Time: 0.00ms

Hot Restart Status

Member	Status
127.0.0.1:5701	SUCCESSFUL
127.0.0.1:5702	SUCCESSFUL
127.0.0.1:5703	SUCCESSFUL

Last Hot Backup Task Status

Member	Backup Directory	Status	Progress
127.0.0.1:5702	/home/emre/hazelcast-hot-backup-5702	SUCCESS	<div></div>
127.0.0.1:5703	/home/emre/hazelcast-hot-backup-5703	SUCCESS	<div></div>
127.0.0.1:5701	/home/emre/hazelcast-hot-backup-5701	SUCCESS	<div></div>

26.7.4. Status Information

At the bottom of "Hot Restart" tab, you can see the Hot Restart and Hot Backup statuses of cluster members, as shown below.

Hot Restart Status

Member	Status
127.0.0.1:5701	SUCCESSFUL
127.0.0.1:5702	SUCCESSFUL
127.0.0.1:5703	SUCCESSFUL

Last Hot Backup Task Status

Member	Backup Directory	Status	Progress
127.0.0.1:5702	/home/emre/hazelcast-hot-backup-5702	SUCCESS	<div></div>
127.0.0.1:5703	/home/emre/hazelcast-hot-backup-5703	SUCCESS	<div></div>
127.0.0.1:5701	/home/emre/hazelcast-hot-backup-5701	SUCCESS	<div></div>

You can see the status and progress of your Hot Backup operation under "Last Hot Backup Task Status". It can be IN_PROGRESS and SUCCESS/FAILURE according to the result of the operation.

You can also see the status of Hot Restart operation of your cluster members, under "Hot Restart Status". It can be PENDING and SUCCESSFUL/FAILED according to the result of Hot Restart operation.

27. License Information

Using the "License" menu item, you can view the details of your cluster and Management Center licenses. An example screenshot is shown below.

Cluster License Details		
License Key Hash	2Qp7pH4BGFTgV//bIH4n9gwWwPNWDpgM6ZJCooTMJE=	
Expires	30th November 2099	81 years and 1 month remaining
Licensed Cluster Members	9999	Current Cluster Size is 3
License Type	Enterprise HD	

Management Center License Details		
License Key Hash	UrQLLnUxq8aGS+azCla8AIVO6ZoNzA+a4KA8Ansmziw=	
Expires	17th November 2018	4 weeks and 1 day remaining
Licensed Cluster Members	10	
License Type	Custom	

It shows the expiration date, total licensed member count and type of cluster and Management Center licenses.

For security reasons, the license key itself is not shown. Instead, [SHA-256](#) hash of the key as a Base64 encoded string is shown.

If there are any problems related to your cluster or Management Center license, "License" menu item will be highlighted with red exclamation points, as shown below.



CLUSTER

Status

Clients [0]

Members [3]

Administration

! License !

Alerts

WAN Replication [2]

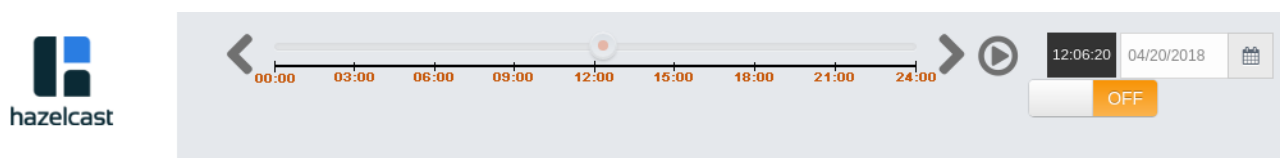
Scripting

Console

In this case, please check this screen to see what the problem is. The following are the possible problems: * One or both of your licenses are expired. * You have cluster members which are more than the allowed count by the license.

28. Checking Past Status with Time Travel

Use the Time Travel toolbar item to check the status of the cluster at a time in the past. When you select it on the toolbar, a small window appears on top of the page, as shown below.



To see the cluster status in a past time, you should first enable the Time Travel. Click on the area where it says **OFF** (on the right of Time Travel window). It will turn to **ON** after it asks whether to enable the Time Travel with a dialog: click on **Enable** in the dialog to enable the Time Travel.

Once it is **ON**, the status of your cluster will be stored on your disk as long as your web server is alive.

You can go back in time using the slider and/or calendar and check your cluster's situation at the selected time. All data structures and members can be monitored as if you are using the Management Center normally (charts and data tables for each data structure and members). Using the arrow buttons placed at both sides of the slider, you can go back or further with steps of 5 seconds. It will show status if Time Travel has been **ON** at the selected time in past; otherwise, all the charts and tables will be shown as empty.

The historical data collected with Time Travel feature are stored in a file database on the disk.

These files can be found in the folder `<User's Home Directory>/hazelcast-mancenter3.11.4`, e.g., `/home/someuser/hazelcast-mancenter3.11.4`. This folder can be changed using the `hazelcast.mancenter.home` property on the server where Management Center is running.

Time travel data files are created monthly. Their file name format is `[group-name]-[year][month].db` and `[group-name]-[year][month].lg`. Time travel data is kept in the `*.db` files. The files with the extension `lg` are temporary files created internally and you do not have to worry about them.



Due to security concerns, time travel can only be used if the cluster name consists of alphanumeric characters, underscores and dashes.

29. Clustered REST via Management Center

Hazelcast IMDG Enterprise

The Clustered REST API is exposed from Management Center to allow you to monitor clustered statistics of distributed objects.

29.1. Enabling Clustered REST

To enable Clustered REST on your Management Center, pass the following system property at startup. This property is disabled by default.

```
-Dhazelcast.mc.rest.enabled=true
```

29.2. Clustered REST API Root

The entry point for Clustered REST API is `/rest/`.

This resource does not have any attributes.

29.2.1. Retrieve Management Center License Expiration Time

This endpoint returns the expiration time in milliseconds (since epoch) of the license key assigned for the Management Center. Returns `-1` if no license is assigned.

- **Request Type:** GET
- **URL:** `/rest/license`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/license
```

- **Response:** `200` (application/json)
- **Body:**

```
{  
  "licenseExpirationTime": 4099755599515  
}
```

29.3. Clusters Resource

This resource returns a list of clusters that are connected to the Management Center.

29.3.1. Retrieve Clusters

- **Request Type:** GET
- **URL:** `/rest/clusters`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters
```

- **Response:** `200` (application/json)
- **Body:**

```
["dev", "qa"]
```

29.4. Cluster Resource

This resource returns information related to the provided cluster name.

29.4.1. Retrieve Cluster Information

This endpoint returns address of the master node and the expiration time in milliseconds (since epoch) of the license key assigned for the cluster. Returns `-1` for license expiration time if no license is assigned.

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/
```

- **Response:** `200` (application/json)
- **Body:**

```
{
  "masterAddress": "192.168.2.78:5701",
  "licenseExpirationTime": 4099755599515
}
```

29.5. Members Resource

This resource returns a list of members belonging to the provided clusters.

29.5.1. Retrieve Members [GET] [/rest/clusters/{clustername}/members]

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/members
```

- **Response:** `200` (application/json)
- **Body:**

```
["192.168.2.78:5701", "192.168.2.78:5702", "192.168.2.78:5703", "192.168.2.78:5704"]
```

29.6. Member Resource

This resource returns information related to the provided member.

29.6.1. Retrieve Member Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/members/192.168.2.78:5701
```

- **Response:** `200` (application/json)
- **Body:**

```
{
  "cluster": "dev",
  "name": "192.168.2.78:5701",
  "maxMemory": 129957888,
  "ownedPartitionCount": 68,
  "usedMemory": 60688784,
  "freeMemory": 24311408,
  "totalMemory": 85000192,
  "connectedClientCount": 1,
  "master": true
}
```

29.6.2. Retrieve Connection Manager Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/connectionManager`
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/members/192.168.2.78:5701/connectionManager
```

- **Response:** `200` (application/json)
- **Body:**

```
{
  "clientConnectionCount": 2,
  "activeConnectionCount": 5,
  "connectionCount": 5
}
```

29.6.3. Retrieve Operation Service Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/operationService`
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/members/192.168.2.78:5701/operationService
```

- **Response:** `200` (application/json)
- **Body:**

```
{
  "responseQueueSize":0,
  "operationExecutorQueueSize":0,
  "runningOperationsCount":0,
  "remoteOperationCount":1,
  "executedOperationCount":461139,
  "operationThreadCount":8
}
```

29.6.4. Retrieve Event Service Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/eventService`
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/members/192.168.2.78:5701/eventService
```

- **Response:** 200 (application/json)
- **Body:**

```
{
  "eventThreadCount":5,
  "eventQueueCapacity":1000000,
  "eventQueueSize":0
}
```

29.6.5. Retrieve Partition Service Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/partitionService`
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/members/192.168.2.78:5701/partitionService
```

- **Response:** 200 (application/json)
- **Body:**


```
{
  "partitionCount":271,
  "activePartitionCount":68
}
```

29.6.6. Retrieve Proxy Service Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/proxyService`
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/members/192.168.2.78:5701/proxyService
```

- **Response:** 200 (application/json)
- **Body:**

```
{
  "proxyCount":8
}
```

29.6.7. Retrieve All Managed Executors

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/managedExecutors`
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/members/192.168.2.78:5701/managedExecutors
```

- **Response:** 200 (application/json)
- **Body:**

```
["hz:system","hz:scheduled","hz:client","hz:query","hz:io","hz:async"]
```

29.6.8. Retrieve a Managed Executor

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/members/{member}/managedExecutors/{managedExecutor}`

- **Request:**

```
curl http://localhost:8083/hazelcast-  
mancenter/rest/clusters/dev/members/192.168.2.78:5701  
/managedExecutors/hz:system
```

- **Response:** 200 (application/json)

- **Body:**

```
{  
  "name": "hz:system",  
  "queueSize": 0,  
  "poolSize": 0,  
  "remainingQueueCapacity": 2147483647,  
  "maximumPoolSize": 4,  
  "completedTaskCount": 12,  
  "terminated": false  
}
```

29.7. Client Endpoints Resource

This resource returns a list of client endpoints belonging to the provided cluster. Please consider using the newly added [Client Statistics Resource](#) as it contains more detailed information about clients.

29.7.1. Retrieve List of Client Endpoints

- **Request Type:** GET
- **URL:** /rest/clusters/{clustername}/clients
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/clients
```

- **Response:** 200 (application/json)
- **Body:**

```
[ "192.168.2.78:61708" ]
```

29.7.2. Retrieve Client Endpoint Information

- **Request Type:** GET
- **URL:** /rest/clusters/{clustername}/clients/{client}

- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/clients/192.168.2.78:61708
```

- **Response:** 200 (application/json)

- **Body:**

```
{
  "uuid": "6fae7af6-7a7c-4fa5-b165-cde24cf070f5",
  "address": "192.168.2.78:61708",
  "clientType": "JAVA"
}
```

29.8. Maps Resource

This resource returns a list of maps belonging to the provided cluster.

29.8.1. Retrieve List of Maps

- **Request Type:** GET
- **URL:** /rest/clusters/{clustername}/maps
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/maps
```

- **Response:** 200 (application/json)
- **Body:**

```
[ "customers", "orders" ]
```

29.8.2. Retrieve Map Information

- **Request Type:** GET
- **URL:** /rest/clusters/{clustername}/maps/{mapName}
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/maps/customers
```

- **Response:** 200 (application/json)

- **Body:**

```
{
  "cluster": "dev",
  "name": "customers",
  "ownedEntryCount": 5085,
  "backupEntryCount": 5076,
  "ownedEntryMemoryCost": 833940,
  "backupEntryMemoryCost": 832464,
  "heapCost": 1666668,
  "lockedEntryCount": 2,
  "dirtyEntryCount": 0,
  "hits": 602,
  "lastAccessTime": 1532689094579,
  "lastUpdateTime": 1532689094576,
  "creationTime": 1532688789256,
  "putOperationCount": 5229,
  "getOperationCount": 2162,
  "removeOperationCount": 150,
  "otherOperationCount": 3687,
  "events": 10661,
  "maxPutLatency": 48,
  "maxGetLatency": 35,
  "maxRemoveLatency": 18034,
  "avgPutLatency": 0.5674125071715433,
  "avgGetLatency": 0.2479185938945421,
  "avgRemoveLatency": 5877.986666666667
}
```

29.9. MultiMaps Resource

This resource returns a list of multimaps belonging to the provided cluster.

29.9.1. Retrieve List of MultiMaps

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/multimaps`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/multimaps
```

- **Response:** 200 (application/json)
- **Body:**

```
["customerAddresses"]
```

29.9.2. Retrieve MultiMap Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/multimaps/{multimapname}`
- **Request:**

```
curl http://localhost:8083/hazelcast-  
mancenter/rest/clusters/dev/multimaps/customerAddresses
```

- **Response:** 200 (application/json)
- **Body:**

```
{  
  "cluster": "dev",  
  "name": "customerAddresses",  
  "ownedEntryCount": 4862,  
  "backupEntryCount": 4860,  
  "ownedEntryMemoryCost": 0,  
  "backupEntryMemoryCost": 0,  
  "heapCost": 0,  
  "lockedEntryCount": 1,  
  "dirtyEntryCount": 0,  
  "hits": 22,  
  "lastAccessTime": 1532689253314,  
  "lastUpdateTime": 1532689252591,  
  "creationTime": 1532688790593,  
  "putOperationCount": 5125,  
  "getOperationCount": 931,  
  "removeOperationCount": 216,  
  "otherOperationCount": 373570,  
  "events": 0,  
  "maxPutLatency": 8,  
  "maxGetLatency": 1,  
  "maxRemoveLatency": 18001,  
  "avgPutLatency": 0.3758048780487805,  
  "avgGetLatency": 0.11170784103114931,  
  "avgRemoveLatency": 1638.8472222222222  
}
```

29.10. ReplicatedMaps Resource

This resource returns a list of replicated maps belonging to the provided cluster.

29.10.1. Retrieve List of ReplicatedMaps

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/replicatedmaps`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/replicatedmaps
```

- **Response:** `200` (application/json)
- **Body:**

```
["replicated-map-1"]
```

29.10.2. Retrieve ReplicatedMap Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/replicatedmaps/{replicatedmapname}`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/replicatedmaps/replicated-map-1
```

- **Response:** `200` (application/json)
- **Body:**

```
{
  "cluster": "dev",
  "name": "replicated-map-1",
  "ownedEntryCount": 10955,
  "ownedEntryMemoryCost": 394380,
  "hits": 15,
  "lastAccessTime": 1532689312581,
  "lastUpdateTime": 1532689312581,
  "creationTime": 1532688789493,
  "putOperationCount": 11561,
  "getOperationCount": 1051,
  "removeOperationCount": 522,
  "otherOperationCount": 355552,
  "events": 6024,
  "maxPutLatency": 1,
  "maxGetLatency": 1,
  "maxRemoveLatency": 1,
  "avgPutLatency": 0.006400830377994983,
  "avgGetLatency": 0.012369172216936251,
  "avgRemoveLatency": 0.011494252873563218
}
```

29.11. Queues Resource

This resource returns a list of queues belonging to the provided cluster.

29.11.1. Retrieve List of Queues

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/queues`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/queues
```

- **Response:** 200 (application/json)
- **Body:**

```
[ "messages" ]
```

29.11.2. Retrieve Queue Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/queues/{queueName}`

- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/queues/messages
```

- **Response:** 200 (application/json)

- **Body:**

```
{
  "cluster": "dev",
  "name": "messages",
  "ownedItemCount": 55408,
  "backupItemCount": 55408,
  "minAge": 0,
  "maxAge": 0,
  "aveAge": 0,
  "numberOfOffers": 55408,
  "numberOfRejectedOffers": 0,
  "numberOfPolls": 0,
  "numberOfEmptyPolls": 0,
  "numberOfOtherOperations": 0,
  "numberOfEvents": 0,
  "creationTime": 1403602694196
}
```

29.12. Topics Resource

This resource returns a list of topics belonging to the provided cluster.

29.12.1. Retrieve List of Topics

- **Request Type:** GET

- **URL:** /rest/clusters/{clustername}/topics

- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/topics
```

- **Response:** 200 (application/json)

- **Body:**

```
[ "news" ]
```


29.12.2. Retrieve Topic Information

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/topics/{topicName}`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/topics/news
```

- **Response:** 200 (application/json)
- **Body:**

```
{
  "cluster": "dev",
  "name": "news",
  "numberOfPublishes": 56370,
  "totalReceivedMessages": 56370,
  "creationTime": 1403602693411
}
```

29.13. Executors Resource

This resource returns a list of executors belonging to the provided cluster.

29.13.1. Retrieve List of Executors

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/executors`
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/executors
```

- **Response:** 200 (application/json)
- **Body:**

```
["order-executor"]
```

29.13.2. Retrieve Executor Information [GET] [`/rest/clusters/{clustername}/executors/{executorName}`]

- **Request Type:** GET
- **URL:** `/rest/clusters/{clustername}/executors/{executorName}`

- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/executors/order-executor
```

- **Response:** 200 (application/json)

- **Body:**

```
{
  "cluster": "dev",
  "name": "order-executor",
  "creationTime": 1403602694196,
  "pendingTaskCount": 0,
  "startedTaskCount": 1241,
  "completedTaskCount": 1241,
  "cancelledTaskCount": 0
}
```

29.14. Client Statistics Resource

This resource returns a list of clients belonging to the provided cluster.

29.14.1. Retrieve List of Client UUIDs

- **Request Type:** GET
- **URL:** /rest/clusters/{clustername}/clientStats
- **Request:**

```
curl http://localhost:8083/hazelcast-mancenter/rest/clusters/dev/clientStats
```

- **Response:** 200 (application/json)
- **Body:**

```
[
  "f3b1e0e9-ea67-41b2-aba5-ea7480f02a93",
  "cebf4dc9-852c-4605-a181-ffe1cca371a4",
  "2371eed5-26e0-4470-92c1-41ea17110ef6",
  "139990b3-fbc0-43a8-9c12-be53913333f7",
  "d0364a1e-8665-46a8-af1d-be1af5580d07",
  "7f337f8a-3538-4b5c-8ffc-9d4ae459e956",
  "6ef9b6e5-5add-40d9-9319-ce502f55b5fc",
  "fead3a99-19de-431c-9dd0-d6ecc4a4b9c8",
  "e788e04e-2ded-4992-9d76-52c1973216e5",
  "654fc9fb-c5c1-48a0-9b69-0c129fce860f"
]
```

29.14.2. Retrieve Detailed Client Statistics [GET] [/rest/clusters/{clustername}/clientStats/{clientId}]

- **Request Type:** GET
- **URL:** /rest/clusters/{clustername}/clientStats/{clientId}
- **Request:**

```
curl http://localhost:8083/hazelcast-
mancenter/rest/clusters/dev/clientStats/2371eed5-26e0-4470-92c1-41ea17110ef6
```

- **Response:** 200 (application/json)
- **Body:**

```
{
  "type": "JAVA",
  "name": "hz.client_7",
  "address": "127.0.0.1:42733",
  "clusterConnectionTimestamp": 1507874427419,
  "enterprise": true,
  "lastStatisticsCollectionTime": 1507881309434,
  "osStats": {
    "committedVirtualMemorySize": 12976173056,
    "freePhysicalMemorySize": 3615662080,
    "freeSwapSpaceSize": 8447324160,
    "maxFileDescriptorCount": 1000000,
    "openFileDescriptorCount": 191,
    "processCpuTime": 252980000000,
    "systemLoadAverage": 83.0,
    "totalPhysicalMemorySize": 16756101120,
    "totalSwapSpaceSize": 8447324160
  },
  "runtimeStats": {
    "availableProcessors": 12,
```

```

    "freeMemory": 135665432,
    "maxMemory": 3724541952,
    "totalMemory": 361234432,
    "uptime": 6894992,
    "usedMemory": 225569000
  },
  "nearCacheStats": {
    "CACHE": {
      "a-cache": {
        "creationTime": 1507874429719,
        "evictions": 0,
        "hits": 0,
        "misses": 50,
        "ownedEntryCount": 0,
        "expirations": 0,
        "ownedEntryMemoryCost": 0,
        "lastPersistenceDuration": 0,
        "lastPersistenceKeyCount": 0,
        "lastPersistenceTime": 0,
        "lastPersistenceWrittenBytes": 0,
        "lastPersistenceFailure": ""
      },
      "b.cache": {
        "creationTime": 1507874429973,
        "evictions": 0,
        "hits": 0,
        "misses": 50,
        "ownedEntryCount": 0,
        "expirations": 0,
        "ownedEntryMemoryCost": 0,
        "lastPersistenceDuration": 0,
        "lastPersistenceKeyCount": 0,
        "lastPersistenceTime": 0,
        "lastPersistenceWrittenBytes": 0,
        "lastPersistenceFailure": ""
      }
    },
    "MAP": {
      "other,map": {
        "creationTime": 1507874428638,
        "evictions": 0,
        "hits": 100,
        "misses": 50,
        "ownedEntryCount": 0,
        "expirations": 0,
        "ownedEntryMemoryCost": 0,
        "lastPersistenceDuration": 0,
        "lastPersistenceKeyCount": 0,
        "lastPersistenceTime": 0,
        "lastPersistenceWrittenBytes": 0,
        "lastPersistenceFailure": ""
      }
    }
  }
}

```

```

    },
    "employee-map": {
      "creationTime": 1507874427959,
      "evictions": 0,
      "hits": 100,
      "misses": 50,
      "ownedEntryCount": 0,
      "expirations": 0,
      "ownedEntryMemoryCost": 0,
      "lastPersistenceDuration": 0,
      "lastPersistenceKeyCount": 0,
      "lastPersistenceTime": 0,
      "lastPersistenceWrittenBytes": 0,
      "lastPersistenceFailure": ""
    }
  },
  "userExecutorQueueSize": 0,
  "memberConnection": "ALL",
  "version": "UNKNOWN"
}

```

30. Clustered JMX via Management Center

Hazelcast IMDG Enterprise

Clustered JMX via Management Center allows you to monitor clustered statistics of distributed objects from a JMX interface.

30.1. Configuring Clustered JMX

In order to configure Clustered JMX, use the following command line parameters for your Management Center deployment.

- `-Dhazelcast.mc.jmx.enabled=true` (default is false)
- `-Dhazelcast.mc.jmx.port=9000` (optional, default is 9999)
- `-Dcom.sun.management.jmxremote.ssl=false`

Starting with Hazelcast Management Center 3.8.4, you can also use the following parameters:

- `-Dhazelcast.mc.jmx.rmi.port=9001` (optional, default is 9998)
- `-Dhazelcast.mc.jmx.host=localhost` (optional, default is server's host name)

With embedded Jetty, you do not need to deploy your Management Center application to any container or application server.

You can start Management Center application with Clustered JMX enabled as shown below.

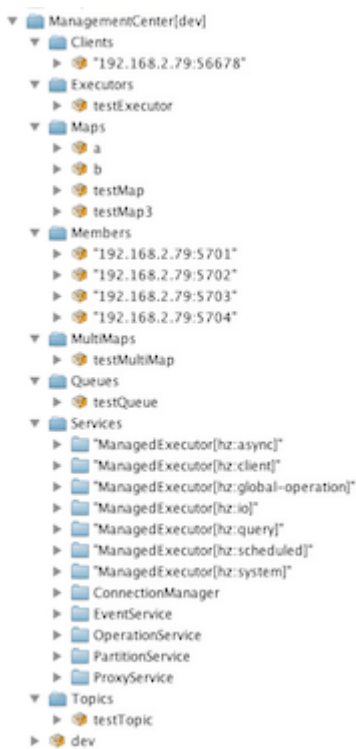
```
java -Dhazelcast.mc.jmx.enabled=true -Dhazelcast.mc.jmx.port=9999 -Dcom.sun.management.jmxremote.ssl=false -jar hazelcast-mancenter-3.11.4.war
```

Once Management Center starts, you should see a log similar to below.

```
INFO: Management Center 3.3  
Jun 05, 2014 11:55:32 AM com.hazelcast.webmonitor.service.jmx.impl.JMXService  
INFO: Starting Management Center JMX Service on port :9999
```

You should be able to connect to Clustered JMX interface from the address `localhost:9999`.

You can use `jconsole` or any other JMX client to monitor your Hazelcast Cluster. As a sample, below is the `jconsole` screenshot of the Clustered JMX hierarchy.



30.1.1. Enabling TLS/SSL for Clustered JMX

By default, Clustered JMX is served unencrypted. To enable TLS/SSL for Clustered JMX, use the following command line parameters for your Management Center deployment.

- `-Dhazelcast.mc.jmx.ssl=true` (default is false)
- `-Dhazelcast.mc.jmx.ssl.keyStore=path to your keyStore`
- `-Dhazelcast.mc.jmx.ssl.keyStorePassword=password for your keyStore`

Following is an example on how to start Management Center with a TLS/SSL enabled Clustered JMX service on port 65432:

```
java -Dhazelcast.mc.jmx.enabled=true -Dhazelcast.mc.jmx.port=65432 -Dhazelcast.mc.jmx
.ssl=true -Dhazelcast.mc.jmx.ssl.keyStore=/some/dir/selfsigned.jks -Dhazelcast.mc.jmx
.ssl.keyStorePassword=yourpassword -jar hazelcast-mancenter-3.11.4.war
```



You can encrypt the keyStore password and pass it as a command line argument in encrypted form for improved security. See [Variable Replacers](#) for more information.

Then you can use the following command to connect to the Clustered JMX service using JConsole with address `localhost:65432`:

```
jconsole -J-Djavax.net.ssl.trustStore=/some/dir/selftrusted.ts -J-Djavax.net.ssl
.trustStorePassword=trustpass
```

Additional TLS/SSL Configuration Options

Following are some additional command line arguments that you can use to configure TLS/SSL for clustered JMX:

- `-Dhazelcast.mc.jmx.ssl.keyStoreType`: Type of the keystore. Its default value is JKS.
- `-Dhazelcast.mc.jmx.ssl.keyManagerAlgorithm`: Name of the algorithm based on which the authentication keys are provided. System default will be used if none provided. You can find out the default by calling `javax.net.ssl.KeyManagerFactory#getDefaultAlgorithm` method.

30.2. Clustered JMX API

The management beans are exposed with the following object name format.

```
ManagementCenter[`*cluster name*`]:type=<`*object type*`>,name=<`*object name*`>
,member="<`*cluster member IP address*`>"
```

Object name starts with `ManagementCenter` prefix. Then it has the cluster name in brackets followed by a colon. After that, `type`, `name` and `member` attributes follows, each separated with a comma.

- `type` is the type of object. Values are `Clients`, `Executors`, `Maps`, `Members`, `MultiMaps`, `Queues`, `Counters`, `Services`, and `Topics`.
- `name` is the name of object.
- `member` is the member address of object (only required if the statistics are local to the member).

A sample bean is shown below.

```
ManagementCenter[dev]:type=Services,name=OperationService,member="192.168.2.79:5701"
```

Here is the list of attributes that are exposed from the Clustered JMX interface.

- **ManagementCenter**
- ManagementCenter
 - LicenseExpirationTime
- **ManagementCenter[<ClusterName>]**
- <ClusterName>
 - MasterAddress
 - LicenseExpirationTime
- ClientStats
 - <Client UUID>
 - HeapUsedMemory
 - HeapFreeMemory
 - HeapMaxMemory
 - HeapTotalMemory
 - ClientName
 - AvailableProcessors
 - Uptime
 - Enterprise
 - MemberConnection
 - ClusterConnectionTimestamp
 - LastStatisticsCollectionTime
 - UserExecutorQueueSize
 - CommittedVirtualMemorySize
 - FreePhysicalMemorySize
 - FreeSwapSpaceSize
 - MaxFileDescriptorCount
 - OpenFileDescriptorCount
 - ProcessCpuTime
 - SystemLoadAverage
 - TotalPhysicalMemorySize
 - TotalSwapSpaceSize
 - Version
 - Address
 - Type
 - CACHE

- **<Cache Name>**
 - Evictions
 - Expirations
 - Hits
 - Misses
 - OwnedEntryCount
 - OwnedEntryMemoryCost
 - LastPersistenceDuration
 - LastPersistenceKeyCount
 - LastPersistenceTime
 - LastPersistenceWrittenBytes
 - LastPersistenceFailure
 - CreationTime
- MAP
 - **<Map Name>**
 - Evictions
 - Expirations
 - Hits
 - Misses
 - OwnedEntryCount
 - OwnedEntryMemoryCost
 - LastPersistenceDuration
 - LastPersistenceKeyCount
 - LastPersistenceTime
 - LastPersistenceWrittenBytes
 - LastPersistenceFailure
 - CreationTime
- Clients
 - **<Client Address>**
 - Address
 - ClientType
 - Uuid
- Executors
 - **<Executor Name>**
 - Cluster

- Name
- StartedTaskCount
- CompletedTaskCount
- CancelledTaskCount
- PendingTaskCount
- Maps
 - **<Map Name>**
 - Cluster
 - Name
 - BackupEntryCount
 - BackupEntryMemoryCost
 - CreationTime
 - DirtyEntryCount
 - Events
 - GetOperationCount
 - HeapCost
 - Hits
 - LastAccessTime
 - LastUpdateTime
 - LockedEntryCount
 - MaxGetLatency
 - MaxPutLatency
 - MaxRemoveLatency
 - OtherOperationCount
 - OwnedEntryCount
 - PutOperationCount
 - RemoveOperationCount
 - AvgGetLatency
 - AvgPutLatency
 - AvgRemoveLatency
- ReplicatedMaps
 - **<Replicated Map Name>**
 - Cluster
 - Name
 - BackupEntryCount

- BackupEntryMemoryCost
- CreationTime
- DirtyEntryCount
- Events
- GetOperationCount
- HeapCost
- Hits
- LastAccessTime
- LastUpdateTime
- LockedEntryCount
- MaxGetLatency
- MaxPutLatency
- MaxRemoveLatency
- OtherOperationCount
- OwnedEntryCount
- PutOperationCount
- RemoveOperationCount
- AvgGetLatency
- AvgPutLatency
- AvgRemoveLatency
- Members
 - **<Member Address>**
 - ConnectedClientCount
 - HeapFreeMemory
 - HeapMaxMemory
 - HeapTotalMemory
 - HeapUsedMemory
 - IsMaster
 - OwnedPartitionCount
- MultiMaps
 - **<MultiMap Name>**
 - Cluster
 - Name
 - BackupEntryCount
 - BackupEntryMemoryCost

- CreationTime
- DirtyEntryCount
- Events
- GetOperationCount
- HeapCost
- Hits
- LastAccessTime
- LastUpdateTime
- LockedEntryCount
- MaxGetLatency
- MaxPutLatency
- MaxRemoveLatency
- OtherOperationCount
- OwnedEntryCount
- PutOperationCount
- RemoveOperationCount
- AvgGetLatency
- AvgPutLatency
- AvgRemoveLatency
- Queues
 - **<Queue Name>**
 - Cluster
 - Name
 - MinAge
 - MaxAge
 - AvgAge
 - OwnedItemCount
 - BackupItemCount
 - OfferOperationCount
 - OtherOperationsCount
 - PollOperationCount
 - RejectedOfferOperationCount
 - EmptyPollOperationCount
 - EventOperationCount
 - CreationTime

- Counters
 - <Counter Name>
 - Cluster
 - Name
 - ReplicaCount
 - Time
 - OpsPerSecInc (for each member)
 - OpsPerSecDec (for each member)
 - Value (for each member)
- Services
 - ConnectionManager
 - ActiveConnectionCount
 - ClientConnectionCount
 - ConnectionCount
 - EventService
 - EventQueueCapacity
 - EventQueueSize
 - EventThreadCount
 - OperationService
 - ExecutedOperationCount
 - OperationExecutorQueueSize
 - OperationThreadCount
 - RemoteOperationCount
 - ResponseQueueSize
 - RunningOperationsCount
 - PartitionService
 - ActivePartitionCount
 - PartitionCount
 - ProxyService
 - ProxyCount
 - ManagedExecutor[hz::async]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize

- QueueSize
- RemainingQueueCapacity
- Terminated
- ManagedExecutor[hz::client]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize
 - QueueSize
 - RemainingQueueCapacity
 - Terminated
- ManagedExecutor[hz::global-operation]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize
 - QueueSize
 - RemainingQueueCapacity
 - Terminated
- ManagedExecutor[hz::io]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize
 - QueueSize
 - RemainingQueueCapacity
 - Terminated
- ManagedExecutor[hz::query]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize
 - QueueSize
 - RemainingQueueCapacity
 - Terminated

- ManagedExecutor[hz::scheduled]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize
 - QueueSize
 - RemainingQueueCapacity
 - Terminated
- ManagedExecutor[hz::system]
 - Name
 - CompletedTaskCount
 - MaximumPoolSize
 - PoolSize
 - QueueSize
 - RemainingQueueCapacity
 - Terminated
- Topics
 - **<Topic Name>**
 - Cluster
 - Name
 - CreationTime
 - PublishOperationCount
 - ReceiveOperationCount
- Flake ID Generators
 - **<Generator Name>**
 - Cluster
 - Name
 - Time
 - OpsPerSec (per member)

30.3. Integrating with New Relic

Use the Clustered JMX interface to integrate Hazelcast Management Center with **New Relic**. To perform this integration, attach New Relic Java agent and provide an extension file that describes which metrics will be sent to New Relic.

Please see [Custom JMX instrumentation by YAML](#) on the New Relic webpage.

Below is an example Map monitoring `.yaml` file for New Relic.

```
name: Clustered JMX
version: 1.0
enabled: true

jmx:
  - object_name: ManagementCenter[clustername]:type=Maps,name=mapname
    metrics:
      - attributes: PutOperationCount, GetOperationCount, RemoveOperationCount, Hits,\
        BackupEntryCount, OwnedEntryCount, LastAccessTime, LastUpdateTime
        type: simple
  - object_name: ManagementCenter[clustername]:type=Members,name="member address in\
    double quotes"
    metrics:
      - attributes: OwnedPartitionCount
        type: simple
```

Put the `.yaml` file in the `extensions` folder in your New Relic installation. If an `extensions` folder does not exist there, create one.

After you set your extension, attach the New Relic Java agent and start Management Center as shown below.

```
java -javaagent:/path/to/newrelic.jar -Dhazelcast.mc.jmx.enabled=true\
-Dhazelcast.mc.jmx.port=9999 -jar hazelcast-mancenter-3.11.4.war
```

If your logging level is set as FINER, you should see the log listing in the file `newrelic_agent.log`, which is located in the `logs` folder in your New Relic installation. Below is an example log listing.


```

Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINE:
    JMX Service : querying MBeans (1)
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    JMX Service : MBeans query ManagementCenter[dev]:type=Members,
    name="192.168.2.79:5701", matches 1
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric OwnedPartitionCount : 68
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    JMX Service : MBeans query ManagementCenter[dev]:type=Maps,name=orders,
    matches 1
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric Hits : 46,593
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric BackupEntryCount : 1,100
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric OwnedEntryCount : 1,100
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric RemoveOperationCount : 0
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric PutOperationCount : 118,962
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric GetOperationCount : 0
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric LastUpdateTime : 1,401,962,426,811
Jun 5, 2014 14:18:43 +0300 [72696 62] com.newrelic.agent.jmx.JmxService FINER:
    Recording JMX metric LastAccessTime : 1,401,962,426,811

```

Then you can navigate to your New Relic account and create Custom Dashboards. Please see [Creating custom dashboards](#).

While you are creating the dashboard, you should see the metrics that you are sending to New Relic from Management Center in the **Metrics** section under the JMX folder.

30.4. Integrating with AppDynamics

Use the Clustered JMX interface to integrate Hazelcast Management Center with **AppDynamics**. To perform this integration, attach AppDynamics Java agent to the Management Center.

For agent installation, refer to [Install the App Agent for Java](#) page.

For monitoring on AppDynamics, refer to [Using AppDynamics for JMX Monitoring](#) page.

After installing AppDynamics agent, you can start Management Center as shown below.

```

java -javaagent:/path/to/javaagent.jar -Dhazelcast.mc.jmx.enabled=true\
-Dhazelcast.mc.jmx.port=9999 -jar hazelcast-mancenter-3.11.4.war

```

When Management Center starts, you should see the logs below.

Started AppDynamics Java Agent Successfully.
Hazelcast Management Center starting on port 8080 at path : /hazelcast-mancenter

31. Management Center Documentation

To see the Management Center documentation (this Reference Manual), click on the **Documentation** button located at the toolbar. This Management Center manual will appear as a tab.

32. Suggested Heap Size

Table 1. For 2 Cluster Members

Mancenter Heap Size	# of Maps	# of Queues	# of Topics
256m	3k	1k	1k
1024m	10k	1k	1k

Table 2. For 10 Members

Mancenter Heap Size	# of Maps	# of Queues	# of Topics
256m	50	30	30
1024m	2k	1k	1k

Table 3. For 20 Members

Mancenter Heap Size	# of Maps	# of Queues	# of Topics
256m [1: With 256m heap, Management Center is unable to collect statistics.]	N/A	N/A	N/A
1024m	1k	1k	1k