This document applies to Terracotta DB and Terracotta Ehcache Version 10.2 and to all subsequent releases.

Specifications contained herein are subject to change and these changes will be reported in subsequent release notes or new editions.

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Getting Started with the Terracotta Management Console

About the Terracotta Management Console

This document describes the Terracotta Management Console (TMC), which is a browser-based application served by the Terracotta Management Server (TMS). The TMC provides a complete view of your Terracotta Server Array (TSA) and connected clients.

With the TMC you can:

- observe the cluster topology and categories of connected clients
- view statistics
- clear cache contents
- and more

Installing the TMS

The TMS is a standard Java web application and bundled web container. It gathers information from throughout the cluster and serves it to the TMC for display in your browser. The TMS is located in the installed Terracotta kit under the tools/management directory.

Configuring the TMS

Certain aspects of the TMS can be customized via the properties file located in the installed Terracotta kit at tools/management/conf/tmc.properties. While that file contains many more properties, those that follow are the most likely to be useful to the TMS administrator:

```
server.port=9480
tms.storageFolder=target/tmc/data
tms.allowedOrigins=[*]
tms.offheapSizeMB=1024
tms.offheapMonitoringDetail=false
tms.statisticsMaxAgeMinutes=10
tms.eventLogMaxRecords=5000
tms.diagnosticConnectTimeoutSec=5
tms.diagnosticRequestTimeoutSec=5
tms.stripeMonitoringFrequencySec=5
tms.topologyUpdateFrequencySec=10
```

Security

The TMS can be configured with SSL/TLS to securely transmit information between:

- Browser and TMS, which uses one-way authentication and two-way data encryption
SSL/TLS security can be configured by setting the following two options in the tmc.properties file:

1. security.root.directory
2. security.level

**Important:** Please remember that both properties must be set and valid for security to be enabled.

**security.root.directory**

The `security.root.directory` property defines the location of your security certificates.

For an explanation of how to set up the security root directory, please refer to the section SSL/TLS Security Configuration in Terracotta in the Terracotta Server Administration Guide.

**Important:** Certificates must be created using the RSA algorithm. DO NOT create the certificates with the DSA algorithm because they are not supported by many modern day browsers.

Below are configuration examples per operating system family:

- **Windows**
  - Remember to escape the file separator when using Windows paths
    - `security.root.directory=C:\\path\\to\\security-root-directory`
  - You may also use UNIX-like paths
    - `security.root.directory=/path/to/security-root-directory`

- **UNIX and UNIX-like systems**
  - `security.root.directory=/path/to/security-root-directory`

**security.level**

The `security.level` property is used to specify which communication channels will use security. Below are the four possible configuration options:

1. **none**
   - Indicates no security enabled
   - e.g. `security.level=none`
2. **browser-security**
   - Enables security between a browser and the TMS
   - e.g. `security.level=browser-security`
3. **cluster-security**  
   - enables security between the cluster and the TMS  
   - e.g. `security.level=cluster-security`

4. **full**  
   - enables both `browser-security` and `cluster-security`  
   - we recommend the **full** option because it’s the most secure system wide security configuration  
   - e.g. `security.level=full`

**HTTPS protocol**

After setting the `security.level` to `browser-security` or `full`, the TMC will only be accessible over the HTTPS protocol. Thus, you’ll need to replace `http` with `https` in all the URLs, e.g. "https://some.host:9480", where "some.host" is the host where the TMS is running.

**Browser warnings**

If you are using self-signed certificates, you may see a security warning in your browser when connecting to the TMS. This is because the certificate was not signed by a certificate authority registered with the browser as a trusted certificate authority. We do suggest that you check the certificate and verify its authenticity. Furthermore, you should add the certificate to your browser’s list of trusted root certificate authorities. However, if you decide against it, the security warning may be ignored as the communication is still encrypted.

**Starting and Stopping the TMS**

To start the TMS, execute the script `start.bat` (on Windows) or `start.sh` (on UNIX-based systems), located in `tools/management/bin` under the installed Terracotta kit.

To terminate the TMS, use the associated `stop.bat` or `stop.sh` script, or platform-provided process management tools.

**Adding Manageability to your Ehcache CacheManager**

In order to get the fullest manageability and monitorability you must configure your CacheManager to make use of a ManagementRegistryService:

```java
import org.ehcache.config.builders.CacheManagerBuilder;  
import org.ehcache.management.registry.DefaultManagementRegistryConfiguration;  
import org.ehcache.management.registry.DefaultManagementRegistryService;  
DefaultManagementRegistryConfiguration registryConfig =  
    new DefaultManagementRegistryConfiguration().setCacheManagerAlias("MyCacheManager");  
DefaultManagementRegistryService managementRegistry =  
    new DefaultManagementRegistryService(registryConfig);  
CacheManagerBuilder<PersistentCacheManager> clusteredCacheManagerBuilder =  
    CacheManagerBuilder.newCacheManagerBuilder().using(managementRegistry);  
```
Associating your CacheManager with a management registry bestows upon it various capabilities allowing it to be exposed via the TMS REST interface with the alias you provide. It is encouraged to assign the same alias to equivalent instances of your CacheManager, across different clients so as to support statistics aggregation.

If you do not make use of a management registry, your CacheManager will still appear in the TMC but will not be uniquely named (UNKNOWN) and most management and monitoring features will not operate.

For related information, see the section Ehcache API Developer Guide > Management and Monitoring with Ehcache.

Adding Manageability to your TCStore Dataset

Unlike for an Ehcache CacheManager, there is no need to explicitly add manageability to your TCStore Dataset.

Connecting to the TMC

After starting the TMS, open a browser and visit http://localhost:9480. The TMC will load and present you with the Home Page, where persistent connections to your clusters can be created, viewed and managed.
Using the Home Page

The TMC home page is where you:
- create/delete persistent connections to your cluster(s)
- optionally modify your connection properties
- view
  - the status of the servers that make up your cluster
  - the various categories of clients making use of your cluster
  - the server entities that are contained by the cluster and to which clients connect
- drill-down/jump to various presentations such as statistics and monitoring relating to those servers, clients, and entities
- take actions, such as clearing the contents of a cache

For information about starting and stopping Terracotta servers, refer to the section Starting and Stopping the Terracotta Server in the Terracotta Server Administration Guide.

For information about creating Terracotta clusters, refer to the section The Cluster Tool in the Terracotta Server Administration Guide.

Connections and Global Settings

To create a persistent connection to a particular operational cluster:

1. Click Create New Connection
2. In the Connection URL input area enter a URL addressing at least a single, running member of the fully configured Terracotta Server Array (TSA):

   **Terracotta Server URL**

   terracotta://<server-host>:<listen-port>[,<server-host>:<listen-port>]*

   If the TMS is able to connect to the specified server, it will request the complete TSA topology, persisting the addresses of each server in its database. This means that, in the future, the TMS will be able to connect to the TSA, even if the originally specified server should be unreachable, as long as at least one member of the TSA is running.
If you attempt to connect to a running server that is not part of a configured cluster, the TMS will return an error indicating that no license was discovered.

Note: It is a best-practice to specify the addresses of all the members of a particular TSA stripe in the connection URL to support high-availability. Simply comma-separate each server's address (host:port).

The TMS will attempt to connect to each server, in turn, until a successful connection is established.

3. Enter the name you would like associated with this connection, for example "MyCluster", then click Next to create the connection.

4. Upon completion of creating the new connection, a new connection region is shown on the Home Page, displaying the current state of your cluster.
The connection to MyCluster in the example above shows a TSA comprised of 2 stripes, each containing a pair of Active-Passive servers, 4 currently connected clients, a single Ehcache server entity and a single TCStore server entity. Further detail can be exposed by drilling down into the display hierarchy.

**Note:** For Terracotta Ehcache product users, the TCStore dropdown is deactivated.

### Modifying a Connection's Properties

If you wish to modify your new connection’s properties, use the *Edit this cluster* (✍️) icon on the connection’s header area.

![Edit Cluster](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Timeout</td>
<td>Timeout value, in seconds, when connecting to a cluster the first time or when reconnecting. Default is 20 seconds.</td>
</tr>
<tr>
<td>Read Timeout</td>
<td>Timeout value, in seconds, for all cluster communications. Default is 10 seconds.</td>
</tr>
<tr>
<td>Collector Interval</td>
<td>Collector interval for statistics. Default is 10 seconds.</td>
</tr>
</tbody>
</table>

### Deleting a Connection

To delete an existing connection use the *Delete this cluster* (🗑️) icon on the connection header area.
Using the Configured Connections

The TMC home page shows each of your configured connections in its own collapsible region of the display that presents the totality of the cluster, allowing you to drill-down to different levels of hierarchy then jump to various detail views, such as for statistics or an entity’s server-side resource usage.

Each configured connection region is comprised of several high-level facets which will now be described.

Buttons in the connection region header
The header of the connection region for a selected cluster contains the following selectable buttons:

- **Ehcache**
- **TCStore**
- **Monitoring**
- **Export Diagnostic Data**

If you select the **Ehcache**, **TCStore** or **Monitoring** button, the **Detail** page will be displayed, with the appropriate tab (**Ehcache**, **TCStore** or **Monitoring**) already selected.

Each of these three buttons contains a dropdown menu. If you select an item from any of these dropdown menus, the **Detail** page will be displayed and the details for the selected dropdown entry will be in focus.

For details of the **Ehcache**, **TCStore** and **Monitoring** tabs of the **Detail** page, see the sections "Using the Ehcache Tab" on page 19, "Using the TCStore Tab" on page 27 and "Using the Monitoring Tab" on page 43.

For information about the button **Export Diagnostic Data**, see the following topic.

Export Diagnostic Data (Cluster level)
The **Export Diagnostic Data** button at the cluster level provides diagnostic information for every server in the cluster.

The cluster level **Export Diagnostic Data** button exports the following diagnostic data as a zip file.

- **Event Log** - a csv file named **EventLog.csv**, containing cluster wide events. This can also be exported from the monitoring event log panel.
For each server it also downloads 6 diagnostic data files, which are explained in the next section, View Diagnostic Details (Server level).

The zip file is named using the format: diagnostic-connectionName-dateTime.zip

- e.g. diagnostic-myClusterConnection-20170705221353.zip

and the layout of the zip file is:

- one folder for each stripe, which contains one folder for each server within the stripe
- each server folder contains the 6 files referenced in the next section, View Diagnostic Details (Server level)
- in the root of the zip file there is the cluster wide event log, EventLog.csv

Server Array

The Terracotta Server Array (TSA) is a collection of groups of servers, known as stripes. Servers within a stripe work together to provide High-Availability. If the Active server should fail, any one of the remaining Passive servers takes over as active. The Active server serves to (1) handle requests from clients to entities it contains and (2) to relay those client requests to each of the Passive servers. Servers in different stripes do not interact.

The TMC presents the current state of the server array, indicating the roles of each server. The following shows a server array consisting of two stripes, each containing two members, one active and one passive.

<table>
<thead>
<tr>
<th>Server Array</th>
<th>stripes(2): active(2) passive(2) unreachable(0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>stripe[0]</td>
<td>active(1) passive(1) unreachable(0)</td>
</tr>
<tr>
<td>localhost:19410 (server21)</td>
<td><img src="view" alt="View Diagnostic Details" /> <img src="export" alt="Export Diagnostic Data" /></td>
</tr>
<tr>
<td>localhost:19411 (server22)</td>
<td><img src="view" alt="View Diagnostic Details" /> <img src="export" alt="Export Diagnostic Data" /></td>
</tr>
<tr>
<td>stripe[1]</td>
<td>active(1) passive(1) unreachable(0)</td>
</tr>
<tr>
<td>localhost:9410 (server11)</td>
<td><img src="view" alt="View Diagnostic Details" /> <img src="export" alt="Export Diagnostic Data" /></td>
</tr>
<tr>
<td>localhost:9411 (server12)</td>
<td><img src="view" alt="View Diagnostic Details" /> <img src="export" alt="Export Diagnostic Data" /></td>
</tr>
</tbody>
</table>

The possible server states are:

<table>
<thead>
<tr>
<th>Server state</th>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STARTING</td>
<td><img src="up" alt="Up" /></td>
<td>Server is beginning to run</td>
</tr>
<tr>
<td>Server state</td>
<td>Icon</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SYNCHRONIZING</td>
<td>✗</td>
<td>Server is loading data from the active server</td>
</tr>
<tr>
<td>PASSIVE</td>
<td>✧</td>
<td>This server has finished synchronizing with the active server and is currently running as a passive server. It is ready to take over as the active server when needed.</td>
</tr>
<tr>
<td>ACTIVE</td>
<td>✔</td>
<td>This server is the active server and handles the client requests</td>
</tr>
<tr>
<td>ACTIVE_RECONNECTING</td>
<td>✡</td>
<td>Newly started active server that is waiting for existing clients to reconnect</td>
</tr>
<tr>
<td>UNREACHABLE</td>
<td>✖</td>
<td>Server is not running or is otherwise inaccessible</td>
</tr>
<tr>
<td>UNKNOWN</td>
<td>✪</td>
<td>Unable to determine server status</td>
</tr>
</tbody>
</table>

Diagnostic information for the members of your TSA can be downloaded as an archive file or viewed directly.

**View Diagnostic Details (Server level)**
The View Diagnostic Details dropdown at the server level lets you view directly the diagnostic information for that particular server. There is one diagnostic data dropdown per server and it is always positioned to the immediate right of the server name.

- **Server Array**  
  stripes(2): active(2) passive(2) unreachable(0)
  - stripe[0]  
    active(1) passive(1) unreachable(0)
    - localhost:19410 (server21)
    - localhost:19411 (server22)
  - stripe[1]  
    active(1) passive(1) unreachable(0)
    - localhost:9410 (server11)
    - localhost:9411 (server12)
Note: Please don’t confuse the stripe count with the stripe name. In this example there are two stripes, indicated by stripes(2), and they are named stripe[0] and stripe[1].

Export Diagnostic Data (Server level)
The Export Diagnostic Data button at the server level lets you download diagnostic information for that particular server in an archive file, similar in format to that provided at the cluster level.

The dropdown provides access to the 6 diagnostic data files below. The file contents can be viewed/exported individually by selecting that option from the dropdown or by selecting the top level Export Diagnostic Data option which exports a zip file containing all of them.

1. Environment - shows a list of all the environment variables.
2. TC Properties - provides a list of all the TC config properties.
3. Process Args - displays all the command line arguments submitted for the process.
4. TC Config - shows the Terracotta configuration file.
5. Cluster State - displays information on the current cluster state.
6. Thread dump - exports the thread dump as a txt file.

Tip: What is a thread dump? A Java thread dump is a way of finding out what every thread in the JVM is doing at a particular point in time. This is especially useful if your Java application sometimes seems to hang when running under load, as an analysis of the dump will show where the threads are stuck.

The zip file is named using the format: diagnostic-connectionName-stripeName-serverName-dateTime.zip

- e.g. diagnostic-myClusterConnection-stripe[0]-testServer0-20170705221356.zip

and the layout of the zip file is one folder, named after the server name, containing the 6 data files above.

Connected Clients
In the Terracotta Platform, a client is an application end-point. In your application, the clustered CacheManager that is configured and initialized is a Terracotta client. Each client maintains a connection to the active server in each stripe. In general, anything that connects to a server is considered a client.

For more information, see section Terracotta Server Administration Guide > Clients in a Cluster.

Each client has a Client Identifier that serves to uniquely identify that client. The form of the identifier is:
<pid>@<ip-addr>:<client-type>:<server-entity-name>:<uuid>
where:

<table>
<thead>
<tr>
<th>&lt;pid&gt;</th>
<th>the process identifier of the Java Virtual Machine hosting this client</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;ip-addr&gt;</td>
<td>the IP address of the machine hosting this JVM</td>
</tr>
<tr>
<td>&lt;client-type&gt;</td>
<td>[Ehcache</td>
</tr>
<tr>
<td>&lt;server-entity-name&gt;</td>
<td>the name of the server-side entity the client is connected to</td>
</tr>
<tr>
<td>&lt;uuid&gt;</td>
<td>a unique identifier that serves to disambiguate clients in the same JVM, accessing the same server entity</td>
</tr>
</tbody>
</table>

### Ehcache Clients

The following shows two caching clients.

- **Connected Clients (4)**
  - **Ehcache Clients (2)**
    - 81384@127.0.0.1Ehcache:PointOfSale:51e5effa7d08484bad6210b...  
      - ehcache  
      - node-1  
      - webapp-1  
    - 81390@127.0.0.1Ehcache:PointOfSale:9d220155e55942bf9ce946...  
      - ehcache  
      - node-1  
      - webapp-1  

The input field located next to Connected Clients serves to show only those clients whose identifier contains the entered value. In the example above, entering 81390 (the process identifier of the 2nd client) would filter out the first client.

**Filtering Rules**

- accepts a space-separated list of terms to match (prefix with ! to negate)
- terms can apply to any components of the Client Identifier or any supplied tags
  - negated terms must not match any of the above
- clear the input field content or click the toggle button (▼) to show all clients

Under each identifier is an optional set of user-defined tags, specified in the CacheManager’s configuration.

Expanding a caching client exposes the CacheManager’s alias, which is defined in the configuration. The dropdown lets you jump to various detail views, pre-
selecting this client and CacheManager in those views. View the CacheManager’s configuration by selecting the configuration icon. The cache entries can be cleared by selecting the clear cache icon.

- Connected Clients (4)

- Ehcache Clients (2)

- 81794@127.0.0.1:ehcache:PointOfSale:2f547c8162f3462bbea4ae1...
  - ehcache
  - node-1
  - webapp-1
  - PointOfSale
    - Orders
    - Products
    - Shippers

Expanding the cache shows important configuration elements related to that cache.

- Connected Clients (4)

- Ehcache Clients (2)

- 81794@127.0.0.1:ehcache:PointOfSale:2f547c8162f3462bbea4ae1...
  - ehcache
  - node-1
  - webapp-1
  - PointOfSale
    - Orders

heap (size: 3000 entries)

offheap (size: 10 MB)

clustered-shared (server resource: resource-pool-a)

TCStore Clients

Within the connected clients section there is also a subsection for all the dataset clients.

Expanding the TCStore Clients section provides a list of all the connected clients, ordered by client identifiers.

Further expanding a client identifier shows all datasets associated with that particular client and for each dataset there is a dropdown to navigate quickly to its overview or chart statistics.

Lastly when expanding each dataset there is also a list of all its dataset instances.
Ehcache Entities
The Terracotta Platform consists of client-side programmatic (API) artifacts and server-side entities that work together to provide highly-available, performant, distributed data access. In your application you configure a CacheManager, both on the client- and server-side. The client-side configuration relates to such things as the maximum OnHeap size-in-bytes for a particular cache. The server-side configuration relates to the remote storage tier that is used to store your cache entries.

Each of your Ehcache Clients communicates with its remote storage tier when executing normal cache operations, such as putting an entry into the cache.

Ehcache clients configured to use the same remote storage tier are effectively sharing access to the same cache data.

TCStore Entities
A TCStore client is essentially a connection to a clustered or embedded Dataset.

A single client instance can fetch an arbitrary number of handles to the underlying Dataset, referred to as a Dataset instance. Operations statistics are maintained on a per-instance basis.

Other Entities
Server entities created by 3rd parties, and therefore unknown to the TMC, appear here. Currently there is not much that can be done with these entities, but a future release may allow for the declarative exposure of management and monitoring features from entities.
3 Using the Ehcache Tab

The Ehcache tab of the Detail page contains detailed presentations relating to your caching clients. The Detail page is selectable via buttons in the home page.

You can view:

- Overview statistics concerning this moment in time, in grid form. Select this view by clicking the icon 📊.
- Historical statistics, in chart form. Select this view by clicking the icon 📈.
- Cache size information. Select this view by clicking the icon 📡.

Your caching client automatically gathers and periodically sends to the TMS low-level statistics concerning counters and sizing. From those low-level statistics the TMS can synthesize a variety of derived statistics, such as rates (HitRate) and ratios (HitRatio).

The following categories of statistics are available:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache</td>
<td>encompasses all the following caching tiers</td>
</tr>
<tr>
<td>OnHeap</td>
<td>the JVM heap tier</td>
</tr>
<tr>
<td>OffHeap</td>
<td>the JVM OffHeap (direct memory) tier</td>
</tr>
<tr>
<td>Disk</td>
<td>the disk tier</td>
</tr>
<tr>
<td>Clustered</td>
<td>the cluster tier</td>
</tr>
</tbody>
</table>

The following raw counter values, as well as associated rate of change, are available for each category listed above:

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Category&gt;:PutCount</td>
<td>number of times your application has put a new entry into the cache</td>
</tr>
<tr>
<td>&lt;Category&gt;:UpdateCount</td>
<td>number of times your application has put a new entry into the cache that replaced an existing entry (same key)</td>
</tr>
</tbody>
</table>
### Using the Ehcache Tab

The Ehcache Tab allows you to monitor and manage cache performance. Various counters and gauges can be accessed, providing insights into cache operations and resource usage. Here are some of the key performance metrics available:

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Category&gt;:RemovalCount</td>
<td>number of times your application explicitly removed an entry from the cache</td>
</tr>
<tr>
<td>&lt;Category&gt;:ExpirationCount</td>
<td>number of entries removed from the cache due to an expiration policy (time-to-live, etc.)</td>
</tr>
<tr>
<td>&lt;Category&gt;:EvictionCount</td>
<td>number of entries removed from the cache due to space constraints</td>
</tr>
<tr>
<td>&lt;Category&gt;:HitCount</td>
<td>number of gets that returned an existing entry</td>
</tr>
<tr>
<td>&lt;Category&gt;:HitRatio</td>
<td>ratio of hits to gets</td>
</tr>
<tr>
<td>&lt;Category&gt;:MissCount</td>
<td>number of gets that did not return an entry</td>
</tr>
<tr>
<td>&lt;Category&gt;:MissRatio</td>
<td>ratio of misses to gets</td>
</tr>
</tbody>
</table>

The following category-specific raw counters are also available:

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk:MappingCount</td>
<td>number of entries stored on disk</td>
</tr>
<tr>
<td>Disk:OccupiedByteSize</td>
<td>total size of all entries stored on disk</td>
</tr>
<tr>
<td>OffHeap:MappingCount</td>
<td>number of entries stored in direct memory</td>
</tr>
<tr>
<td>OffHeap:OccupiedByteSize</td>
<td>total size of all entries stored in direct memory</td>
</tr>
<tr>
<td>OnHeap:MappingCount</td>
<td>number of entries that store in regular heap memory</td>
</tr>
<tr>
<td>OnHeap:OccupiedByteSize</td>
<td>total size of all entries store in regular heap memory</td>
</tr>
</tbody>
</table>

The following category-specific gauges are also available:
<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache:GetMaxLatency</td>
<td>maximum latency for get operations sampled over a 500 ms. window</td>
</tr>
</tbody>
</table>

**Note:** Ratios and Rates

The TMS gathers raw counters from your application and the servers. Rates of change (rates) and ratios are synthesized based on windowed sample averaging. For example, the TMC requests 30 samples over the last 5 minutes for display in the Charts panels. The median raw counter values are calculated for each window, from which rates and ratios can be derived.

The units for rates are always operations per second. Ratios are unitless.

**Overview Panel**

The Overview Panel lets you view statistics concerning what is happening right now (or just a while ago) with your caching client, broken out by cache. By default the statistics are aggregated across all clients using the same CacheManager. Any particular caching client can also be selected for viewing.

Use the **CacheManagers** dropdown to select the aliased CacheManager for which to show statistics. The entries in this dropdown are of the form *CacheManager Alias > Storage Handle* due to the fact that different client-side CacheManagers can be configured to use the same storage on the TSA. Furthermore, CacheManagers that are otherwise identical can be configured with different aliases. We show the mapping here so you have a chance to disambiguate CacheManagers should you choose to configure them in this way.

Use the **Clients** dropdown to select a particular caching client for viewing. By default, statistics are aggregated across all clients of the selected CacheManager.

**Additional Grid Features**

- Temporarily re-arrange grid columns via drag-and-drop
- Sort on columns or filter on CacheName
Scroll horizontally if the grid columns overflow the available space.

Use the **Export** (💾) icon to download a spreadsheet of the currently displayed values.

Use the **Filter cache statistics** (⬇️) icon to select which statistics to display. The set of statistics to view defaults to **Cache**-level statistics that are applicable to all use-cases.

### Charts Panel

The **Charts** Panel lets you view statistics over the past 5 minutes. The TMC requests 30 samples be returned. Unlike the **Overview** Panel, which shows all the caches contained by the selected CacheManager, the **Charts** Panel shows statistics for particular caches.
Use the **CacheManagers** dropdown to select the aliased CacheManager for which to show statistics. The entries in this dropdown are of the form **CacheManager Alias > Storage Handle** due to the fact that different client-side CacheManagers can be configured to use the same storage on the TSA. Furthermore, CacheManagers that are otherwise identical can be configured with different aliases. We show the mapping here so you have a chance to disambiguate CacheManagers should you choose to configure them in this way.

Use the **Clients** dropdown to select a particular caching client for viewing. By default, statistics are aggregated across all clients of the selected CacheManager.

Use the **Caches** dropdown to select a particular cache for viewing. By default, the first cache listed is selected.

Use the slider to set how many columns of charts you would like displayed.

Use the **Filter cache statistics** icon to select which statistics to display. The set of statistics to view defaults to **Cache-level statistics** that are applicable to all use-cases.

Use the **Take a snapshot of all charts** icon to download a single PNG file containing the current values of all displayed charts.

Directly under each individual chart, use the **Export to PDF** icon or the **Export to PNG image** icon to download the chart in the selected format.

**Additional Chart Features**

- Temporarily re-arrange charts via drag-and-drop
- Double-click a chart to get an enlarged snapshot

**Sizing Panel**

The Sizing Panel shows how much space is being used by your CacheManagers and caches across the different local storage tiers you’ve configured. Sizing information related to the **Clustered Storage Tier** can be accessed via the **Remote** buttons.

The **Sizing** Panel is composed of two sections: **CacheManager Level Sizing** and **Cache Level Sizing**.
Shown is a pie chart for each local storage tier you’ve configured for use by your caches, displaying the amount of the available storage that is being used.

Use the **CacheManagers** dropdown to select the aliased CacheManager for which to display sizing information.

Use the **Clients** dropdown to select a particular caching client for which to display sizing information. By default the first client listed is selected.

Use the **Remote** button to navigate to the Resource Usage panel to view how the server-side caching entity is making use of the server’s configured resources, such as OffHeap storage. See the section ”Resource Usage Panel” on page 43 for related information.

**Cache Level Sizing**
Use the **View By Tier** dropdown to view tier-specific sizing information for all caches contained by the selected CacheManager in grid form.

**Note:** *Byte-sizing Limitations*

Cache tiers that are sized by *entries* cannot provide *Occupied Size* or *Average Entry Size* and are displayed as **N/A** for *Not Applicable*.

Use the **View By Cache** dropdown to view the tier usage breakdown for a particular cache, in pie chart form.
The **TCStore** tab of the **Detail** page opens a view containing detailed statistics for TCStore dataset operations. The **Detail** page is selectable via buttons in the home page.

The following raw counter values, as well as associated rate of change, are available:

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add:AlreadyExists</td>
<td>count of adds that failed due to a record with the specified key already existing in the dataset</td>
</tr>
<tr>
<td>Add:Failure</td>
<td>count of unsuccessful additions to a dataset</td>
</tr>
<tr>
<td>Add:Success</td>
<td>count of successful additions to a dataset</td>
</tr>
<tr>
<td>Delete:Failure</td>
<td>count of unsuccessful deletions from a dataset</td>
</tr>
<tr>
<td>Delete:NotFound</td>
<td>count of deletes that failed due to a record with the specified key not existing in the dataset</td>
</tr>
<tr>
<td>Delete:Success</td>
<td>count of successful deletions from a dataset</td>
</tr>
<tr>
<td>Get:Failure</td>
<td>count of unsuccessful gets from a dataset</td>
</tr>
<tr>
<td>Get:NotFound</td>
<td>count of failed gets that were due to no record with the specified key existing in the dataset</td>
</tr>
<tr>
<td>Get:Success</td>
<td>count of successful gets from a dataset</td>
</tr>
<tr>
<td>Update:Failure</td>
<td>count of unsuccessful attempts to update a record in the dataset</td>
</tr>
<tr>
<td>Update:NotFound</td>
<td>count of update failures due to no record with the specified key existing in the dataset</td>
</tr>
<tr>
<td>Update:Success</td>
<td>count of successful record updates</td>
</tr>
<tr>
<td>Stream:Request</td>
<td>count of record streams obtained from the dataset</td>
</tr>
</tbody>
</table>
Using the TCStore Tab

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream:Failure</td>
<td>count of unsuccessful stream requests</td>
</tr>
</tbody>
</table>

**Note:** Each of the statistics listed above is a simple counter but each has an associated rate, for instance, Get:Success:Rate, whose units are gets per second.

These dataset operation statistics are sent to the TMS periodically by each dataset client and then are available to view in the TMC.

There are two TMC panels that show visualizations of the dataset operation statistics:

- Overview panel: displays the latest statistics for datasets and dataset instances in a tabular layout.
- Charts panel: presents a historical view of dataset statistics over a period of time via a graphical layout.

**Note:** A dataset (e.g. dataset1) can have multiple instances and you can distinguish each dataset instance by its name, which will end in a dash '-' followed by a number. Thus an instance of dataset1 could be named: dataset1-1.

**The TCStore Overview Panel**

The TCStore overview panel allows you to see the latest real time statistics for all of your datasets. In addition, the datasets can be filtered by:

- Dataset name
- Clients (Dataset instances in your application)

**Note:** Note that the top highlighted dataset row is an aggregation of all the dataset instance statistics.

**Filter by Dataset Name**

The Datasets dropdown option allows you to view a selected dataset. The resulting view will show all dataset instances for the selected dataset.
Filter by a single client

The **Clients** dropdown option allows you to filter by a particular client or all clients. When selecting a single client the result will only include the dataset and dataset instances of the chosen client.

Filter by All Clients

When selecting all clients from the dropdown list the view will slightly change to show all clients for a particular dataset. In this layout the highlighted top row shows the aggregated statistics from all clients for the selected dataset instance. The row directly
below the aggregated dataset statistics displays the client identifier, which can be expanded to show statistics for every dataset instance on that client.

![Image of TCStore Tab]

**Note:** Additional Grid Features

- Temporarily re-arrange grid columns using drag-and-drop
- Sort on columns
- Scroll horizontally if the grid columns overflow the available space

Use the Export to Excel ( ⬇️ ) icon to download a spreadsheet of the currently displayed values.

Use the Filter dataset statistics ( ⬇️ ) icon to select which statistics to display.
The TCStore Charts Panel

The charts panel allows you to view dataset statistics over a period of time. Each statistic is represented in its own chart which shows its values over the last 5 minutes. This 5 minute window also constantly updates to ensure always seeing the most recent historical statistics.

Filter by dataset

The historical view can be filtered by a particular dataset, which is useful because a dataset could exist on more than one client.
Filter by client

There is also an option to filter the history by a specific client or all clients.

- one client - you only see dataset statistics for the selected client, which is represented as a client identifier in the dropdown
- all clients - the dataset instance statistics are aggregated across all the clients
Filter by instances

You can filter by dataset instances, either by a specific instance or all instances.

- one instance - this only shows statistics for the selected dataset instance
- all instances - this selection aggregates all dataset instance values for the selected dataset
Use the slider (  ) to set how many columns of charts you would like displayed.

Use the **Filter dataset statistics** ( ) icon to select which statistics to display.

Use the **Take a snapshot of all charts** ( ) icon to download a single PNG file containing the current values of all displayed charts.

Directly under each individual chart, use the **Export to PDF** ( ) icon or the **Export to PNG image** ( ) icon to download the chart in the selected format.

**Note:** Additional Chart Features

- Temporarily re-arrange charts using drag-and-drop
- Double-click a chart to get an enlarged snapshot

**The TCStore Explorer Panel (Ad-hoc Query)**

This panel is designed to run ad-hoc queries against a selected dataset in the cluster. It is not meant to replace programming Stream queries or the SQL query API. The panel’s typical use case is: When you need to verify the existence of a record in an ad-hoc manner, you can run simple queries in this panel and check the result.

**Access to the panel**

From the Landing Page,
Using the TCStore Tab

Select "Explorer" under "TCStore" button group,
You will see the Explorer Panel (under the TCStore tab)

A dataset must be selected, as every query is executed against a particular dataset. If your cluster already contains datasets, the dropdown list will be populated. From this
Using the TCStore Tab

dropdown the dataset to be queried can be selected. If there is no dataset existing in your cluster, there will be a notification window indicating the error.

There are 2 query methods to choose from:

1. Query by Record Key
2. Query by Filters

**Query by Record Key**
If you know the record key you want, you can query by record key. Record key can be all valid Cell types except BYTES. Normally, the result should contain only one record.

**Query by Filters**
If you don’t know the record key, but you have some ideas about how certain Cells should look like, you can search by filters. The limitation is: You cannot filter by BYTES Cells.
You can add or remove filters. Each filter is targeted at a certain cell type (defined by cellName:cellType). Depending on the cell type, you have different query options. For example, if you select a STRING cell, then the operators can be "equals" and "starts with", which corresponds to the portable TCStore API. Additionally, you can uncheck the "cell exists" option, and filter for all the records that MUST NOT contain the cell. This is different to not specifying any filter for the cell: If you do not specify any filter for "myStringCell", the returned records MAY OR MAY NOT contain "myStringCell". If any filter input field contains characters that cannot be converted to the target cell type, then an error notification will be displayed.

To simplify things, all the filters share the same connecting logic: You can choose "match All" or "match Any". Default is "match All".

When you think your filters look good, you can click "Run" button, and the query will be executed in the cluster against the selected dataset, in an optimized way. If you want to start over, click "Reset" button, it will clear all filters.
Grid Details

<table>
<thead>
<tr>
<th>Record Key (LONG)</th>
<th>myBoolCell (BOOL)</th>
<th>myBytesCell (BYTES)</th>
<th>myStringCell (STRING)</th>
<th>myLongCell (LONG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>743</td>
<td>true</td>
<td>≤ length: 7</td>
<td>f576f8a</td>
<td>N/A</td>
</tr>
<tr>
<td>167</td>
<td>true</td>
<td>≤ length: 2</td>
<td>1d</td>
<td>N/A</td>
</tr>
<tr>
<td>436</td>
<td>true</td>
<td>≤ length: 3</td>
<td>f6fc95</td>
<td>N/A</td>
</tr>
<tr>
<td>2259</td>
<td>true</td>
<td>≤ length: 8</td>
<td>f694e27</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The first column will always be Record Keys, with the key type shown in the header. Each cell header will also include the cell type. If the cell type is BYTES, the content is not rendered in String, as this would be meaningless for human consumption. Instead, the length of the Bytes content is displayed. If a record does not contain a certain cell, then you will see a specially formatted [underline]N/A. This is to visually differentiate from a String cell with content "N/A".

You can choose to sort records by column, by clicking any of the column headers. You can further filter records by records keys, by clicking on the "funnel" icon in Records Key column header.

The maximum number of records that can be returned is set to 100, a pre-determined value, intended to avoid the complete dataset to be returned to the client (and front-end UI). It is recommended to specify sufficient filters to narrow the return to only a couple of records.

**Sample Cells and its configuration (advanced topic)**

If you click on Sample Cells configuration button,

![Query Filters](image)

you will see the Sample Cell Configuration popup window,
Sample Cells is an advanced feature. Use it only if you are sure that the returned records do not match your expected schema. Since TCStore datasets do not enforce any schema, you can have records with very different Cells (cell name and/or cell type). The management console has to send a query to sample some records/cells in order to get a general sense of the schema in order to parse and show results in the grid. The sampled cells may not represent the accurate schema. For example, you may have a cell called "myLongCell" but it’s not sampled, so it will not show up in the grid. In such a situation, you have 2 options:

1. Re-sample cells until the schema matches
2. Add a custom cell with cell name "myLongCell" and cell type "LONG"

This UI window provides all features mentioned above. It features three major parts:

- You can specify a sample size. The larger the number, the more accurate, but the slower its performance. Default value is 20
- You can re-sample the cells and the results will be listed in "Sampled Cells" list
- You can add custom cells by specifying a cell name and cell type, and the current list of custom cells will be listed in "Custom Cells" list

Duplicated cells do not cause any problems, but we recommend to remove the duplicate cells in "Custom Cell" list and keep only what is needed.
The TCStore Query Statistics Panel

The Query Statistics tab of the Monitoring panel displays the top TCStore server-side query pipelines ordered by the total amount of server time they are costing.

Each query pipeline entry is comprised of the following fields:

<table>
<thead>
<tr>
<th><strong>Field</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dataset</td>
<td>Name of the Dataset upon which the query was executed</td>
</tr>
<tr>
<td>Query</td>
<td>Shape of the server-side query pipeline</td>
</tr>
<tr>
<td>Scan Type</td>
<td>If the query pipeline took advantage of indexes (INDEXED) or needed to do a full scan (FULL)</td>
</tr>
<tr>
<td>Server Executions</td>
<td>Number of times the pipeline was presented to a server for execution</td>
</tr>
<tr>
<td>Server Time</td>
<td>Time taken (wall clock) by the servers to handle the query pipeline</td>
</tr>
<tr>
<td>Total Time</td>
<td>Time (wall clock) the query stream was held open</td>
</tr>
</tbody>
</table>

This information is not held by the TMS persistently, rather, it is obtained by querying each server.

These query statistics are refreshed automatically each time the tab is visited. The Refresh button at the top-left of the presentation is used to update the grid.
5 Using the Monitoring Tab

The **Monitoring** tab of the **Detail** page is where you can find information relating to the server-side of your application. The **Detail** page is selectable via buttons in the home page.

You can view:

- Resource usage relating to your cache's or dataset's use of the Terracotta Server's configured resources. Select this view by clicking the icon 📊.
- Event log details. Select this view by clicking the icon ⚡.

### Resource Usage Panel

The **Resource Usage** Panel displays information relating to your cache's or dataset's use of the Terracotta Server's configured resources, including *OffHeap* memory and Fast Restartable Store (FRS) data directories.

![Resource Usage Panel](image)

Use the **Servers** dropdown to view the resource usage of a particular Terracotta Server.

Use the **View By** radio buttons to toggle between a server resource or a caching entity-focused presentation, as shown below.
Using the Monitoring Tab

OffHeap

The **Server Resource** view shows how caching entities are making use of the allocated OffHeap resources configured for the server. Any number of server entities can use a particular server resource simultaneously.

The **Entity** view shows how caching entities are using the OffHeap resources configured for the server.

A caching entity can be configured to make use of one or more server resources via the pools (both shared and dedicated) they carve out of those server resources. Caches can be configured to store their entries in the pools configured by their containing CacheManager. The amount of space occupied by a caching entity is displayed, along with the total amount of space reserved for the pool.

While caching entities are associated with offheap resource pools, dataset entities make use of server offheap resources directly. The amount of space occupied by the dataset entity, the total amount of space reserved for the offheap server resource, as well as the count of records stored are displayed. Further, the cell names of the indexes that have been defined on your dataset, the type of index, the amount of offheap space occupied, the count of records indexed, and the number of times the index has been used are all displayed.

**Data Directories**

Data directories are configured in the server configuration and your application points to these named disk areas for persistent storage.
For each defined data directory, the filesystem location and occupied space are displayed, as well as the names of the server entities utilizing the directory and amount of filesystem space each is occupying.

**Event Log**

The Event Log tab of the Monitoring panel displays, in reverse chronological order, important activities occurring in your cluster. The TMS listens for and persists these events, meaning that if the TMS is not running no events will be stored.

The types of activities that generate events include:

- server state transitions
- clients connecting/disconnecting to TSA stripes
- server entities being created/destroyed
- resource constraint alerts
- and more

The event log is included in the set of diagnostics artifacts that can be downloaded from the cluster’s connection panel on the Home Page, but in addition it can be downloaded separately using the Export button.

Events that are deemed to be critical are noted as alerts, displayed with an attention-focusing icon in the alert grid. Further, alert events are displayed in a temporary popup and the count of un-read alerts is shown in the cluster’s connection panel on the Home Page.

Newly added events are shown in the grid with bold text, and reset to normal after navigating away.

An event is comprised of the following fields:
<table>
<thead>
<tr>
<th>alert</th>
<th>Is this event deemed critical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timestamp</td>
<td>Time at which the TMS recorded the event</td>
</tr>
<tr>
<td>Type</td>
<td>Categorization of the event</td>
</tr>
<tr>
<td>Name</td>
<td>Sub-categorization</td>
</tr>
<tr>
<td>Detail</td>
<td>Description of the event</td>
</tr>
</tbody>
</table>

The maximum number of events that are saved in the TMS is controlled by the configuration property `tms.eventLogMaxRecords`, whose default value is 5000. The event log store in the TMS, as well as the event log grid, can be cleared using the **Clear** button.