Turbonomic 8.4.2 Installation Guide

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Contents

Introduction

Thank you for choosing Turbonomic, the Intelligent Workload Automation Management solution for Virtualized Environments. This guide gives you information you need to install Turbonomic in your virtual environment, install your license, and get started managing your resources.

If you have any questions, please contact Turbonomic support. Visit our support site at https://support.turbonomic.com.

Sincerely:

The Turbonomic Team

Minimum Requirements

License Requirements

To run Turbonomic on your environment, you must install the appropriate license. Licenses enable different sets of Turbonomic features, and they support a specified number of workloads in your environment.

User Interface Requirements

To display the Turbonomic user interface, you must log into the platform with a browser that can display HTML5 pages. Turbonomic currently supports the following browsers:

- Apple Safari
- Google Chrome
- Microsoft Edge
- Mozilla Firefox

Network Addressing Requirements

Turbonomic requires static IP addressing. Static IP setup is covered as a step when installing the Turbonomic VM image.

Compute and Storage Requirements

The requirements for running a Turbonomic instance depend on the size of the environment you are managing. Turbonomic keeps a real-time representation of your environment in memory. The greater the number of entities to manage, and the more extensive the relationships between them, the more resources you need for the VM that runs Turbonomic. And as the VM requirements increase, so do the requirements for the physical machine that hosts the VM.

The requirements listed here are recommendations that you should keep in mind as you plan your Turbonomic deployment. After deploying, if you find that you need to change memory capacity, CPU capacity, or both for the VM, you can shut it down, make changes, and then power it up again to use the new capacity.

> **NOTE:**
> The machine that hosts the Turbonomic platform must support the SSE4.2 instruction set. Support for this instruction set was introduced at different times for different chip manufacturers:
>
> - Intel: November 2008
> - AMD: October 2011
>
> The machine you use to host Turbonomic should be newer than these dates. On a Linux system, you can run the following command to check for this support:
>
> ```
> cat /proc/cpuinfo | grep sse4
> ```
>
> For more information, see the glossary entry at http://www.cpu-world.com/Glossary/S/SSE4.html.

In most cases you can run Turbonomic on a host that meets the following minimum requirements:

Supported VM Image Technology		Storage Requirements	Memory	CPUs
VMware	vCenter versions 5.5, 6.0, 6.5, 6.7, and 7.0	1.25 TB or greater. **NOTE:** Can be thin provisioned depending on the storage requirements.	• Default: 128 GB • For 10,000 VMs or less, 64 GB	8 vCPUs
Microsoft	Hyper-V Server 2012 R2 or later			

Turbonomic provides a VM image (an OVA or VHD file) which is preconfigured with two hard drives. A minimum of 1.25 TB is necessary to ensure that the drives have the proper amount of space for storage.

Installing on a Virtual Machine Image

You can get a download of the Turbonomic platform as a:

- VMware OVA `1.0` image
- Microsoft Hyper-V image

> **NOTE:**
> For minimum requirements, we recommend 128 GB of memory for the VM that hosts Turbonomic. However, if you plan to manage a smaller environment (10,000 VMs or less), you can install on a VM that provides 64 GB of memory. (See Minimum Requirements *(on page 6)*).
>
> If you plan to install a VM with 64 GB of memory, then you must modify the default for VM memory. (See Deploy the Turbonomic VM *(on page 9)*).

You will install the platform in two main steps:

1. Install the Turbonomic VM image on your network.

   This installs and starts up the VM that will host your instance of the Turbonomic platform.
2. Deploy the Turbonomic components on the VM.

About the Turbonomic VM Image

Turbonomic installs as a VM that runs the CentOS Linux OS. For each new version, we deliver a VM image (OVA or VHD) that you install to run the product. Typically you install this image once, and for subsequent updates to Turbonomic you will execute product updates on that installed VM. This means two things:

- Product updates patch new components of the Turbonomic application stack onto the same CentOS platform that you got when you originally installed the VM image. Product updates do not affect the underlying OS.
- Over time, you might learn of important security patches for the CentOS distribution. It is your responsibility to keep the OS up to date. You can install these patches on your Turbonomic VM whenever necessary.

> **NOTE:**
> We currently release the VM image with the CentOS Linux OS. We have found it to meet overall security requirements. We intend to continue with CentOS for as long as that platform remains viable and secure.

Turbonomic Updates

Turbonomic continually and rapidly innovates and improves all aspects of this product. This means that we periodically release product updates for you to install. For more information about installing updates, see Updating Turbonomic to a New Version *(on page 79)*.

Turbonomic installs as a Kubernetes cluster on the VM. When you do update the product, the update can change:

- The application stack

  This comprises a number of components and services such as:

  - Application services for the user interface, analysis, and other product components.
  - The historical database.
  - Probes – Components that implement the different targets you can configure.

  For a full list of components in the application stack, you can inspect the platform's cr.yaml file.
- Datastores

  The installation configures persistent and ephemeral storage for the Turbonomic product to use.
- Cluster configuration and management services

  This includes Kubernetes Operator, and associated Kubernetes configuration files.

OVA: Installing the vCenter Image

The first step to installing Turbonomic is to deploy the VM that will host the platform. For vCenter environments, we deliver an OVA image for each bi-weekly release.

> **NOTE:**
> For minimum requirements, we recommend 128 GB of memory for the VM that hosts Turbonomic. However, if you plan to manage a smaller environment (10,000 VMs or less), you can install on a VM that provides 64 GB of memory. (See Minimum Requirements *(on page 6)*).
>
> If you plan to install a VM with 64 GB of memory, then you must modify the default for VM memory. (See Deploy the Turbonomic VM *(on page 9)*).

To install the Turbonomic OVA:

1. Download the Turbonomic installation package.

   The email you received from Turbonomic includes links to the Turbonomic download pages. You can get the installation package from there.

   The installation package includes the `turbonomic_t8c-<version>-<XXXXXXXXXXXXXX>.ova` file

   where <version> is the Turbonomic version number and <XXXXXXXXXXXXXX> is the timestamp.

   For example: `turbonomic-t8c-8.0.5-20190916164429000.ova`

   The OVA file deploys as a VM with the Turbonomic components ready for installation.
2. Import the OVA file into your datacenter.

   Use the vCenter Server client to import the OVA into your environment.
3. Deploy the Turbonomic VM.

Configure the VM that was deployed from the OVA file.

For minimum requirements, we recommend 128 GB of memory for the VM that hosts Turbonomic. However, if you plan to manage a smaller environment (10,000 VMs or less), you can install on a VM that provides 64 GB of memory. (See Minimum Requirements *(on page 6)*).

If you want to deploy a VM with 64 GB of memory, manually modify the default value for Memory:

a. Right-click the VM and choose **Edit Settings**.
b. Type **64** for Memory.
c. Click **OK** to save the settings
d. Power on the VM.

4. Open the remote console.

   For the Turbonomic VM that you just deployed:

   a. Choose the **Summary** tab.
   b. Click **Launch Remote Console**.

5. Set up the Turbonomic System Administrator account.

   a. In the remote console, log in with the following default credentials:

      - Username: `turbo`

        Do not use the account name, `root`.
      - Password: `vmturbo`

        Then, you will be prompted to enter a new password.

   b. Enter your new password.

      The new password must comply with the strong password policy (a mixture of upper- and lower-case letters, numbers, and a symbol). Only you will know this new password.

      > **NOTE:**
      > *Be sure to save the changes account credentials in a safe place.* For security reasons, this is the only account that can access and configure the Turbonomic VM.

   c. Enter your new password again to verify it.

6. Update the root password.

   The platform uses the `root` account for certain processes, such as rolling up log messages in `/var/log/messages`. To ensure the account credentials are current, you must change the password:

   a. Open a SuperUser session.

      - In the remote console, enter `su -`
      - At the password prompt, enter the default password: `vmturbo`

   b. Reset a new password.

      After you log in as root with the default password, the system prompts you for a `New password`. This new password must comply with the strong password policy (a mixture of upper- and lower-case letters, numbers, and a symbol). Only you will know this new password.

      > **NOTE:**
      > *Be sure to save the root account credentials in a safe place.*

   c. Exit the SuperUser session.

Enter `exit`.

7. Set up the static IP address.

   Operation and management of the Turbonomic platform both require a static IP address for the VM. The installed VM includes the `ipsetup` script to perform this task. To run the script, execute the following:

   ```
   sudo /opt/local/bin/ipsetup
   ```

   When the script runs it requests the following inputs.

   > **NOTE:**
   > *You must provide values for these required fields*. Otherwise the installation can fail or your VM can be unreachable:
   >
   > - **Required:** `Do you want to use DHCP or set a static IP...`
   >
   >   Choose `static`
   > - **Required:** `Please enter the IP Address for this machine`
   > - **Required:** `Please enter the network mask for this machine`
   > - **Required:** `Please enter the Gateway address for this machine`
   > - **Required:** `Enter DNS Server(s) IP Address for this machine`

   You should make a note of the IP address that you provide.

   As part of running `ipsetup`, you can configure a proxy for internet access. To verify that your proxy has been properly set, first complete the full installation procedure. After you run the installation you can view the proxy configuration in `/etc/systemd/system/docker.service.d/http-proxy.conf`. Find the `[Service]` section. It should contain your `proxy` and `no_proxy` settings. For example, it should be similar to:

   ```
   Environment="HTTP_PROXY=http://10.10.12.34:3123" "NO_PROXY=<YourStaicIP>, node1,
    127.0.0.1, 127.0.0.0"
   ```

8. Perform other necessary configuration steps, and then install the Turbonomic components.

   To perform the required and important configuration steps for the Turbonomic instance, see General Configuration Tasks *(on page 20)*.

   To install the Turbonomic components, see Deploying the Turbonomic Components *(on page 14)*.

VHD: Installing the Microsoft Hyper-V Image

The first step to installing Turbonomic is to deploy the VM that will host the platform.

For Hyper-V environments, we deliver a Hyper-V image for each quarterly release. If you want to run Turbonomic on a Hyper-V VM, you can install the Quarterly Release, and then update to a later point release if necessary.

> **NOTE:**
> For minimum requirements, we recommend 128 GB of memory for the VM that hosts Turbonomic. However, if you plan to manage a smaller environment (10,000 VMs or less), you can install on a VM that provides 64 GB of memory. (See Minimum Requirements *(on page 6)*).
>
> If you plan to install a VM with 64 GB of memory, then you must modify the default for VM memory. (See Deploy the Turbonomic VM *(on page 9)*).

To install Turbonomic:

1. Download the Turbonomic installation package.

   The email you received from Turbonomic includes links to the Turbonomic download pages. You can get the installation package from there.
2. Expand the .zip file and copy the contents, which includes the Virtual Machine image, to your Hyper-V server (either to your cluster shared volume or to a local hard drive).
3. Use the Import Virtual Machine Wizard in the Hyper-V Manager to import the Virtual Machine into your environment.
4. Make sure your virtual network adapter is connected to the correct virtual network.
5. Ensure the Turbonomic instance will have sufficient memory.

   Turbonomic recommends that you use static memory for your Turbonomic instance. However, you can specify static or dynamic memory for the instance. By default, the installation sets static memory to128 GB.
6. Start the Turbonomic appliance and record its IP address.
7. Set up the Turbonomic System Administrator account.
   a. Log into the VM's Hyper-V console with the following default credentials:
      - Username: `turbo`

        Do not use the account name, `root`.
      - Password: `vmturbo`

        Then, you will be prompted to enter a new password.
   b. Enter your new password.

      The new password must comply with the strong password policy (a mixture of upper- and lower-case letters, numbers, and a symbol). Only you will know this new password.

      > **NOTE:**
      > *Be sure to save the changed account credentials in a safe place.* For security reasons, this is the only account that can access and configure the Turbonomic VM.
   c. Enter your new password again to verify it.
8. Update the root password.

   The platform uses the `root` account for certain processes, such as rolling up log messages in `/var/log/messages`. To ensure the account credentials are current, you must change the password:
   a. Open a SuperUser session.
      - In the remote console, enter `su -`
      - At the password prompt, enter the default password: `vmturbo`
   b. Reset a new password.

After you log in as root with the default password, the system prompts you for a `New password`. This new password must comply with the strong password policy (a mixture of upper- and lower-case letters, numbers, and a symbol). Only you will know this new password.

> **NOTE:**
> *Be sure to save the root account credentials in a safe place.*

c. Exit the SuperUser session.

Enter `exit`.

9. Set up the static IP address.

Operation and management of the Turbonomic platform both require a static IP address for the VM. The installed VM includes the `ipsetup` script to perform this task. To run the script, execute the following:

```
sudo /opt/local/bin/ipsetup
```

When the script runs it requests the following inputs.

> **NOTE:**
> *You must provide values for these required fields*. Otherwise the installation can fail or your VM can be unreachable:
>
> - **Required:** `Do you want to use DHCP or set a static IP...`
>
> Choose `static`
> - **Required:** `Please enter the IP Address for this machine`
> - **Required:** `Please enter the network mask for this machine`
> - **Required:** `Please enter the Gateway address for this machine`
> - **Required:** `Enter DNS Server(s) IP Address for this machine`

You should make a note of the IP address that you provide.

As part of running `ipsetup`, you can configure a proxy for internet access. To verify that your proxy has been properly set, first complete the full installation procedure. After you run the installation you can view the proxy configuration in `/etc/systemd/system/docker.service.d/http-proxy.conf`. Find the `[Service]` section. It should contain your `proxy` and `no_proxy` settings. For example, it should be similar to:

```
Environment="HTTP_PROXY=http://10.10.12.34:3123" "NO_PROXY=<YourStaicIP>, node1,
 127.0.0.1, 127.0.0.0"
```

10. Configure the NICs for the installed VM.

The Turbonomic instance configuration includes two NICs. These are not enabled or connected to a network. Display the NICs in the Hyper-V Manager to configure them:

- NIC #1:

  Configure the network VLAN settings to suit the requirements of your cluster's network.
- NIC #2:

  Enable the NIC.

11. Perform other necessary configuration steps, and then install the Turbonomic components.

To perform the required and important configuration steps for the Turbonomic instance, see General Configuration Tasks *(on page 20)*.

To install the Turbonomic components, see Deploying the Turbonomic Components *(on page 14)*.

Deploying the Turbonomic Components

> **NOTE:**
> This section describes the default installation process. If you want to customize your installation, then you should consider taking the steps in Appendix: Stepwise Platform Deployment *(on page 93)*
>
> For example, to do the following, you must perform a stepwise installation:
>
> - Change the Kubernetes host name for the deployment
> - Configure a proxy server for the Turbonomic VM

After you have installed the Turbonomic VM that will host the platform, you can install the platform components, as follows:

First, gather the information you will need to run the installation:

- Network Time Source for Time Synchronization (optional)

  You can perform this step during installation, or at a later date. If you want to synchronize the VM's clock now, you will be prompted for the Network Time Source. For more information about synchronizing the VM's clock, see Synchronizing Time *(on page 20)*.
- Your updated `root` password

  The installation script requires that you have updated the `root` password for the VM. If you followed the instructions in OVA: Installing the vCenter Image *(on page 9)* or in VHD: Installing the vCenter Image *(on page 11)*, then you should have already performed this step.

When you are ready with the necessary information, you can run the installation script.

1. Start up the installation script.

   Start a secure session (SSH) on your Turbonomic VM as the `turbo` user, then execute the installation script:

   ```
   sudo t8cInstall.sh
   ```

2. Verify that you have configured a static IP address for the Turbonomic VM.

   As a first step, the script prompts you with:

   ```
   Have you run the ipsetup script to setup networking yet? [y/n] n
   ```

   If you have not configured a static IP for the platform VM, enter n to exit the installation script now, and configure a static IP.

   If you have already configured a static IP for the platform VM, enter y to continue the installation. The script output displays the IP address that it recognizes for the VM, for example:

   ```
   ----------------------------------
   Old IP Address: 10.0.2.15
   New IP Address: 10.10.123.123
   ```

```
-----------------------------------
```

> **NOTE:**
> Because of dependencies between the platform components and the VM address, you cannot easily change the IP address after you have installed the components. For a production installation of Turbonomic, the VM must run with a static IP. For a testing or evaluation installation, you can use DHCP. However, if you plan to later use such an installation in a production environment, you should be sure to configure a static IP.
>
> If you followed the instructions in OVA: Installing the vCenter Image *(on page 9)* or in VHD: Installing the vCenter Image *(on page 11)*, then you should have already run the `ipsetup.sh` script to do this.

3. Wait while the script performs the installation.

   As the installation process continues, the script:

   - Configures the platform environment with the necessary certificates
   - Configures the Kubernetes cluster on the VM

     This can take a few tries before it succeeds. For each try that does not succeed, you will see messages similar to:

     ```
     To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
     ```

     When the connection succeeds, the script advances to the next steps.
   - Establishes local storage for the platform
   - Creates the kubernetes namespace for the platform as `turbonomic`
   - Configures authorization to access the required Kubernetes secrets
   - Initializes the MariaDB database server to manage historical data for the platform

     The script creates two accounts on the MariaDB that have full privileges:

     - `root@localhost`

       This account does not use a password. To connect via this account the user must be `system root`.
     - `mysql@localhost`

       This account does not use a password. To connect via this account the user must be `system mysql`.

     You can connect with these accounts via sudo. For example, `sudo mysql`. After you connect, you can then set passwords to these accounts. For more information, see the MariaDB Knowledgebase at https://mariadb.com/kb.
   - Installs the Timescale database for Embedded Reports and the Data Exporter
   - Deploys and starts up the platform components

   As the deployment begins, the script prints out the following:

   ```
   ############################
   Start the deployment rollout
   ############################
   ```

   After it deploys the components, it waits for the components to start up:

   ```
   The installation process is complete, waiting for all the components to start up.
   ** The script will wait for as long as 30 minutes. **
   ```

   If the components all start up within 30 minutes, then the installation is complete and successful.

   If the components do not all start up within 30 minutes, the script displays the following and then exits:

```
==========================================================================
    One or more of your deployments has not started up yet.
    ** Please give your environment another 30 minutes to stablize. **
    To check the status of your components, execute the following command:
    kubectl get pods
    If some components are still not ready, contact your support representative
    Deployments not ready:
```

The script then displays the formatted result of the `kubectl get pods` command. This shows you the current status of the pods in the Turbonomic platform.

> **NOTE:**
> If the script exits before the components have all started up, we recommend that you give the platform another 30 minutes. To periodically check the component status, execute `kubectl get pods`. If the components do not all start up after you have waited another 30 minutes, contact your support representative.

If the installation is successful and the components have all started up, the script displays a message similar to the following, where it gives the VM's static IP address:

```
################################################
Deployment Completed, please login through the UI
https://10.10.123.123
################################################
```

You can move on to the next steps.

4. Save a copy of the platform's Master Key secret.

   The installation procedure creates a Master Key secret in the Kubernetes cluster. Turbonomic uses this secret to provide access for the platform components. You should save the key data to a safe location. If for some reason the key data gets corrupted or is otherwise unusable, Turbonomic will fail to operate. If this happens, you can contact your support representative and use this saved data to recover your platform.

   To save the data:

   a. List the platform secrets.

      Execute the command:

      ```
      kubectl get secrets
      ```

      The results should include the Master Key secret, similar to the following:

      ```
      ...
      master-key-secret             Opaque                          1      57d
      ...
      ```

   b. Display the Master Key data.

      Once you find the Master Key name, you can then display the key data:

      ```
      get secret master-key-secret -o yaml
      ```

      The command result should be similar to the following:

      ```
      apiVersion: v1
      data:
      ```

```
  primary_key_256.out: AfnJWutxNHAduaIOdAii3DRA2fMa6lzX4rWetZxxZvc=
kind: Secret
metadata:
  creationTimestamp: "2021-06-30T02:59:19Z"
  managedFields:
  - apiVersion: v1
    fieldsType: FieldsV1
    fieldsV1:
      f:data:
        .: {}
        f:primary_key_256.out: {}
      f:type: {}
    manager: kubectl-create
    operation: Update
    time: "2021-06-30T02:59:19Z"
  name: master-key-secret
  namespace: turbonomic
  resourceVersion: "1072"
  uid: a314b2ba-2061-4b41-b844-56caf2c3728d
type: Opaque
```

The important key data to save is the `primary_key...` data. In the above example, you should save the line:

```
primary_key_256.out: AfnJWutxNHAduaIOdAii3DRA2fMa6lzX4rWetZxxZvc=
```

c. Save the data to a safe place.

Write this data to a file and save it in a safe backup location. If you ever need to recover the Master Key, your support representative will use this data to perform the recovery.

5. Log in to the Turbonomic user interface and set the administrator user account password.

After the components start up, go to your Web browser and type the static IP address of your Turbonomic VM. Your browser redirects the login page for Turbonomic users.

Turbonomic includes a default user account named `administrator` which has an `ADMINISTRATOR` role. As you log in for the first time, you must set your own password for that account. You can create or delete other accounts with the `ADMINISTRATOR` role, but your installation of Turbonomic must always have at least one account with that role.

In the login page, enter the information as required, and make a note of it.

- Use the default credential for **USERNAME**: `administrator`.
- Type a password for **PASSWORD**.

  The new password must comply with the strong password policy (a mixture of upper- and lower-case letters, numbers, and a symbol). Only you will know this new password.
- Type the password again to verify it for **REPEAT PASSWORD**.
- Click **CONFIGURE**.

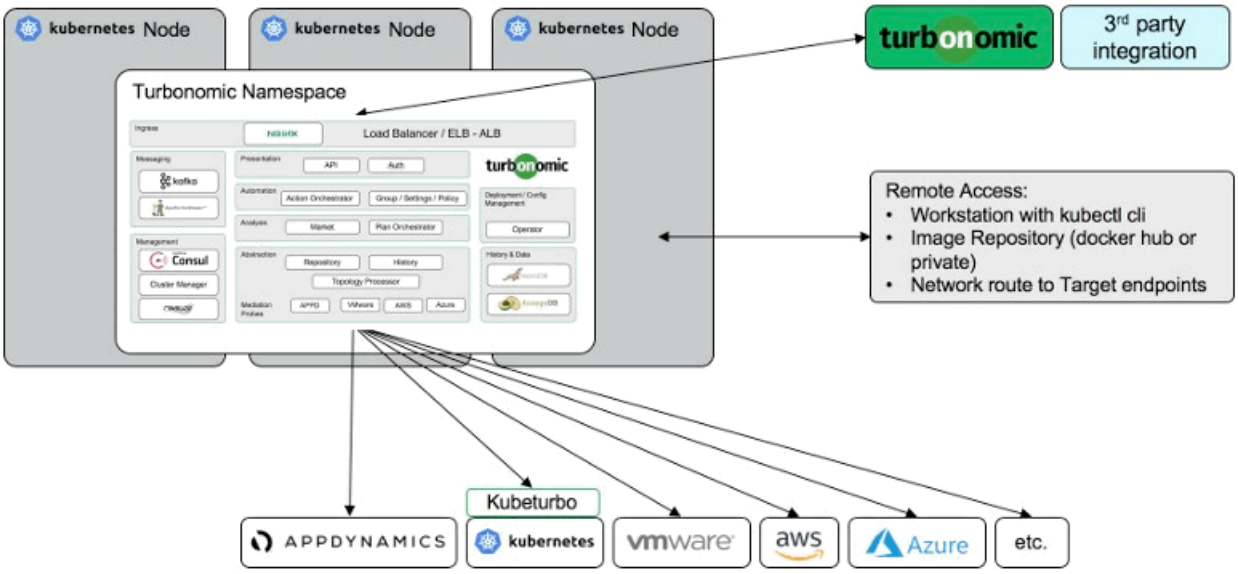
This is the account you will use to access the Turbonomic user interface with administrator permissions. *Be sure to save the user interface administrator account credentials in a safe place.*

> **NOTE:**
> The initial login is always for the `administrator` account. This is an administration *user* account. Do not confuse this with the Turbonomic System Administrator account that you previously set up to log into shell sessions on the VM itself.

6. After you have logged in as `administrator`, you can create other user accounts, and you can give them various roles. For more information about user accounts and roles, see the *Turbonomic User Guide*.

Installing on Kubernetes Nodes

You can deploy Turbonomic to a node cluster on Kubernetes or to OpenShift platforms.



Turbonomic is a containerized microservices platform that installs on a node cluster in a single namespace deployment. The platform uses Operator to deploy, manage and run the Turbonomic components. Operator includes a configuration file that you can use to adjust your setup.

Note that as part of your deployment, you can take advantage of the backup and HA capabilities of an external database service running outside of the node cluster. You can also deploy using the default database component, or using an external database service for the historical database.

For more information, see the instructions to install on Kubernets nodes at https://github.com/turbonomic/t8c-install/wiki.

General Configuration Tasks

After you install the Turbonomic instance, perform the following configuration tasks:

- (Required) Synchronize the system clock and configure your time servers.
- (Important) Verify your MariaDB version.
- (Important) Increase your database capacities.
- (Optional) Enforce secure access via LDAP.
- (Optional) Enforce secure access via trusted certificate.
- (Optional) Enable secure access for probes.
- (Optional) Modify the certificates for Cluster Manager.
- (Optional) Integrate Turbonomic with Turbonomic DataCloud
- (Optional) Enable embedded reports.
- (Optional) Enable the Data Exporter.
- (Optional) Change the IP address of the platform node.
- (Optional) Enable and disable probe components.

(Required) Synchronizing Time

It is important that you synchronize the clock on the Turbonomic instance with the other devices on the same network. By default, the Turbonomic server is configured to synchronize with any one of the following time servers:

- `0.centos.pool.ntp.org`
- `1.centos.pool.ntp.org`
- `2.centos.pool.ntp.org`
- `3.centos.pool.ntp.org`

To synchronize with these servers, your installation of Turbonomic must have access to the internet. If your environment restricts internet access, then you have to configure synchronization with a time server on your network.

In all cases, you should verify that the Turbonomic clock is properly synchronized. To check the system clock:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`
2. Verify your time settings.

   Execute the `date` command. You should see results similar to:

   ```
   Thu Feb 2 14:25:45 UTC 2019
   ```

   To verify the time, you can execute the command, `timedatectl`. The output should be similar to:

   ```
         Local time: Fri 2019-12-06 21:09:26 UTC
     Universal time: Fri 2019-12-06 21:09:26 UTC
           RTC time: Fri 2019-12-06 21:09:27
          Time zone: UTC (UTC, +0000)
        NTP enabled: yes
   NTP synchronized: yes
    RTC in local TZ: no
         DST active: n/a
   ```

   This tells you whether you have NTP enabled, and whether it is currently synchronized, along with other time synchronization information.

If the output is correct *and* your environment has access to the internet, you can assume the system clock is synchronized.

If the output is incorrect, or if you need to configure synchronization with a time server on your network, you must configure `chrony` on the server instance.

To set up `chrony` on your Turbonomic instance:

1. Open an SSH terminal session to your Turbonomic instance.
2. Open the `chrony` configuration file.

   For example, execute the command: `sudo vi /etc/chrony.conf`
3. Specify the time servers that you want to use in your environment.

   The `chrony` file includes the following statements to configure time servers:

   ```
   server 0.centos.pool.ntp.org iburst
   server 1.centos.pool.ntp.org iburst
   server 2.centos.pool.ntp.org iburst
   server 3.centos.pool.ntp.org iburst
   ```

   Enter statements for the servers you want to use. Then delete or comment out the statements that you do not want to use.

   Specify a time server via the following command syntax:

   ```
   server My_Time_Server_Name iburst
   ```
4. Save the file.

5. Restart the chrony service.

   Execute the command: `sudo systemctl restart chronyd`

6. Verify that your time is correct.

   Execute the `date` command. You should see results similar to:

   ```
   Fri Dec 6 21:09:26 UTC 2019
   ```

   To verify the time has been synchronized, you can execute the command, `timedatectl`. The output should be similar to:

   ```
         Local time: Fri 2019-12-06 21:09:26 UTC
     Universal time: Fri 2019-12-06 21:09:26 UTC
           RTC time: Fri 2019-12-06 21:09:27
          Time zone: UTC (UTC, +0000)
        NTP enabled: yes
   NTP synchronized: yes
    RTC in local TZ: no
         DST active: n/a
   ```

   To verify the time, compare the `date` output with the output from a known UTC time server.

   If the output is correct you can assume the system clock is synchronized.

   If the output is incorrect, contact your support representative.

(Important) Verifying your MariaDB Version

For its default historical database, Turbonomic currently supports MariaDB version 10.5.12. This support includes comprehensive testing and quality control for Turbonomic usage of the historical database.

If you are running Turbonomic installed as a VM image (OVA or VHD), and using the database that is included in that image installation, then you must use version 10.5.12.

This section shows you how to check the version of MariaDB on your VM image installation of Turbonomic. Also, if you have used the update script to updated your Turbonomic to version 8.3.5 or later, you can use the steps in this section to update your MariaDB.

IMPORTANT:
It is a requirement that you run MariaDB version 10.5.12 or later.

When you initially installed Turbonomic, that installation included MariaDB running a specific version. As you update your Turbonomic version, the MariaDB version remains the same. If you have not explicitly updated your MariaDB to 10.5.12, then you must do it now.

Turbonomic can operate with other versions of MariaDB. However, it is fully tested to operate with MariaDB version 10.5.12.

Turbonomic also supports MySQL 5.7.x, deployed as a custom installation.

For VM image installations, it is possible to configure the installation to use a remote database (external to the VM). If you are using a remote MariaDB instance, we recommend that you use version 10.5.12. For a remote MySQL, you should use version 5.7.x. For such deployments, you must manage the database versioning yourself.

For installations on a Kubernetes cluster (not deployed as a Turbonomic VM image), if you are using MariaDB we recommend that you use version 10.5.12. For MySQL, you should use version 5.7.x. For such deployments, you must manage the database versioning yourself.

Checking your MariaDB Version

To check the version of MariaDB running on your Turbonomic OVA:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`
2. Check the MariaDB version.

   ```
   mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'version';"
   ```

   The output should be similar to:

   ```
   +---------------+-----------------+
   | Variable_name | Value           |
   +---------------+-----------------+
   | version       | 10.5.12-MariaDB |
   +---------------+-----------------+
   ```

If the version is lower than `10.5.12-MariaDB`, then you must update your database.

If your version is equal to or higher than `10.5.12-MariaDB` you should not perform the update steps below.

Updating your MariaDB

If you are using Turbonomic installed as a VM image, and you are using the default MariaDB that was installed with that image, you must run MariaDB version 10.5.12.

> **IMPORTANT:**
> *Before you perform these steps, you must have already used the update script to update your Turbonomic to version 8.3.5 or later*.
>
> Using the update script to update to 8.3.5 or later installs the necessary MariaDB update scripts. If your current version of Turbonomic is lower than 8.3.5, then update your installed version before executing these steps. For instructions to use the product update script, see Updating Turbonomic to a New Version *(on page 79)*.
>
> If your MariaDB version is equal to or higher than `10.5.12-MariaDB` you should not perform these update steps.
>
> If your current Turbonomic version is earlier than 8.3.5 and you want to update MariaDB but you do *not* want to update Turbonomic, contact your support representative.

To update your MariaDB on your Turbonomic VM:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Password: `[your_private_password]`
2. If you perform *offline* updates, ensure the VM is mounted on the Turbonomic update ISO image.

   > **NOTE:**
   > If you do not allow internet access, then you must perform offline updates of Turbonomic. When you complete the update, the system automatically unmounts the ISO image. To perform the MariaDB update, your Turbonomic instance ***must be mounted*** on the same ISO image that you used to update it to version 8.3.5 or later.

   For information about offline updates and mounting the ISO image, see Offline Update *(on page 88)*.

3. Set up the MariaDB update script.
   a. Log in to the Turbonomic VM.

      Use SSH to log in to the Turbonomic VM using the turbo account and password.
   b. Change to the scripts directory.

      ```
      cd /opt/local/bin
      ```
   c. Get the latest version of the script.

      ```
      curl -O --proxy PROXY_NAME_IP:PORT \
      https://\
      raw.githubusercontent.com/turbonomic/t8c-install/master/bin/mariadbUpgrade.sh
      ```

      Where `--proxy PROXY_NAME_IP:PORT` is an optional specification to execute the download through a proxy.

      > **NOTE:**
      > If you perform *offline* updates, download the script to your local machine.
   d. Save the script on the Turbonomic server to:

      `/opt/local/bin/mariadbUpgrade.sh`.

      > **NOTE:**
      > If you perform *offline* updates, use a secure shell session to upload the script from your local machine, to the Turbonomic server.
4. Execute the MariaDB update script.

   Before you execute the script, you will need to know the Mysql password. By default, this password is `vmturbo`.
   a. Navigate to the scripts directory:

      ```
      cd /opt/local/bin
      ```
   b. Make the script executable.

      ```
      chmod +x mariadbUpgrade.sh
      ```
   c. Execute the database update script:

      ```
      sudo ./mariadbUpgrade.sh
      ```

   The script updates the version of MariaDB. It also increases size limits for the allowed packets, and buffer and log sizes for the innodb. The script output should include the following (where `Total Memory` and `buffer pool size` can vary depending on your VM configuration):

   ```
   ================================
   Update the mariadb configuration
   ================================
   Total Memory: 128773 MB
   Changing Innodb buffer pool size to: 9216 MB
   Changing max allowed packets to: 1G
   Changing innodb log file size to: 10G
   ================================
   ```
5. Verify the updated MariaDB version.

When the script completes, you should be running version 10.5.12. To check the version, execute the following command:

```
mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'version';"
```

The output should be:

```
+---------------+-----------------+
| Variable_name | Value           |
+---------------+-----------------+
| version       | 10.5.12-MariaDB |
+---------------+-----------------+
```

6. Scale up the Turbonomic platform's pods.

   To update the database, the script scales down your platform pods. When it completes, the script displays the following prompt:

   ```
   ################################################################################
   When confirmed the mariadb has been upgraded and is properly working, run:
   kubectl scale deployment --replicas=1 t8c-operator -n turbonomic
   ################################################################################
   ```

   After you verify that the correct version of MariaDB is running, scale up the platform:

   ```
   kubectl scale deployment --replicas=1 t8c-operator -n turbonomic
   ```

(Important) Increasing your Database Capacities

For Turbonomic versions 8.0.6 or later, your historical database must provide certain storage size capacities. For MariaDB or MySQL installations, you must ensure your database provides the necessary messaging and logging capacity. (Turbonomic supports MariaDB version 10.5.12 or MySQL 5.7.X for the historical database. For more information, see Verifying your MariaDB Version *(on page 22)*.)

> **NOTE:**
> If you installed Turbonomic as a VM image (OVA or VHD), the image includes MariaDB for the historic database. Most installations use that instance. However, you can use an external database if you like. In addition, you can install Turbonomic directly to a Kubernetes cluster (instead of installing the VM image), and you can provide your own historical database.

Do I Need to Increase My DB Capacities?

The way you have deployed the historical database in your Turbonomic installation determines whether you must perform this procedure:

For this installation:	DB storage update requirements
• You installed Turbonomic as a VM image at version 8.0.6 or earlier • You use the default MariaDB as your historical database • You updated Turbonomic to version 8.0.7 or later • You ran the script that updates your MariaDB version (see Verifying your MariaDB Version *(on page 22)*).	You do not need to increase your DB capacities. You can skip this procedure. **NOTE:** If you are still running MariaDB 10.5.6 or 10.5.9, you must update to 10.5.12. See Verifying your MariaDB Version *(on page 22)*.
• You installed Turbonomic as a VM image at version 8.0.6 or earlier • You use the default MariaDB as your historical database • You have not updated Turbonomic to version 8.0.7 or later • You have not run the script that updates your MariaDB version (see Verifying your MariaDB Version *(on page 22)*).	You must increase your DB capacities. **NOTE:** The simplest way to increase capacities and ensure you are running the correct version of MariaDB is to update Turbonomic to version 8.2.3 or later (see Updating Turbonomic to a New Version *(on page 79)*). If you want to update your MariaDB without updating Turbonomic, contact your support representative.
• You installed Turbonomic as a VM image • You use an *external* MariaDB or MySQL as your historical database	You must increase your DB capacities.
• You installed Turbonomic directly on a Kubernetes cluster (not deployed as the Turbonomic VM image) • You use MariaDB or MySQL as your historical database	You must increase your DB capacities.

Checking you Current DB Capacities

Before you update your DB capacities, check to make sure they need to be increased. Open an SSH terminal session that can administer your database, and execute the following commands:

- Check the size for `max_allowed_packet`.

  ```
  mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'max_allowed_packet';"
  ```

  You should see output similar to:

  ```
  +--------------------+-------------+
  | max_allowed_packet | {PacketSize} |
  +--------------------+-------------+
  ```

  Where **`{PacketSize}`** is your current value. If it is greater than or equal to `1073741824`, you do not need to increase this capacity.

- Check the size for `innodb_log_file_size`.

  ```
  mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'innodb_log_file_size';"
  ```

  You should see output similar to:

  ```
  +----------------------+-------------+
  | innodb_log_file_size |  {LogSize}  |
  +----------------------+-------------+
  ```

  Where **`{LogSize}`** is your current value. If it is greater than or equal to `10737418240` (10 times the max allowed packet size), you do not need to increase this capacity.

Configuring the Capacities

To configure your DB capacities:

1. Edit your `server.cnf` file to set the following server system variables:
   - `max_allowed_packet = 1G`
   - `innodb_log_file_size = 10G`

   To make these settings, open the `server.cnf` file in an editor, change the values for these system variables, and then save your changes.

   By default, you can find the configuration file at this location:

   ```
   sudo /etc/my.cnf.d/server.cnf
   ```

2. Restart yourDB instance.

   Execute the command:

   - For MariaDB:

     ```
     sudo systemctl restart mariadb
     ```

   - For MySQL:

     ```
     sudo systemctl restart mysqld
     ```

3. Verify the system capacities.

   After the database restarts, execute the following commands:

   - `mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'max_allowed_packet';"`

     You should see output similar to:

     ```
     +--------------------+------------+
     | Variable_name      | Value      |
     +--------------------+------------+
     | max_allowed_packet | 1073741824 |
     +--------------------+------------+
     ```

   - `mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'innodb_log_file_size';"`

     You should see output similar to:

```
+----------------------+-------------+
| Variable_name        | Value       |
+----------------------+-------------+
| innodb_log_file_size | 10737418240 |
+----------------------+-------------+
```

Increasing Available Disk Space

A standard installation of Turbonomic on a VM image includes a MariaDB database server for historical data. If you enable Embedded Reports, the platform also uses TimescaleDB Postgres database to manage the reports data. For various reasons, you might find that the default storage capacity for your database services is not sufficient. In that case, you need to increase the available storage capacity.

A common reason to increase this capacity is to accomodate estimated needs for Embedded Reports. The storage requirements for Embedded Reports can change over time as your environment changes, or as you increase the number of targets you configure your your Turbonomic installation. For information about estimating Embedded Reports requirements, see Embedded Reports Storage Requirement Estimates *(on page 55)*.

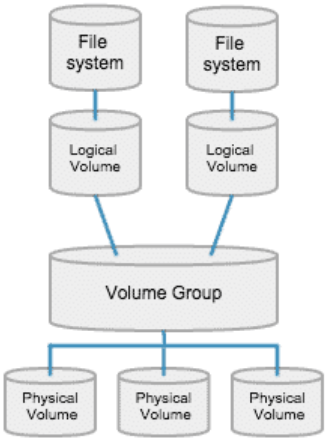
A summary of the steps you will perform is:

- Add a new disk to the VM
- Rescan the scsi devices
- Create a new LVM partition
- Create a physical volume (pv)
- Add the pv to the existing volume group (vg)
- Extend the logical volume (lv)
- Extend the file system to use the new lv
- To increase storage for Embedded Reports, increase the XFS quota

  To increase space for MariaDB, you do not need to perform this step.

Logical Volume Management for Turbonomic Storage

The platform uses Logical Volume Management (LVM) to manage the VM disks. To increase database storage, you should add a new disk to the VM, and then use it to extend the LVM logical volume, `/dev/turbo/var_lib_mysql`. This logical volume serves both the historical database and the Embedded Reports database.



Increasing Storage – Procedure

To increase the storage space available to your databases:

1. Add a new disk to the VM.

   Use the steps for your VM datacenter to add a new disk to the VM. Turbonomic installs as a VMware or a Hyper-V VM. Refer to the documentation for your hypervisor for the steps to add a new disk.

2. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`

3. Rescan the scsi devices.

   To make sure the new disk is available, rescan the scsi devices and then list your block devices.

   To scan the devices, execute:

   ```
   echo "- - -" > /sys/class/scsi_disk//0\:0\:0\:0/device/rescan
   ```

   To check for the new disk, execute:

   ```
   lsblk
   ```

The new disk should appear with a name similar to `/dev/sdc`. If you don't see the new disk, try this alternative to force a rescan:

- Check the number of scsi host devices that are on your VM:

  ```
  ls /sys/class/scsi_host
  ```

  You should see a list of devices, such as `host0, host1, host2... hostn`
- Scan each device

  For each device execute the command (where **<hostn>** is a numbered host device such as `host0` or `host1`):

  ```
  echo "- - -" > /sys/class/scsi_host/host0/scan
  ```

- List the block devices

  Execute `lsblk` again to list the block devices.

4. Create a new LVM partition.

   Assuming the new disk is named `/dev/sdc1`, execute the command:

   ```
   cfdisk /dev/sdc1
   ```

   Then execute the operations:

   - `new`
   - `primary`
   - `confirm size`
   - `change type to 8E`
   - `write`
   - `quit`

5. Create the Physical Volume (pv).

   Assuming the new disk is named `/dev/sdc1`, execute the command:

   ```
   pvcreate /dev/sdc1
   ```

6. Add the new pv to the existing Volume Group.

   Assuming the new disk is named `/dev/sdc1`, execute the command:

   ```
   vgextend /dev/turbo /dev/sdc1
   ```

7. Extend the Logical Volume (lv) to use the free space in the new pv.

   First list the physical extents (PE) that are available. Execute the command:

   ```
   vgdisplay
   ```

   You should see results similar to:

   ```
   Free  PE / Size       128000 / 500.00 GiB
   ```

In this example, `128000` is the amount to extend the lv. Forthis example, execute the comand:

```
lvextend -l +128000 /dev/turbo/var_lib_mysql
```

8. Extend the XFS file system to use all the current lv space.

   Before you extend the XFS, view the free disk space and record the number. To verify that you have increased the available space, you will compare this value to the free space after you have extended XFS. Execute the command:

   ```
   df -h
   ```

   Then extend the XFS capacity:

   ```
   xfs_growfs /dev/turbo/var_lib_mysql
   ```

   Then list the updated free disk space and compare it to your original number:

   ```
   df -h
   ```

9. If you are increasing capacity for Embedded Reports, extend the XFS quota for the TimescaleDB.

   To increase space for MariaDB, you do not need to perform this step.

   To increase capacity for the Timescale DB, you need to increase the quota for that process by the amount you want. The quota name is `Postgresql`.

   For example, assume you added a 400 GB volume, and the current `Postgresql` quota is 400 GB. In that case, you could increase the quota to 800 GB. Following this example, execute the command:

   ```
   xfs_quota -x -c 'limit -p bhard=800g Postgresql' /var/lib/dbs
   ```

   To see the current quotas set for `/var/lib/dbs`, execute the command:

   ```
   xfs_quota -xc 'report -pbih' /var/lib/dbs
   ```

(Optional) Enforcing Secure Access Via LDAP

If your company policy requires secure access, you can use a certificate with your LDAP service to set up secure access for your users. For example, you can configure Active Directory (AD) accounts to manage *External Authentication* for users or user groups. The user interface to enable AD includes a **Secure** option, which enforces certificate-based security. For more information, see "Managing User Accounts" in the *Turbonomic User Guide*.

If your LDAP service uses a Certificate Authority (CA), then the certificate signed by that CA should support this feature as it is. Simply turn on the **Secure** option when you are setting up your AD connection.

If your LDAP service uses a self-signed certificate, then you must install that certificate on the Turbonomic authorization pod. The steps you will perform include:

- Get the certificate from your LDAP server
- Import the certificate to the platform's TrustStore
- Add the certificate to the Turbonomic platform's authorization pod
- Enable the TrustStore in the Turbonomic platform's Operator chart

The procedure to install the certificate is different depending on the version of Turbonomic that you initially installed:

- If you *initially installed* Turbonomic 8.1.5 or later, see 8.1.5 or Later: Installing a Self-signed Certificate *(on page 33)*
- If you *initially installed* Turbonomic 8.1.4 or earlier, see 8.1.4 or Earlier: Installing a Self-signed Certificate *(on page 35)*.

8.1.5 or Later: Installing a Self-signed Certificate

This section describes how to set up secure access from an LDAP server, to a Turbonomic platform that was installed as version 8.1.5 or later. It assumes you have authorization to get a certificate from the LDAP server, as well as admin authority on the Turbonomic platform.

To set up secure access:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Password: `[your_private_password]`
2. Download your LDAP Server certificate to the Turbonomic instance.

   Acquire a certificate from your LDAP administrator, and download it to the Turbonomic platform. For example, you can download it to the file `/tmp/ldapserver.crt`:
3. Import the `.crt` file to the Turbonomic TrustStore.

   This step modifies the `cacerts` file on the Turbonomic platform.

   > **NOTE:**
   > To import a certificate to the Turbonomic TrustStore, you must use the `keytool` utility. To install this utility, execute the command:
   >
   > `sudo yum install java-1.8.0-openjdk`
   >
   > This installs the utility in `/usr/bin/keytool`.

   If an alias for an LDAP certificate already exists, delete that certificate. For example, assuming the alias `ldapcert1`, execute the following command:

   ```
   keytool -delete -alias ldapcert1 -keystore cacerts -storepass changeit
   ```

   Then use the following command to import your new certificate to the TrustStore:

   ```
   keytool -import -alias ldapcert1 -file /tmp/ldapserver.crt -keystore cacerts \
       -deststoretype jks -storepass changeit -noprompt
   ```
4. Create an `auth` secret from the `cacerts` file.

   ```
   base64 cacerts > auth-secrets.yaml
   ```
5. Open the secrets file for editing.

   ```
   vi auth-secrets.yaml
   ```

6. Edit the file to make it a valid yaml file.

   a. Indent every line of the certificate by four spaces.

      When you created the file, you concatenated the contents of the certificate. The first step is to indent the certificate by four spaces. For example, in a `vi` editor, execute the following command:

      ```
      :%s/^/    /g
      ```

   b. Add data fields to the secrets file.

      Add the following text to the top of the file:

      ```
      apiVersion: v1
      kind: Secret
      metadata:
        name: auth-secret
      data:
        cacerts: |
      ```

   c. Save your changes.

   The completed file should be similar to:

```
apiVersion: v1
kind: Secret
metadata:
  name: auth-secret
data:
  cacerts: |
    /u3+7QAAAAIAAAABAAAAAgAFY2VydDEAAAF5H2lEigAFWC41MDkAAAYQMIIGDDCCBPSgAwIBAgIT
    HAAAARHIFJdLbG90sAAAAAABETANBgkqhkiG9w0BAQUFADBcMRMwEQYKCZImiZPyLGQBGRYDY29t
    MRcwFQYKCZImiZPyLGQBGRYHdm10dXJibzEUMBIGCgmSJomT8ixkARkWBGNvcnAxFjAUBgNVBAMT
    DWNvcnAtREVMTDEtQ0EwHhcNMjEwNDA4MDM0OTEyWhcNMjIwNDA4MDM0OTEyWjAhMR8wHQYDVQQD
    ExZkZWxsMS5jb3JwLnZtdHVyYm8uY29tMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEA
    sCXuh2MTrFERyU/aKgdbgyjLezNuwF6nmZveZUhDaJDpfLHJlzhwfyYRTGfSSusVo4polJS4WqPZ
    T3Zk8f2IaX04RpfpQErq5N3uY/BxFkATWLMDiquSd0Di798k2diYXAxXvzMmfmIkBBYJta9oztum
    uXyh/42dXOGznQ5fFuxosgAksZ6CnXGDKrTBlb0bHpST1z1Pdg+fJ+f9Tq7IffOYdVbuedFTwsik
    Z0JgDCIRrmmsOJphiHdBqJ6ZLdbSeEzBIbboiQs81pAELw7V0ZZUfKV6y8+zMTACGwpVPJSFv7LX
    RlW1TWcqhXVAOmroe2WcU8KJE6XZTBxp7z7dzwIDAQABo4IDADCCAvwwLwYJKwYBBAGCNxQCBCIe
    IABEAG8AbQBhAGkAbgBDAG8AbgB0AHIAbwBsAGwAZQByMB0GA1UdJQQWMBQGCCsGAQUFBwMCBggr
    BgEFBQcDATAOBgNVHQ8BAf8EBAMCBaAweAYJKoZIhvcNAQkPBGswaTAOBggqhkiG9w0DAgICAIAw
    DgYIKoZIhvcNAwQCAgCAMAsGCWCGSAFlAwQBKjALBglghkgBZQMEAS0wCwYJYIZIAWUDBAECMAsG
    CWCGSAFlAwQBBTAHBgUrDgMCBzAKBggqhkiG9w0DBzBCBgNVHREEOzA5oB8GCSsGAQQBgjcZAaAS
    BBDswjlHut/nQZ0uK2aUglGbghZkZWxsMS5jb3JwLnZtdHVyYm8uY29tMB0GA1UdDgQWBBR6M7Hb
    BiirpjIXQ3PXXScB8LkmRDAfBgNVHSMEGDAWgBRjs9l3el7SuKUDMlrHHRhBkENgaDCB0QYDVR0f
    BIHJMIHGMIHDoIHAoIG9hoG6bGRhcDovLy9DTj1jb3JwLURFTEwxLUNBLENOPWRlbGwxLENOPUNE
    UCxDTj1QdWJsaWMlMjBLZXklMjBTZXJ2aWNlcyxDTj1TZXJ2aWNlcyxDTj1Db25maWd1cmF0aW9u
    LERDPWNvcnAsREM9dm10dXJibyxEQz1jb20/Y2VydGlmaWNhdGVSZXZvY2F0aW9uTGlzdD9iYXNl
    P29iamVjdENsYXNzPWNSTERpc3RyaWJ1dGlvblBvaW50MIHHBggrBgEFBQcBAQSBujCBtzCBtAYI
    KwYBBQUHMAKGgadsZGFwOi8vL0NOPWNvcnAtREVMTDEtQ0EsQ049QUlBLENOPVB1YmxpYyUyMEtl
    eSUyMFNlcnZpY2VzLENOPVNlcnZpY2VzLENOPUNvbmZpZ3VyYXRpb24sREM9Y29ycCxEQz12bXR1
    cmJvLERDPWNvbT9jQUNlcnRpZmljYXRlP2Jhc2U/b2JqZWN0Q2xhc3M9Y2VydGlmaWNhdGlvbkF1
    dGhvcml0eTANBgkqhkiG9w0BAQUFAAOCAQEADP6OYLONkZ2j6gaBdfdoIJtvn1g1qXTsRrtFuUcF
    C9mUxL0G5Tudr0VlyEnLH2wtj10CGsIi54+aPGYiElXijThEe1WTHaO2hklRLdNrM8KxUp3tUNb/
    cP4d+EYt297wVWgxpl9MStiND8+7M2+65daoEu5IOLtq4lC7YlCSXay19N5HdiGBHV5L07PTZ261
    qDzShSb0ZWtG7++5VkqveVEIfs3hUYdaItz0Zu6sym90aUcvn5wohV1GPPqGDvVCg5Kf50hsZfmy
    ltNlaqiiqLMnYVMa93CkpFFjoP9gmGFJky0yTfh6G8HuqbI7guddDsUqMQTT3uv3EBwSYeImOya7
```

```
Zye5C4NnsAfnx8kOwXdsVERC
```

7. Apply this secrets file to the platform environment.

   ```
   kubectl apply -f auth-secrets.yaml
   ```

8. Update the platform's Operator Chart to use use the `cacerts` certificate that you created in the secrets file.
   a. Open the chart file for editing.

      Open the file, `/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml`.

   b. Add the certification secret as an authorization spec for the component options.

      In the chart file, find the `spec:` section. Within that section, find the `auth:` subsection.

      This should be the second subsection in `spec:`, after `global:`. If there is no `auth:` subsection, you can add it to `spec:`.

   c. Add the certification secret to the file:

      You will add the secret's path to a `javaComponentOptions:` statement within the `auth:` subsection. Add the path as a `-D` option. The `auth:` subsection should be similar to the following, with `auth` indented by two spaces and `javaComponentOptions` indented by four spaces:

      ```
      # Pass in the JAVA_OPTS to the auth POD to set up additional options such as
      # a trustStore for AD Certificate(s) for LDAPS (Secure LDAP)
      auth:
       javaComponentOptions: "-Djavax.net.ssl.trustStore=/home/turbonomic/data/helpe
      r_dir/cacerts"
      ```

   d. Apply your Operator Chart changes to the Turbonomic platform.

      Execute the following command:

      ```
      kubectl apply -f \
      /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
      ```

      This restarts the authorization component so it can use the new setting.

8.1.4 or Earlier: Installing a Self-signed Certificate

This section describes how to set up secure access from an LDAP server, to a Turbonomic platform that was installed as version 8.1.4 or earlier. It assumes you have authorization to get a certificate from the LDAP server, as well as admin authority on the Turbonomic platform.

To set up secure access:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Password: `[your_private_password]`

2. Download your LDAP Server certificate to the Turbonomic instance.

   Acquire a certificate from your LDAP administrator, and download it to the Turbonomic platform. For example, you can download it to the file `/tmp/ldapserver.pem`:

3. Import the `.pem` file to the Turbonomic TrustStore.

   This step modifies the `cacerts` file on the Turbonomic platform.

   > **NOTE:**
   > To import a certificate to the Turbonomic TrustStore, you must use the `keytool` utility. To install this utility, execute the command:
   >
   > `sudo yum install java-1.8.0-openjdk`
   >
   > This installs the utility in `/usr/bin/keytool`.

   If an alias for an LDAP certificate already exists, delete that certificate. For example, assuming the alias `ldapcert1`, execute the following command:

   ```
   keytool -delete -alias ldapcert1 -keystore cacerts -storepass changeit
   ```

   Then use the following command to import your new certificate to the TrustStore:

   ```
   keytool -import -alias ldapcert1 -file /tmp/ldapserver.pem -keystore cacerts \
    -deststoretype jks -storepass changeit -noprompt
   ```

4. Add the TrustStore to the Turbonomic authorization pod.

   Execute the following command to copy the `cacerts` file into the authorization pod:

   ```
   kubectl cp cacerts $auth_pod:/home/turbonomic/data/cacerts
   ```

5. Update the platform's Operator Chart to use the TrustStore.

   a. Open the chart file for editing.

      Open the file, `/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml`.

   b. Add the TrustStore as an authorization spec for the component options.

      In the chart file, find the `spec:` section. Within that section, find the `auth:` subsection.

      This should be the second subsection in `spec:`, after `global:`. If there is no `auth:` subsection, you can add it to `spec:`.

   c. Add the TrustStore to the `auth:` subsection.

      You will add the TrustStore path to a `javaComponentOptions:` statement within the `auth:` subsection. Add the path as a `-D` option. Use the same path that you copied the `cacerts` file to in the Turbonomic authorization pod. In the above example, you copied it to `$auth_pod:/home/turbonomic/data/cacerts`.

      Following the above example, the `auth:` subsection should be similar to the following, with `auth` indented by two spaces and `javaComponentOptions` indented by four spaces:

      ```
      # Pass in the JAVA_OPTS to the auth POD to set up additional options such as
      # a trustStore for AD Certificate(s) for LDAPS (Secure LDAP)
      auth:
       javaComponentOptions: "-Djavax.net.ssl.trustStore=/home/turbonomic/data/cacer
      ts"
      ```

   d. Save the `charts_v1alpha1_xl_cr.yaml` file.

6. Apply your Operator Chart changes to the Turbonomic platform.

   Execute the following command:

```
kubectl apply -f \
/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
```

This restarts the authorization component so it can use the new setting. As the component restarts, the `rsysloc` output should include the following Message:

```
-Djavax.net.ssl.trustStore=/home/turbonomic/data/cacerts
```

(Optional) Enforcing Secure Access Via Trusted Certificate

If your company policy requires SSL connections via trusted certificate, Turbonomic enables you to install a trusted certificate from a known certificate authority.

Requesting a Certificate

The first step is to acquire a certificate. The following steps describe how to generate a certificate request.

1. Open a shell terminal session.

   Open an SSH terminal session on your Turbonomic instance. Log in as `turbo`, and use the password that you created for the administration account in the installation steps above. For information, see the installation step, Set up the Turbonomic System Administrator account *(on page 10)*.
2. Change to the directory where you want to store the private key file.

   If your shell session is on your Turbonomic instance, you should use the `/opt/turbonomic` directory:

   ```
   cd /opt/turbonomic
   ```
3. Create and save the private key file.

   Execute the command to create a private key file.

   For this example, the private key file is named `myPrivate.key`

   ```
   openssl genrsa -out myPrivate.key 2048
   ```

   You will need this file later. If you are in a session on your Turbonomic instance, you might want to copy the file to your local machine.
4. Create a file to contain the information that will generate the signed certificate request (CSR).

   ```
   vi certsignreq.cfg
   ```
5. Add the request data to the `certsignreq.cfg` file.

   In the file, insert the following code. For any fields marked by angle brackets (for example `<city>`), provide the indicated value. For example, your country, city, company, etc.

   ```
   [req]
   ts = 2048
   prompt = no
   default_md = sha256
   ```

```
req_extensions = req_ext
distinguished_name = dn

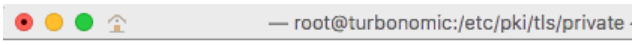
[dn]
C=<country, 2 letter code>
L=<city>
O=<company>
OU=<organizational unit name>
CN=<FQDN>
emailAddress=<email address>

[req_ext]
subjectAltName = @alt_names

[alt_names]
DNS.1 = <FQDN>
DNS.2 = <server's short name>
DNS.3 = <server's IP address>
```

> **NOTE:**
> For the `CN` field, specify the fully-qualified domain name of the Turbonomic instance.
>
> Alternate names are other ways to access the Turbonomic instance. In the `[alt_names]` section, the value for the `DNS.1` field is required. For `DNS.1`, specify the fully-qualified domain name of the Turbonomic instance. Values for the `DNS.2` and `DNS.3` are optional. You can add more DNS.<n> fields if needed.

For example:




```
ts = 2048
prompt = no
default_md = sha256
req_extensions = req_ext
distinguished_name = dn

[dn]
C=US
ST=New York
L=White Plains
O=Turbonomic
OU=Educational Services
CN=demo.turbonomic.com
emailAddress= <first.lastname> @turbonomic.com

[req_ext]
subjectAltName = @alt_names

[alt_names]
DNS.1 = demo.turbonomic.com
DNS.2 = demo
DNS.3 = my.ip.add.ress
```

6. Write and quit the file.

   Press **esc**, type `:wq!`, and press **Enter**.

7. Generate the certificate request file.

   In this example, we name the file `myRequest.csr`.

   Execute the command:

   ```
   openssl req -new -sha256 -nodes -out myRequest.csr -key \
     myPrivate.key -config certsignreq.cfg
   ```

8. Send the generated request file to your certificate authority.

   If you generated the file on your Turbonomic instance, you should transfer the file to your local machine. The path to the certificate request file on your remote machine is `/opt/turbonomic/myRequest.csr`.

   Your certificate authority will use this file to create the certificate for you.

   If your certificate authority gives you an encoding choice between DER and Base 64, choose **Base 64**.

9. When you receive the certificate, save it to disk.

   If you did not receive the certificate encoded in Base 64, you must convert it from DER to Base 64. Execute the following command, assuming the certificate is named `MyCertificate.crt`:

   ```
   openssl x509 -inform der -in MyCertificate.der -out MyCertificate.crt
   ```

Installing the Signed Certificate in Turbonomic

Once you have obtained the signed certificate, you can install it on your Turbonomic instance. You will use the private key and certificate files you obtained when requesting the the signed certificate:

- `myPrivate.key`
- `MyCertificate.crt`

To install the signed certificate:

1. Open an SSH terminal session on your Turbonomic instance.
2. Add the key and certificate data to your Turbonomic charts.yaml file.

   Open the file: `/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml`

   Find the section for `global` parameters. Under the `global` parameters, create the `ingress:secrets` section, and then create entries for `certificate`, `key`, and `name`.

   Your global parameters should be similar to the following:

   ```
   global:
     ingress:
       secrets:
         - certificate: |
             -----BEGIN CERTIFICATE-----
             SAMPLE PUBLIC KEY
             -----END CERTIFICATE-----
           key: |
             -----BEGIN RSA PRIVATE KEY-----
             SAMPLE PRIVATE KEY
             -----END RSA PRIVATE KEY-----
           name: nginx-ingressgateway-certs
   ```

For the fields you added:

- `certificate:` This field holds the content of your `MyCertificate.crt` file. Open that file to copy its contents and paste them here.
- `key:` This field holds the content of your `myPrivate.key` file. Open that file to copy its contents and paste them here.
- `name:` This field is required, and the name must be `nginx-ingressgateway-certs`.

3. Apply the changes you made to the CR file.

   Execute the command:

   ```
   kubectl apply -f \
     kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

4. Restart the `nginx` pod.

   To require a certificate for HTTPS access, you must restart the `nginx` pod:

   a. Get the full name of the pod.

      Execute the command `kubectl get pods -n turbonomic`. In the output, look for the entry for `nginx`. You should find an entry similar to:

      ```
      nginx-5b775f498-sm2mm                          1/1     Running   0
      ```

   b. Restart the pod.

      Execute the following command, where **<UID>** is the generated ID for the pod instance:

      ```
      kubectl delete pod nginx-<UID>
      ```

   This should restart the nginx pod. After restart, Turbonomic will then require a certificate for HTTPS access.

(Optional) Enabling Secure Access for Probes

If your targets require SSL connections via trusted certificate, Turbonomic enables you to install a trusted certificate on the associated probe component.

The Turbonomic platform includes a number of probe components that it uses to connect to targets and discover their data. This procedure assumes setup for one component, the *Dynatrace* probe. You can use the same steps for other probes, providing a different Kubernetes Secret Name for each.

> **NOTE:**
> To configure SSL communication for multiple probes, you must get a unique certificate for each one.

To install a certificate on a probe component, you must know the Kubernetes secret name for the given probe. This table lists the probes that you can configure, plus their secret names:

Probe:	K8s Secret Name:
mediation-awsbilling mediation-aws mediation-awscost	aws

Probe:	K8s Secret Name:
mediation-awslambda	
mediation-appinsights	appinsights
mediation-newrelic	newrelic
mediation-azuresp mediation-azure mediation-azurevolumes mediation-azurecost	azure
mediation-azureea	azureea
mediation-dynatrace	dynatrace

Installing the Signed Certificate on the Probe Component

This procedure assumes you already have a valid `.crt` file. For steps to get a signed certificate, see Requesting a Certificate *(on page 37)*. However, instead of generating the certificate on your Turbonomic instance, you should generate it on your local machine.

Once you have obtained the signed certificate, you can install it on your probe instance. You will use the certificate file you obtained when requesting the the signed certificate:

```
MyCertificate.crt
```

To install the signed certificate on a probe:

1. Copy the certificate from your local machine to the Turbonomic instance.

   Use SCP to copy the `MyCertificate.crt` from your local machine to the `/tmp` directory on the instance. Once you have done this, you can use `kubectl` to transfer the certificate to the probe component.
2. Open an SSH terminal session on your Turbonomic instance, using the `turbo` user account.
3. Copy the certificate file to the probe component.

   First, get the ID for the pod that runs the probe. To get the ID, execute the command:

   ```
   kubectl get pod
   ```

   This lists the pods running in the Turbonomic platform, including their IDs. Record the ID of the pod you want to configure.

   To copy the certificate, execute the following command, where **<Probe-Pod-Id>** is the ID you recorded:

   ```
   kubectl cp /tmp/MyCertificate.crt <Probe-Pod-Id>:/tmp
   ```
4. Copy the keystore `cacerts` file to the component's `/tmp` directory.

   Use these commands to open a bash session on the pod and copy the file:

   - `kubectl exec -ti <Probe-Pod-Id> bash`
   - `cp /etc/pki/ca-trust/extracted/java/cacerts /tmp`
5. Import the certificate into the pod's keystore.

As part of this step, you will ensure that the certificate is in Base64 format. While still in the bash session on your probe component, execute the following commands:

- `chmod 775 /tmp/cacerts`
- ```
  keytool -import -alias MyCertificate.crt -file \
    /tmp/ca.crt -keystore /tmp/cacerts -deststoretype jks \
    -storepass changeit -no-prompt
  ```

  Where **`MyCertificate.crt`** is the name of the certificate that you acquired.
- `base64 /tmp/cacerts > base64.txt`

6. Create the yaml file to contain the certificate data.

   You will create a yaml file using the K8s Secret Name for the probe, with the following naming convention:

   `/tmp/<Secret_Name>-secrets.yaml`

   For example, assume you are enabling SSL for the Dynatrace probe. In that case, the secret name is `dynatrace`, and you would create the yaml file:

   `/tmp/dynatrace-secrets.yaml`

   a. While still in the bash session on the probe component, open the yaml file in a vi editor session:

      `vi /tmp/<Secret_Name>-secrets.yaml`

   b. Then add the following content to the file:

      ```
      apiVersion: v1
      kind: Secret
      metadata:
        name: dynatrace
      data:
        cacerts: |
          xxxxxxxxxxxxxxxxxxxxxxxx
          xxxxxxxxxxxxxxxxxxxxxxxx
      ```

      In the `cacerts` section, replace the `xxx` characters with the `base64.txt` data that you generated.

   c. Align the base64 data to the yaml format.

      Press ESC to exit the edit mode you were in to add the content to the file. Then type `:` to enter the command mode. For the command, type the following, where the whitespace token is four space characters:

      ```
      7,$s/^/    /
      ```

      Press RETURN to execute the command. Then save and exit the vi editor.

7. Exit your session on the probe component.

   You now have a yaml file on the probe component that configures a certificate for communications from that probe. You must leave the session on the probe so you can apply the yaml to the Turbonomic platform.

   To leave the component session and return to your session on the Turbonomic VM, type `exit` in the shell.

8. Apply the yaml file to the Turbonomic platform.

   To apply the yaml file to your platform, you copy it from the probe component to the platform, and then you apply it.
      ```

To copy the file from the probe component, you must know the pod ID. To get the ID, execute the command `kubectl get pod`, and record the ID of the pod you have just configured. Then execute the following commands, where **<Probe-Pod-Id>** is the ID you recorded, and :

- `kubectl cp <Probe-Pod-Id>:/tmp/<Secret_Name>-secrets.yaml \ /tmp/<Secret_Name>-secrets.yaml`
- `kubectl apply -f /tmp/<Secret_Name>-secrets.yaml`

9. For each probe that you configure with a SSL certificate, add an entry in the chart_v1alpha1_cl_cr.yaml file.
   a. With a shell session running on the Turbonomic platform, open the following file in a text editor:

      ```
      /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
      ```

   b. Search the file for the entry for the probe that you are configuring. Use the probe names listed in the table above. For example, if you are configuring the Dynatrace probe, find the entry for `mediation-dynatrace`.
   c. Underneath the probe entry, add the following entry for `javaComponentOptions:`

      ```
      javaComponentOptions: -Djavax.net.ssl.trustStore=/etc/targets/cacerts -Dorg.eclipse.jetty.websocket.jsr356.ssl-trust-all=true -DLog4jContextSelector=com.vmturbo.mediation.common.context.ThreadGroupPrefixContextSelector
      ```

      For example, if you are configuring the Dynatrace probe, the entry should be similar to:

      ```
      mediation-dynatrace:
          javaComponentOptions: -Djavax.net.ssl.trustStore=/etc/targets/cacerts -Dorg.eclipse.jetty.websocket.jsr356.ssl-trust-all=true -DLog4jContextSelector=com.vmturbo.mediation.common.context.ThreadGroupPrefixContextSelector
          resources:
            limits:
              memory: 2Gi
      ```

   d. Save and exit the chart_v1alpha1_cl_cr.yaml file.
   e. Apply the changed file to your Turbonomic platform.

      Execute the command:

      ```
      kubectl apply -f /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
      ```

(Optional) Modifying the Certificates for Cluster Manager

For installations behind a firewall, to upload diagnostics from the `clustermgr` component, you must modify its certificates. If you decide to modify these certificates, you must be running Turbonomic version 8.1.5 or later.

These steps to modify the certificates on `clustermgr` assume you have already generated the certificates that you want to add to the cluster manager.

1. Open an SSH terminal session on your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username:

     ```
     turbo
     ```

   - Password:

     ```
     [your_private_password]
     ```

2. Get the full name of the clustermgr pod.

   Execute the command:

   ```
   kubectl get pods -n turbonomic | grep clustermgr
   ```

   The result should be similar to:

   ```
   clustermgr-5f487f58f-tf84b   0/1     Running   52         2d4h
   ```

   In this example, `clustermgr-5f487f58f-tf84b` is the full name of the pod, and `5f487f58f-tf84b` is the POD_ID.

3. Save a copy of the pod's current ca-bundle.crt file to /tmp.

   Execute the following command, where <POD_ID> is the ID you get from the pod's full name.

   ```
   kubectl cp \
   clustermgr-<POD_ID>:etc/pki/ca-trust/extracted/pem/tls-ca-bundle.pem \
   /tmp/ca-bundle.crt
   ```

4. Add your certificates to the bundle.

   Repeat this command for each certificate, where <MY_CERT> is your certificate file.

   ```
   cat <MY_CERT> >> /tmp/ca-bundle.crt
   ```

5. Create a Kubernetes secret for the modified certificates.

   ```
   kubectl create secret generic clustermgr-secret --from-file=/tmp/ca-bundle.crt
   ```

6. Open the cr.yaml file for editing.

   For example:

   ```
   vi /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

7. Modify the cr.yaml file to use this secret.

   Add the following to the file:

   ```
   clustermgr:
     env:
       - name: component_type
         value: clustermgr
       - name: instance_id
         valueFrom:
   ```

```
      fieldRef:
        fieldPath: metadata.name
  - name: instance_ip
    valueFrom:
      fieldRef:
        fieldPath: status.podIP
  - name: serverHttpPort
    value: "8080"
  - name: kafkaServers
    value: kafka:9092
  - name: kafkaNamespace
    valueFrom:
      fieldRef:
        apiVersion: v1
        fieldPath: metadata.namespace
  - name: CURL_CA_BUNDLE
    value: /home/turbonomic/data/ca-bundle.crt
```

8. Save your changes and apply the cr.yaml file.

```
kubectl apply -f \
/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
```

If you watch the log with `grep ^clustermgr`, then you should see the appropriate curl command execute whenever you send diagnostics.

You can also check the .crt file in the cluster manager pod via the following commands, where <POD_ID> is the ID you got from the pod's full name:

```
kubectl exec -it clustermgr-<POD_ID> bash
vi /home/turbonomic/data/ca-bundle.crt
```

(Optional) Integrating Turbonomic DataCloud

Turbonomic Data Cloud is a unique data service focused on streaming data from the Turbonomic platform to display it visually. Data Cloud integrates directly with your Turbonomic platform to pull data about your Applications, Container Orchestration, Hypervisors, Storage, and Cloud Service Providers. It gives you the means to show and share how Turbonomic is currently assuring application performance as well as helping you find areas to drive further automation.

To integrate DataCloud, you configure a Turbonomic collector to run through your service account. To do this, you will:

- Generate a Service Account key

  You generate this data from the DataCloud user interface.
- Install the Turbonomic Collector

  You install the Collector on your Turbonomic instance.

Prerequisites

Before you begin, make sure your environment meets the requirements:

- Turbonomic version 7.22.6 or later

- Firewall and/or proxy access from the Turbonomic platform, out to `https://datacloud.turbonomic.io`
- Access to the image for the Turbonomic Collector container

  You can access this image via these routes:

  - Offline, using the Turbonomic ISO, attached to the Turbonomic VM.

    For an example of using the ISO in an offline update, see Offline Update *(on page 88)*.
  - Online, accessing Docker Hub services to get the image

    You will need firewall and/or proxy access to `https://hub.docker.com`. For a list of Docker Hub endpoints you need to access, see Online Update *(on page 84)*.
- Your Project ID

  This is the identifier of your Data Cloud project that was configured when you signed up for Data Cloud. To find the project ID, log into your project and review the URL that appears in your browser's address bar. For example, assume your project ID is **`MyProject`**. In that case, the URL in the address bar will be similar to:

  `https://datacloud.turbonomic.io/?projectid=`**`MyProject`**

Generating a Service Account Key

You must generate a key for your account, and save it as a file on the Turbonomic instance.

1. Log into the DataCloud user interface.
2. Generate the key data.

   In the Nvigation Menu, choose **Data Sources**, and display the **Turbonomic** tab. Then click **Generate Key**.

   DataCloud generates the key data and displays it on the screen. You will copy this data to paste it in a file on your Turbonomic instance. (Note that DataCloud also downloads the key data as a JSON file to your local computer.)

   > **NOTE:**
   > *Keep this data safe, and do not share it.* If you download the generated JSON file, you should also keep the file safe and not share it.
3. Create a Key Data file on your Turbonomic instance.

   We recommend that you store the file on the instance in the `/tmp` directory:

   a. Start an SSH session on the Turbonomic instance.
   b. Change to the `/tmp` directory.
   c. Use a text editor to open a file for editing.

      Name the file `DataCloudKey.json`.
   d. Copy the key data from the DataCloud user interface, and paste it into the file you are editing.
   e. Save the file.

Installing the Turbonomic Collector

To install the collector, you will create a Kubernetes secret to store the DataCloud key data, modify the configuration for the Turbonomic cluster, and then apply your changes.

1. If you have not already, start an SSH session on your Turbonomic instance.

2. Create a Kubernetes secret for your DataCloud key.

   Execute the following command, where **`/tmp/DataCloudKey.json`** is the path to the DataCloud key file that you created on the Turbonomic instance:

   ```
   kubectl create secret generic datacloud-collector-key \
     --from-file=credentials.json="/tmp/DataCloudKey.json"
   ```

3. Edit the Turbonomic cr.yaml file.

   Open the following file for editing in a text editor:

   ```
   /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

   In the `global:` section, add the following, where **`<ProjectID>`** is the project ID that you recorded for the prerequisites above:

   ```
     datacloud:
       enabled: true
       credentials:
         project_id: <ProjectID>
         type: service_account
         secret_name: datacloud-collector-key
   ```

   Note that the `datacloud:` entry (the first line of this listing) must be indented by two spaces. The indents in yaml files are significant.

4. Apply your changes.

   Execute the command:

   ```
   kubectl apply \
   -f /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml \
   -n turbonomic
   ```

(Optional) Enabling Embedded Reports

Embedded reporting runs in its own component, as part of the Turbonomic platform. This architecture enhances performance and reduces storage requirements. When you enable Embedded Reports, you can navigate to a set of pre-built dashboards that chart multiple environment details. Dashboards and charts are powered by the Grafana observability platform. With Grafana, it's easy to navigate the existing dashboards, and to make your own charts and dashboards with no coding required.

> **NOTE:**
> Embedded Reports use the TimescaleDB service, a time-series SQL database that provides fast analytics and scalability on a proven storage engine. These instructions are for the default configuration of TimescaleDB. As an alternative, you can configure an external deployment of TimescaleDB, and use that to manage you Embedded Reports data. For more information, see Configuring an External TimescaleDB.

The method you use to enable embedded reports depends on the version status of your Turbonomic instance, as follows:

- Script Interface *(on page 48)*

You have installed Turbonomic version 8.1.5 or later as a new VM image (OVA or VHD; see Installing on a Virtual Machine Image *(on page 8)*). In this case, you can execute the `enable_reporting.py` script to set up embedded reporting.

- Editing the Turbonomic cr.yaml File *(on page 49)*

  You have installed Turbonomic version 7.22.5 or later (up to verrsion 8.1.5) as a new VM image.

  OR

  You have installed Turbonomic as a Kubernetes cluster, not using the OVA image for your Turbonomic installation.

  In these cases, you manually edit the `charts_v1alpha1_xl_cr.yaml` file for your installation of Turbonomic.

> **NOTE:**
> If you installed Turbonomic version 7.22.4 or earlier as aa VM image, contact your support representative for help enabling Embedded Reports.

Script Interface

If you have installed Turbonomic as a VM image for version 8.1.5 or later, the script to enable Embedded Reports is already installed on your installation at:

```
/opt/local/bin/enable_reporting.py
```

To execute this script:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`
2. Navigate to the script directory.

   ```
   cd /opt/local/bin
   ```
3. Execute the script.

   ```
   ./enable_reporting.py
   ```

   The script prompts you for two passwords:

   - The Grafana admin password.

     This password enables access to Grafana from external URLs and also from the extractor component that feeds data to Grafana.

     Do not use special characters.

     > **IMPORTANT:**
     > *This is the only time that you should change the Grafana Admin password.*
     >
     > If you change the Grafana Admin password subsequent to completing this step, the Embedded Reporting components cannot communicate properly with the other components in the platform. If you have made a subsequent change to this password, contact your support representative.
   - The Grafana database password.

This password enables communication between Grafana and the Postgres database that stores the reporting data.

After you supply the passwords, the script displays a confirmation message similar to:

```
Succesfully applied new changes to /opt/turbonomic/kubernetes/operator/deploy/crds/
charts_v1alpha1_xl_cr.yaml.
Backup written to /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alp
ha1_xl_cr.yaml.bak
```

This indicates that the script successfully updated the Turbonomic configuration. The script then applies the changed configuration to enable the Embedded Reports feature. It should display messages similar to:

```
Applying CR file /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alp
ha1_xl_cr.yaml
Warning: kubectl apply should be used on resource created by either
kubectl create --save-config or kubectl apply
xl.charts.helm.k8s.io/xl-release configured
Waiting for changes to take effect...
Restarting api pod to apply configuration changes.
pod "api-65cf47986f-jxszd" deleted
Changes have been successfully applied. Embedded reporting is now enabled.
```

4. Verify your installation.

   Execute the command:

   ```
   ./enable_reporting.py --validate
   ```

   If Embedded Reports are successfully enabled, the script output should be:

   ```
   No obvious embedded reporting installation errors detected.
   ```

Editing the Turbonomic cr.yaml File

These instructions describe how to locate and edit the `charts_v1alpha1_xl_cr.yaml` for the VM image installation. If you installed on a Kubernetes node cluster, then the file can be in a different location.

To enable Embedded Reports, you will:

- Enable the processes that implement the embedded reporting.
- Update the API pod to enable new search and data ingestion capabilities.
- Double-check the installation.
- Enable PDF reports and email subscriptions (optional).

You must enable the Grafana Exporter, TimescaleDB, and data extraction processes. To do this, edit the `charts_v1alpha1_xl_cr.yaml` file.

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`

2. Open the following file in a text editor:

   `/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml`

3. Specify the IP address of the Turbonomic instance for external access to the TimescaleDB database.

   In the `global:` section of the file, add the following line, where **<Platform_IP>** is the IP address of your instance:

   ```
   global:
     externalTimescaleDBIP: <Platform_IP>
   ```

4. Enable the Grafana process.

   Find the `grafana:` section in the `crds/charts_v1alpha1_xl_cr.yaml` file, and uncomment the line, `enabled: true`.

5. Enable Postgres as the database type.

   Enabling Postgres sets persistent storage of historical data for Embedded Reports. In the `grafana:` section, find the subsection for `grafana.ini: database:` and uncomment the line, `type: postgres`.

   The changes you have made so far should be similar to:

   ```
   global:
       externalTimescaleDBIP: <Platform_IP>
       ...

   grafana:
       enabled: true
       adminPassword: admin
       grafana.ini:
         database:
           type: postgres
           ...
   ```

6. Change the admin and database passwords.

   It is good practice to change any passwords, and not keep their default values.

   > **IMPORTANT:**
   > *Use only alpha-numeric characters for these passwords.*
   >
   > These passwords enable communication between the various Embedded Reports components. Some of the components only accept alpha-numeric characters. If you use special characters, then the components will not be able to communicate. Further, the steps to correct these passwords require assistance from your Support engineer.

   To set the passwords:

   - Set the Grafana admin password.

     This password enables access to Grafana from external URLs and also from the extractor component that feeds data to Grafana. In the `grafana:` section, change the value of `adminPassword`.

     Do not use special characters.

     Assume your password is `MyNewGrafanaPassword`. Then you would set `adminPassword:` **`MyNewGrafanaPassword`**

> **IMPORTANT:**
> *This is the only time that you should change the Grafana Admin password.*
>
> If you change the Grafana Admin password subsequent to completing this step, the Embedded Reporting components cannot communicate properly with the other components in the platform. If you have made a subsequent change to this password, contact your support representative.

- Set the Grafana database password.

  This password enables communication between Grafana and the Postgres database that stores the reporting data. In the `grafana:` section, find the subsection for `grafana.ini: database: password:` and change the password value.

7. Enable the three Embedded Reports processes.

   Just after the `properties:` section that you added, and at the same level to it, add the following entries to enable the reporting processes:

```
  reporting:
    enabled: true
  timescaledb:
    enabled: true
  extractor:
    enabled: true
```

   It is important that you align these entries with the indentation for the `grafana:` section and the `properties:` section. The changes you have made should now be similar to:

```
global:
    externalTimescaleDBIP: <Platform_IP>
    ...

grafana:
    enabled: true
    adminPassword: MyNewGrafanaPassword
    grafana.ini:
      database:
        type: postgres
        password: MyNewDatabasePassword

properties:
    extractor:
        grafanaAdminPassword: MyNewGrafanaPassword

reporting:
    enabled: true
timescaledb:
    enabled: true
extractor:
    enabled: true
```

8. When you are done editing the `charts_v1alpha1_xl_cr.yaml` file, save and apply your changes.

   - Save your changes and quit the text editor.
   - Apply the changes.

     Execute the command:

```
kubectl apply -f \
  /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
```

- Delete the api and extractor pods.

  Deleting these pods triggers them to restart, which loads the changes you made.

  To get the full pod names, execute the command, `kubectl get pods -n turbonomic`. Then find the two entries for the pods that begin with `api` and `extractor`. For example, assume the entries are:

```
...
api-7887c66f4b-shndq                          1/1     Running   0
...
extractor-5b86976bc8-vxwz4                    1/1     Running   0
...
```

  Then you would execute the commands:

  - `kubectl delete pod -n turbonomic api-7887c66f4b-shndq`
  - `kubectl delete pod -n turbonomic extractor-5b86976bc8-vxwz4`

9. Verify your installation.

   To double-check the installation:

   - Verify that the Embedded Reports pods are running.

     To verify that the pods are running, execute `kubectl get pods -n turbonomic`. The output should include entries similar to:

```
NAME                                          READY   STATUS    RESTARTS
extractor-7759dbcb47-vs6hr                    1/1     Running   0
grafana-84ccb4bfb-l7sp7                       1/1     Running   0
```

   - Verify that Postgres is running.

     The Postgres database should be running as a daemon on the Turbonomic server machine. To check the status, execute the command:

     `sudo systemctl status postgresql-12.service`.

     You should see output similar to:

```
postgresql-12.service - PostgreSQL 12 database server
Loaded: loaded (/usr/lib/systemd/system/postgresql-12.service; enabled; vendor p
reset: disabled)
Active: active (running) since Wed 2020-07-29 06:39:43 UTC; 14h ago
     Docs: https://www.postgresql.org/docs/12/static/
Process: 1536 ExecStartPre=/usr/pgsql-12/bin/postgresql-12-check-db-dir ${PGDATA}
 (code=exited, status=0/SUCCESS)
Main PID: 1562 (postmaster)
    Tasks: 15
   Memory: 145.5M
   CGroup: /system.slice/postgresql-12.service
           ##  419 postgres: TimescaleDB Background Worker Scheduler
           ## 1562 /usr/pgsql-12/bin/postmaster -D /var/lib/pgsql/12/data/
           ## 1928 postgres: logger
           ## 1986 postgres: checkpointer
           ## 1988 postgres: background writer
```

```
## 1989 postgres: walwriter
## 1990 postgres: autovacuum launcher
## 1991 postgres: stats collector
## 1992 postgres: TimescaleDB Background Worker Launcher
## 1994 postgres: logical replication launcher
## 4054 postgres: grafana_backend grafana 10.233.90.172(33038) idle
## 4884 postgres: grafana_backend grafana 10.233.90.172(35814) idle
## 4912 postgres: grafana_reader extractor 10.233.90.172(33898) idle
##11365 postgres: grafana_reader extractor 10.233.90.172(40728) idle
##32367 postgres: TimescaleDB Background Worker Scheduler
```

(Optional) Report Editing, PDFs, and Email Subscriptions

After you have completed the steps to enable Embedded Reports, you can click **Reports** in the Turbonomic Navigation Bar to open Grafana dashboards in a new browser tab. From there you can view the list of existing dashboards.

To create and edit reports from this view, and to send these reports to subscribers, you must:

- Configure a single Report Editor user account.

  This user has privileges to create and edit reports, create PDFs, and set up email subscriptions.
- Install a Grafana license in Turbonomic.

  This license is free of charge.
- Configure the Turbonomic email proxy to enable email messages sent from Turbonomic.

  This enables emailing the reports from Turbonomic

> **NOTE:**
> Turbonomic Embedded Reports use Grafana dashboards to display reports. For instructions to generate PDFs from the reports, and have Grafana email them to subscribers, see the Grafana Reporting documentation:
>
> https://grafana.com/docs/grafana/latest/enterprise/reporting/

Configuring a User Account with Report Editor Privileges

The ability to edit reports requires a licensed user. The user account you configure here will have access to that license, which gives the user privileges to edit reports and set up subscriptions.

To create the user account:

1. In Turbonomic, display the User Management page.

   Navigate to **Settings / User Management**.
2. Choose the user account that you want to configure as a Report Editor.

   You can either edit an existing account or create a new one.
3. Choose a role for the user.

   The user can have any role so long as it is not a *Shared* role or a *Scoped* role.
4. Set the Report Editor privileges.

   Under **Options**, choose **DESIGNATE AS REPORT EDITOR**.
5. Set any other properties for the user account that you want, and save the user account.

For complete information about creating user accounts, see "Managing User Accounts" in the *Turbonomic User Guide*.

Installing the Grafana License

For the Report Editor user account to use the licensed privileges, you must install a Grafana license. To install your Grafana license:

1. Request the free license.

   Contact your support representative to request the license file. This request must include the Turbonomic URL to your reporting page. For example, assume you log into the Turbonomic user interface through the domain **`MyCompany.com`**. Then you would provide the URL:

   ```
   https://MyCompany.com/reports/
   ```

   This URL is incorporated in the license file to ensure that the license applies to the domain you provide.
2. Save the file to your local machine.

   The file should have a `.jwt` filename extension.
3. Install the .jwt file as a license in Turbonomic.

   Install the license file the same as you install any license in Turbonomic"

   a. Navigate to the License page.

      Navigate to **Settings / License**.

   b. Apply the license to your Turbonomic instance.

      First click **Import License**. Then drag the license file into the **Enter License** fly-out. Or you can browse to the license file on your local machine and then open it.

After you install the license, navigate to the Reports view (click **Reports** in the Turbonomic Navigation Bar. When you navigate to a dashboard, and click **Share Dashboard**, you can now choose to create a PDF. To email that PDF of the dashboard, you must configure the SMTP relay on Turbonomic.

Configuring the SMTP Relay

The SMTP relay enables Turbonomic to send emails to your report subscribers. To configure the SMTP relay on Turbonomic:

1. Navigate to the Email Settings page.

   Navigate to **Settings / Email and Trap Notifications**.
2. Configure the SMTP settings.

   The SMTP Settings fields identify the mail relay server you use on your network to enable email communication from Turbonomic. The relay you set up here enables emails from to send reports to subscribers.

   If the server requires authentication, provide the username and password here. You can also choose the following encryption options for notifications:

   - None
   - Ssl
   - Tls
3. Configure the return address for emails sent by Turbonomic.

   Provide a FROM address in the General Email Settings section.

After you have created a Report Editor user, installed the Grafana license, and configured the SMTP relay, the user can create PDFs of the dashboards, and send them to subscribers.

Embedded Reports Storage Requirement Estimates

The Embedded Reports feature uses a TimescaleDB server to manage the chart data. This is a PostgreSQL server running with the TimescaleDB extension. You must configure the datastore for your Turbonomic instance so it has enough space to support the TimescaleDB requirements.

When you initially enable Embedded Reports, you should estimate the storage you will need, and configure the platform storage accordingly. If you have already enabled Embedded Reports, you should check your current storage configuration and decide whether it meets your needs now and into the future.

The storage that your TimescaleDB requires depends on:

- Data retention period

  How long to store the TimescaleDB data.
- The size of your environment

  The count of entities Turbonomic manages in your environment. This count changes over time. You should think of it as the average number of entities in your environment over the given data retention period.

Also note that increased entity count increases the data requirement, as does other activity. Storage requirements can increase over time for reasons such as:

- You add entities such as workloads, application components, storage, or hosts to your environment.
- You configure new targets.

Storage Estimates Lookup Tables

We have investigated the TimescaleDB storage requirements for different topologies and retention periods. The following table lists the estimates that we have calculated. Please be aware that your environment could have different requirements.

	Number of Entities						
Retention Period	**10k**	**25k**	**50k**	**100k**	**250k**	**500k**	**1000k**
6 months	36GB	91GB	182GB	364GB	910GB	1.8TB	3.6TB
1 year	72GB	181GB	361GB	723GB	1.8TB	3.5TB	7TB
2 years	144GB	361GB	721GB	1.4TB	3.5TB	7.2TB	14TB

Note that the default installation grants a disk quota of 200GB to the TimescaleDB. For the default installation, we estimate that the database can support the following entity counts:

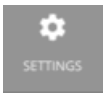
Retention Period	Entity Count
6 months	55k
1 year	27k
2 years	14k

Setting the Data Retention Period

By default, Turbonomic sets the retention period for Embedded Reports to be 365 days. You can see the currently set retention period, and change it in the Turbonomic user interface.

To execute these actions, navigate to the Maintenance Options page:

1. Navigate to the Settings Page.

   Click to navigate to the Settings Page.
2. Choose Maintenance Options.

   Maintenance Options
3. Set the data retention period for Embedded Reports.

   In the **Data Retention** group of controls, find the field for **Saved Reporting Data**. This displays the current data retention period for Embedded Reports, in days. The default is 365 days.

   To change the retention period, enter a different number of days, and then click **Apply Settings**.

Increasing Storage Capacity for TimescaleDB

If you estimate the storage requirements for Embedded Reports *after* you have installed Turbonomic, you might learn that you need to increase the storage capacity that is available to the TimescaleDB.

The platform uses Logical Volume Management (LVM) to manage the VM disks. To increase database storage, you should add a new disk to the VM, and then use it to extend the LVM logical volume, `/dev/turbo/var_lib_mysql`. This logical volume serves both the historical database and the Embedded Reports database. When you have done that, you will increase the quota for the TimescaleDB.

For more information, see Increasing Available Disk Space *(on page 29)*

Estimating Entity Count

To get a sense of entity count in your environment, search the log file for an INFO message that lists the number of entities for each discovery cycle. You can search for the string `INFO [Stages$BroadcastStage]`. The INFO string should be similar to:

```
topology-processor-6f6486df64-zf 2021-09-27 20:51:33,724  INFO [Stages$BroadcastStage]
  : Successfully sent 1505 entities within topology...
```

This example shows that you have 1505 entities in the topology. You should consider how your inventory changes over time. For example, you can check the entity count over time to see whether it increases regularly.

(Optional) Enabling the Data Exporter

To support Data Export, Turbonomic provides an extractor component that can stream data to a standard format. You can load that data into search and analytics services such as Elasticsearch.

To enable the Data Exporter, you must:

- Enable the extractor component.

  The extractor is a component that runs as part your Turbonomic installation. The extractor is not enabled by default.

- Deploy a connector that delivers the extractor's stream to your data service.

  The extractor publishes Turbonomic data as Kafka topics. The connector enables your data service to consume the data topic. This document includes a deployment file for a sample Elasticsearch connector.

Enabling the Extractor Component

The first step to enabling the Data Exporter is to enable the extractor component. To enable the extractor:

1. Open an SSH terminal session to your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`
2. Edit the cr.yaml file to enable the extractor component.

   In the same SSH session, open the cr.yaml file for editing. For example:

   ```
   vi /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```
3. Edit the entry for the extractor component.

   > **NOTE:**
   > If you have enabled Embedded Reporting, then the extractor component will already be enabled (set to `true`).
   >
   > You should uderstand that it is possible to enable the Data Exporter without enabling Embedded Reports, just as it is possible to enable Embedded Reports without enabling the Data Exporter.

   Search for the extractor entry in the cr.yaml file. It should appear as:

   ```
   extractor:
       enabled: false
   ```

   Change the entry to `true`.
4. Edit the entry for the extractor properties.

   Search for the extractor entry in the cr.yaml file. It should appear as:

   ```
   properties:
       extractor:
         enableDataExtraction: false
   ```

   Change the entry to `true`.
5. Save and apply your changes to the platform.

   After you save your changes, use `kubectl` to apply the changes:

   ```
   kubectl apply -f \
   /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```
6. Verify that the extractor component is running.

   Give the platform enough time to restart the components. Then execute the command:

   ```
   kubectl get pods -n turbonomic
   ```

   You should see output similar to the following:

```
NAME                                          READY   STATUS    RESTARTS
...
extractor-5f41dd61c4-4d6lq                    1/1     Running   0
...
```

Look for an entry for the `extractor` component. If the entry is present, then the extractor component is installed and running.

Deploying a Connector

The extractor publishes Turbonomic data as Kafka topics. To load this data into a search and analysis service, you must deploy a connector to that service. For example, if you want to load the data into Elasticsearch, then you must deploy an Easticsearch connector.

You deploy the connector in the same Kubernetes node that runs the Turbonomic platform. To do this, create a Kubernetes *Deployment* that declares the pods you need for the connector. Below, you can see a sample deployment of a connector to Elasticsearch.

To deploy the connector, you create a deployment yaml file on the same host that is running the extractor component, and execute the command:

```
kubectl create -f <MyConnectorDeployment.yaml>
```

Where **<MyConnectorDeployment.yaml>** is the name of the deployment file.

Assume the name of the deployed pod is `es-kafka-connect`. To verify that the connector is running, execute `kubectl get pods -n turbonomic`. You should see output similar to:

```
NAME                                          READY   STATUS    RESTARTS
...
es-kafka-connect-5f41dd61c4-4d6lq             1/1     Running   0
...
```

After you deploy the connector, wait for a cycle of Turbonomic analysis (approximately ten minutes). Then you should be able to see the entities and actions from your Turbonomic environment, loaded as JSON in your data service.

Connector Deployment Sample

Assume that you want to deploy a connector to Elasticsearch so that service can process the exported data. For example, you could use Kibana with Elasticsearch to display data dashboards. Let's say you have:

- Deployed Elasticsearch to a VM on the network where you are running Turbonomic. The Elasticsearch host is visible from the Turbonomic Kubernetes node. You will specify this host address in the connector deployment.
- Set up an Elasticsearch index to load the Turbonomic data. You will specify this index in the connector deployment.

The following listing is a deployment that uses a Logstash image to collect the extractor data and pipe it to the Elasticsearch host. The deployment also sets up storage volumes, configures the input from the extractor, and configures output to the Elasticsearch instance.

As you go over the listing, pay attention to the following:

- The location of the Elasticsearch host and the login credentials:

```
...
        env:
          - name: ES_HOSTS
            value: "<UrlToMyElasticsearchHost>"
          - name: ES_USER
            value: "<MyElasticsearchUser>"
          - name: ES_PASSWORD
            valueFrom:
              secretKeyRef:
                name: <MyES_KeyName>
                key: <MyES_Key>
...
```

  Logstash will use the following environment variables:

  - ES_HOSTS: to identify where to pipe the exported data.
  - ES_USER: to identify the user account on Elasticsearch.
  - ES_PASSWORD: for the account login. This connector example assumes that you have stored the Elasticsearch password as a Kubernetes Secret.

  Logstash uses the ES_HOSTS environment variable to identify where to pipe the exported data.
- The name of the Kafka topic:

```
...
  logstash.conf: |
    input {
      kafka {
        topics => ["turbonomic.exporter"]
...
```

  The Logstash input configuration expects a single topic named `turbonomic.exporter`.
- The Logstash output configuration is to the Elasticsearch server that is identified by the ES_HOSTS environment variable. You specify your own Elasticsearch index in place of **<MyElasticsearchIndex>**

```
...
    output {
      elasticsearch {
        index => "<MyElasticsearchIndex>"
        hosts => [ "${ES_HOSTS}" ]
      }
    }
...
```

Sample Listing: Elasticsearch Connector

This listing is a sample of a deployment file that can work to create an Elasticsearch connector for the Data Exporter. Note that you will need to change some settings, such as username and password. You also might need to specify ports and other settings to make the connector comply with your specific environment.

```
apiVersion: apps/v1
kind: Deployment
metadata:
```

```
  name: elasticsearch-kafka-connect
  labels:
    app.kubernetes.io/name: elasticsearch-kafka-connect
spec:
  replicas: 1
  selector:
    matchLabels:
      app.kubernetes.io/name: elasticsearch-kafka-connect
  template:
    metadata:
      labels:
        app.kubernetes.io/name: elasticsearch-kafka-connect
    spec:
      containers:
      - name: logstash
        image: docker.elastic.co/logstash/logstash:7.10.1
        ports:
          - containerPort: 25826
        env:
          - name: ES_HOSTS
            value: "<UrlToMyElasticsearchHost>"
          - name: ES_USER
            value: "<MyElasticsearchUser>"
          - name: ES_PASSWORD
            valueFrom:
              secretKeyRef:
                name: <MyES_KeyName>
                key: <MyES_Key>
        resources:
          limits:
            memory: 4Gi
        volumeMounts:
          - name: config-volume
            mountPath: /usr/share/logstash/config
          - name: logstash-pipeline-volume
            mountPath: /usr/share/logstash/pipeline
      volumes:
      - name: config-volume
        configMap:
          name: logstash-configmap
          items:
            - key: logstash.yml
              path: logstash.yml
      - name: logstash-pipeline-volume
        configMap:
          name: logstash-configmap
          items:
            - key: logstash.conf
              path: logstash.conf
---
apiVersion: v1
kind: ConfigMap
metadata:
  name: logstash-configmap
data:
```

```
  logstash.yml: |
    http.host: "0.0.0.0"
    path.config: /usr/share/logstash/pipeline
  logstash.conf: |
    input {
      kafka {
        topics => ["turbonomic.exporter"]
        bootstrap_servers => "kafka:9092"
        client_id => "logstash"
        group_id => "logstash"
        codec => "json"
        type => "json"
        session_timeout_ms => "60000"   # Rebalancing if consumer is found dead
        request_timeout_ms => "70000"   # Resend request after 70 seconds
      }
    }
    filter {
    }
    output {
      elasticsearch {
        index => "<MyElasticsearchIndex>"
        hosts => [ "${ES_HOSTS}" ]
        user => "${ES_USER}"
        password => "${ES_PASSWORD}"
      }
    }
---
apiVersion: v1
kind: Service
metadata:
  labels:
    app: elasticsearch-kafka-connect
  name: elasticsearch-kafka-connect
spec:
  ports:
    - name: "25826"
      port: 25826
      targetPort: 25826
  selector:
    app: elasticsearch-kafka-connect
```

(Optional) Changing the IP Address of the Platform Node

For standard installations of Turbonomic (installed as a VM image), you might need to change the platform's IP address. For example, if you have to move the VM then you might need to assign it a different address. If you must change the IP address of the platform, you can use the supplied scripts.

NOTE:
You should change the IP address of your Turbonomic installation as seldom as possible. This is a sensitive action that can impact unforeseen dependencies.

You can safely use the following steps to change your IP address if your installation satisfies one of the following conditions:

- You initially installed the platform OVA as version 8.0.6 or later.
- You have updated your Turbonomic to version 8.0.7 or later.

If your installation does not meet either one of these conditions, *do not use the following instructions to change the IP address*. If you must change your IP address and you cannot update to version 8.0.7 or later, contact your support representative.

To change the IP address of the Turbonomic VM:

1. Get your information ready.

   Identify both the current IP address for your platform, and the new IP address you will use.

   You must also know the credentials to open a shell session on the VM and run commands.
2. Create a full snapshot of the VM.

   It is important to make a full snapshot of your installation before you try to modify its IP address.
3. Change the VM's IP address.

   The Turbonomic VM includes the `ipsetup` script to perform this task.

   a. Open an SSH terminal session to your Turbonomic VM.

      Use the following credentials:

      - Username: `turbo`
      - Password: Give the password that you assigned the `turbo` account when you first installed the platform.

   b. Once the session is open, execute the `ipsetup` script:

      ```
      sudo /opt/local/bin/ipsetup
      ```

      When the script runs it requests the following inputs.

      NOTE:
      You must provide values for these required fields. Otherwise the installation can fail or your VM can be unreachable:

      - **Required:** `Do you want to use DHCP or set a static IP...`

        Choose `static`
      - **Required:** `Please enter the IP Address for this machine`
      - **Required:** `Please enter the network mask for this machine`
      - **Required:** `Please enter the Gateway address for this machine`
      - **Required:** `Enter DNS Server(s) IP Address for this machine`

      You should make a note of the IP address that you provide.

   c. Propagate your IP change through to the Kubernetes cluster on the VM.

      ```
      sudo /opt/local/bin/kubeNodeIPChange.sh
      ```

d. Verify that the change is successful.

   Log into the Turbonomic user interface for the newly located installation, and ensure that it displays correctly. You should review the Supply Chain, your groups, and your policies. You should also ensure that charts show data correctly.

   When you are sure that the change is successful, you can remove the snapshot you made of the VM in its old location.

(Optional) Enabling and Disabling Probe Components

In Turbonomic, a probe is a platform component that connects to a target. It discovers the target's entities and loads them into the Turbonomic supply chain, and it can execute actions on the devices in the target environment. Turbonomic ships with a large number of probe components that you can use to connect Turbonomic with your environment.

When you first install Turbonomic, it enables a certain set of probes by default, and leaves other disabled. Each probe consumes resources in your Turbonomic installation. If there are any probes that you do not need, then you should consider disabling them. On the other hand, if there are disabled probes that you do need, you must enable them to put them into service.

> **NOTE:**
> As Turbonomic evolves, the set of delivered probes can change. Also, from one version to the next, the set of probes that are enabled by default can change. However, when you update to a new version, the update does not change your probe configuration. An update to a newer version does not automatically enable any new probes in your deployment. If you want to take advantage of new probes in an update, then you must enable them manually.

Viewing the Current List of Available Probes

As you update your version of Turbonomic, more probes can come available with the update. However, the update does *not* modify your current configuration of enabled or disabled probes. This means that any new probes that come with an update will not be available to you by default.

To enable any new probes, you must first know the internal name for the probe. To get a list of probes that are *available* to your current version, you can view the contents of the `values.yaml` file.

1. Open an SSH terminal session on your Turbonomic instance.

   Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username:

     `turbo`

   - Password:

     `[your_private_password]`

2. Display the list of available probes.

```
cat /opt/turbonomic/kubernetes/operator/helm-charts/xl/values.yaml
```

The results should be similar to:

```
customdata:
  enabled: false
dynatrace:
  enabled: false
gcp:
  enabled: false
hpe3par:
  enabled: false
...
```

This list gives the internal names of the probes. If you want to add a new probe to your list of configured probes, you must use the internal name, and set `enabled: true`.

Viewing the Current List of Configured Probes

Your current installation of Turbonomic has a certain set of available probes. Some of these will be enabled, and it is likely that some probes are disabled. To View the current configuration of probes that are currently available, open the cr.yaml file for your Turbonomic installation and review the probe entries:

1. In the same SSH session, open the cr.yaml file for editing. For example:

   ```
   vi /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

2. Search for the list of probes

   This will include all the probes that are configured for your current installation. The list will be similar to:

   ```
   actionscript:
     enabled: true
   appdynamics:
     enabled: true
   appinsights:
     enabled: true
   aws:
     enabled: true
   azure:
     enabled: true
   dynatrace:
     enabled: true
   hpe3par:
     enabled: true
   horizon:
     enabled: false
   hyperflex:
     enabled: false
   ...
   ```

   This list identifies all the probes that are currently configured for your installation, and shows whether they are enabled (`true`) or disabled (`false`).

> **NOTE:**
> This list of probes is not identical to the list of probe *pods* that are running in your installation. Some probes use multiple pods. Probe pod names use the following convention, where **`{ProbeName}`** is the probe internal name (in the lists above), and **`{NameExtension}`** is an optional extension to that name in case there are multiple pods for this probe:
>
> `mediation-`**`{ProbeName}{NameExtension}`**
>
> For example, if you execute `kubectl get pods -n turbonomic`, the results can show the following for the `vcenter` probe:
>
> ```
> NAME                                          READY   STATUS    RESTARTS
> mediation-vcenter-5bc4f5fbd4-nzm4j            1/1     Running   0
> mediation-vcenterbrowsing-5c5987f66c-bfjq4    1/1     Running   0
> ```

Enabling/Disabling Probes

To enable or disable probes in Turbonomic, you will edit the cr.yaml file to add new probes and to change the values of the `enabled:` properties. Then you will apply those changes to reload the platform components.

1. In the same SSH session, open the cr.yaml file for editing. For example:

   ```
   vi /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

2. Edit the probe entries.

   To enable or disable currently configured probes, find the probes you want to edit and change the settings to enable or disable them.

   To add new probes to the list, copy the probe entry you want from the output when you used `cat` to view the available probes. Then paste that entry into the cr.yaml file and set `enabled: true`.

3. Save and apply your changes to the platform.

   After you save your changes, use `kubectl` to apply the changes:

   ```
   kubectl apply -f \
   /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

4. Verify that the probes have installed correctly and all the Turbonomic pods have started.

   Execute `kubectl get pods -n turbonomic` and review the list for the mediation pods that implement your probes. Note that all pods should display READY and STATUS states similar to:

   ```
   NAME                      READY   STATUS    RESTARTS
   [...]                     1/1     Running   0
   ```

5. View the new probe configuration in the user interface.

   Refresh your browser and navigate to the Target Management page. You should now see the target categories and types to match your configuration changes.

License Installation and First-time Login

Before you begin, make sure you have your full or trial license key file that was sent to you in a separate email. Save the license file on your local machine so you can upload it to your Turbonomic installation.

To use Turbonomic for the first time, perform the following steps:

1. Type the IP address of your installed Turbonomic instance in a Web browser to connect to it.
2. Log in to Turbonomic.
   - Use the default credential for **USERNAME**: `administrator`.
   - Type a password for **PASSWORD**.
   - Type the password again to verify it for **REPEAT PASSWORD**.
   - Click **CONFIGURE**.
3. Continue setting up your Turbonomic installation.

   Click **LET'S GO**.
4. Open the **Enter License** fly-out.

   Click **IMPORT LICENSE**.
5. Upload your license key file.
   a. In the Enter License fly-out, you can upload the license in one of the following ways:
      - Drag the license key file into the Enter License fly-out.
      - Browse to the license key file.

      Be sure to upload only .xml or .lic files.
   b. Click **SAVE**.

Depending on which license you have installed, the license enables either a trial or a full unlimited license for Turbonomic.

Single Sign-On Authentication

If your company policy supports Single Sign-On (SSO) authentication, you can configure Turbonomic to support SSO authentication via either Security Assertion Markup Language (SAML) 2.0 or OpenID Connect 1.0.

At a high-level, to do this you will:

- Create external groups or at least one external user for SSO. See "Managing User Accounts" in the *Turbonomic User Guide*.
- Configure Turbonomic to use SSO authentication.

  You will configure one of:

  - SSO via a SAML Identity Provider (IdP). See Setting Up SAML Authentication *(on page 68)*.
  - SSO via an OpenID Identity Provider. See Setting Up OpenID Authentication *(on page 72)*.

This section describes how to configure Turbonomic to use either SAML or OpenID to support SSO.

When SSO is enabled, users will provide their SSO credentials to log in to the Turbonomic instance. Once SSO is enabled, users cannot give local or Active Directory (AD) credentials for to login. The Identity Provider (IdP) will perform the authentication.

Prerequisites

Before you begin, make sure the IdP is set up for SSO. You can use a proprietary or public IdP. For examples of settings for a public Okta IdP, see What Are the Typical Settings for an IdP? *(on page 91)*.

Setting Up SAML Authentication

Security Assertion Markup Language (SAML) is an XML-based open standard for exchanging authentication and authorization data between parties. To configure Turbonomic to authenticate via SAML:

1. (Required) Create external groups or at least one external user for SSO.

   > **IMPORTANT:**
   > When SSO is enabled, Turbonomic only permits logins via the SSO IdP. Whenever you navigate to your Turbonomic installation, it redirects you to the SSO Identity Provider (IdP) for authentication before displaying the Turbonomic user interface.
   >
   > Before you enable SSO for your Turbonomic installation, *you must configure at least one SSO user with Turbonomic administrator privileges*. If you do not, then once you enable SSO you will not be able to configure any SSO users in Turbonomic. To authorize an SSO user as an administrator, use **EXTERNAL AUTHENTICATION** to do one of the following:
   >
   > - Configure a single SSO user with administrator authorization.
   >
   >   Add an external user. The username must match an account that is managed by the IdP.
   > - Configure an SSO user group with administrator authorization.
   >
   >   Add an external group. The group name must match a user group on the IdP, and that group must have at least one member.
   >
   > For information about creating external groups or external users for SSO, see "Managing User Accounts" in the *Turbonomic User Guide*.

2. (Required) Ensure that chrony is configured and the system time on your Turbonomic instance is correct.

   For instructions, see Synchronizing Time *(on page 20)*.

3. Obtain the metadata from your IdP.

   You will use this metadata to configure SSO in the Turbonomic CR file located at:

   ```
   /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
   ```

   To get the metadata:

   a. Contact your security administrator to obtain the metadata from IdP.
   b. Save the metadata file in a directory on your local machine. For example, save the file to:

      ```
      /tmp/MySamlMetadata.txt
      ```

   c. Compare your metadata to the sample provided in Example of IdP Metadata *(on page 71)*.

      Cat out the file you just saved. It should be similar to the provided sample.

4. Obtain a certificate from IdP.

   Contact your security administrator to obtain a certificate from IdP.

5. Update the CR file with your SAML configuration.

   You now have the data that you need to configure SSO via SAML. You will edit the `cr.yaml` file that configures your Turbonomic node, and then deploy or restart the node.

   - Display the contents of your downloaded SAML metadata.

     For example, assuming you saved the file to this location on your local machine, execute the command:

```
cat /tmp/MySamlMetadata.txt
```

- Open the CR file for editing.

  In a shell, cd to the deploy/crds directory in the Turbonomic VM:

  ```
  cd /opt/turbonomic/kubernetes/operator/deploy/crds
  ```

  Then open the CR file for editing. For example, to open the file in VI:

  ```
  vi charts_v1alpha1_xl_cr.yaml
  ```

  As you edit this file, you will refer to the metadata that you obtained from yor IdP.
- In the CR file, navigate to the entry for the API component.

  In the CR file search for or scroll to the entry:

  ```
  apiVersion: charts.helm.k8s.io/v1alpha1
  ```

  You will make changes to this component spec, under `spec:properties:api:`
- Turn on the SAML feature.

  For the first API property, set the following:

  ```
  samlEnabled: true
  ```

- Set the SSO endpoint

  In the SAML metadata, find the entry for `md:SingleSignOnService`. Within that element, find the `Location` attribute. The value of `Location` is the SSO endpoint. Using the sample metadata we have provided, you would make the following setting in your CR file:

  ```
  samlWebSsoEndpoint: https://dev-771202.oktapreview.com/app/ibmdev771202_turbo2_1/
  exkexl6xc9MhzqiC30h7/sso/saml
  ```

- Set the SAML entity ID

  In the SAML metadata, find the entry for `md:EntityDescriptor`. Within that element, find the `entityID` attribute. Using the sample metadata we have provided, you would make the following setting in your CR file:

  ```
  samlEntityId: http://www.okta.com/exkexl6xc9MhzqiC30h7
  ```

- Set the SAML registration

  Set the following property:

  ```
  samlRegistrationId: simplesamlphp
  ```

- Set the SAML SP entity ID

  Set the following property:

  ```
  samlSpEntityId: turbo
  ```

- Enter the SAML certificate

  In the metadata that you got from your IdP, find the entry for `<ds:X509Certificate>`. Copy the contents of this tag – copy the characters that are between `<ds:X509Certificate>` and `</ds:X509Certificate>`.

  Create an entry for the certificate in the API properties section of the CR file. On a new line, enter:

```
samlIdpCertificate: |
```

Then open a new line after the entry you just created, and paste the certificate content that you copied from your metadata file.

The finished API section of the CR file should be similar to the following:

```
apiVersion: charts.helm.k8s.io/v1alpha1
kind: Xl
metadata:
  name: xl-release
spec:
  properties:
    api:
      samlEnabled: true
      samlWebSsoEndpoint: https://dev-771202.oktapreview.com/app/ibmdev771202_tur
bo2_1/exkexl6xc9MhzqiC30h7/sso/saml
      samlEntityId: http://www.okta.com/exkfdsn6oy5xywqCO0h7
      samlRegistrationId: simplesamlphp
      samlSpEntityId: turbo
      samlIdpCertificate: |
        -----BEGIN CERTIFICATE-----
        MIIDpDCCAoygAwIBAgIGAWMnhv7cMA0GCSqGSIb3DQEBCwUAMIGSMQswCQYDVQQGEwJVUzETMBEG
        A1UECAwKQ2FsaWZvcm5pYTEWMBQGA1UEBwwNU2FuIEZyYW5jaXNjbzENMAsGA1UECgwET2t0YTEU
        MBIGA1UECwwLU1NPUHJvdmlkZXIxEzARBgNVBAMMCmRldi03NzEyMDIxHDAaBgkqhkiG9w0BCQEW
        DWluZm9Ab2t0YS5jb20wHhcNMTgwNTAzMTk0MTI4WhcNMjgwNTAzMTk0MjI4WjCBkjELMAkGA1UE
        BhMCVVMxEzARBgNVBAgMCkNhbGlmb3JuaWExFjAUBgNVBAcMDVNhbiBGcmFuY2lzY28xDTALBgNV
        BAoMBE9rdGExFDASBgNVBAsMC1NTT1Byb3ZpZGVyMRMwEQYDVQQDDApkZXYtNzcxMjAyMRwwGgYJ
        KoZIhvcNAQkBFg1pbmZvQG9rdGEuY29tMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEA
        ugxQGqHAXpjVQZwsO9n8l8bFCoEevH3AZbz7568XuQm6MK6h7/O9wB4C5oUYddemt5t2Kc8GRhf3
        BDXX5MVZ8G9AUpG1MSqe1CLV2J96rMnwMIJsKeRXr01LYxv/J4kjnktpOC389wmcy2fE4RbPoJne
        P4u2b32c2/V7xsJ7UEjPPSD4i8l2QG6qsUkkx3AyNsjo89PekMfm+Iu/dFKXkdjwXZXPxaL0HrNW
        PTpzek8NS5M5rvF8yaD+eE1zS0I/HicHbPOVvLal0JZyN/f4bp0XJkxZJz6jF5DvBkwIs8/Lz5GK
        nn4XW9Cqjk3equSCJPo5o1Msj8vlLrJYVarqhwIDAQABMA0GCSqGSIb3DQEBCwUAA4IBAQC26kYe
        LgqjIkF5rvxB2QzTgcd0LVzXOuiVVTZr8Sh57l4jJqbDoIgvaQQrxRSQzD/X+hcmhuwdp9s8zPHS
        JagtUJXiypwNtrzbf6M7ltrWB9sdNrqc99d1gOVRr0Kt5pLTaLe5kkq7dRaQoOIVIJhX9wgynaAK
        HF/SL3mHUytjXggs88AAQa8JH9hEpwG2srN8EsizX6xwQ/p92hM2oLvK5CSMwTx4VBuGod70EOwp
        6Ta1uRLQh6jCCOCWRuZbbz2T3/sOX+sibC4rLIlwfyTkcUopF/bTSdWwknoRskK4dBekFcvN9N+C
        p/qaHYcQd6i2vyor888DLHDPXhSKWhpG
        -----END CERTIFICATE-----
```

6. Save your changes to the CR file.
7. Apply the modified cr.yaml file.

   Execute the command:

   ```
   kubectl apply -f /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alp
   ha1_xl_cr.yaml
   ```

8. Restart the API component to load the new spec.
   a. Open an SSH terminal session to your Turbonomic instance.
   b. Restart the API component.

      ```
      kubectl delete api
      ```

9. Verify that the configuration is successful.
   a. Navigate to the Turbonomic User Interface.

      You will be automatically redirected to your IdP for authentication.
   b. Log in with the username that is a member of the external group or external user that you previously configured.
   c. Verify that the system time on your Turbonomic instance is correct.

      If the time is not synchronized, this might cause an `HTTP Status 401 -authentication failed` exception in the browser.
   d. If the configuration is not successful, look for an `HTTP Status 500` exception in the product log. If this exception exists, review your CR file for invalid entries.

Example of IdP Metadata

This section provides an example of IdP metadata which may be useful when you are examining the optional attributes in your metadata.

If your metadata includes optional attribute tags that are not listed in the example, remove those optional attribute tags since they are not supported.

```
<?xml version="1.0" encoding="UTF-8"?>
     <md:EntityDescriptor xmlns:md="urn:oasis:names:tc:SAML:2.0:metadata"
     entityID="http://www.okta.com/exkexl6xc9MhzqiC30h7">
     <md:IDPSSODescriptor WantAuthnRequestsSigned="false"
     protocolSupportEnumeration="urn:oasis:names:tc:SAML:2.0:protocol">
     <md:KeyDescriptor use="signing">
     <ds:KeyInfo xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
     <ds:X509Data>
     <ds:X509Certificate>
     MIIDpDCCAoygAwIBAgIGAWMnhv7cMA0GCSqGSIb3DQEBCwUAMIGSMQswCQYDVQQGEwJVUzETMBEG
     A1UECAwKQ2FsaWZvcm5pYTEWMBQGA1UEBwwNU2FuIEZyYW5jaXNjbzENMAsGA1UECgwET2t0YTEU
     MBIGA1UECwwLU1NPUHJvdmlkZXIxEzARBgNVBAMMCmRldi03NzEyMDIxHDAaBgkqhkiG9w0BCQEW
     DWluZm9Ab2t0YS5jb20wHhcNMTgwNTAzMTk0MTI4WhcNMjgwNTAzMTk0MjI4WjCBkjELMAkGA1UE
     BhMCVVMxEzARBgNVBAgMCkNhbGlmb3JuaWExFjAUBgNVBAcMDVNhbiBGcmFuY2lzY28xDTALBgNV
     BAoMBE9rdGExFDASBgNVBAsMC1NTT1Byb3ZpZGVyMRMwEQYDVQQDDApkZXYtNzcxMjAyMRwwGgYJ
     KoZIhvcNAQkBFg1pbmZvQG9rdGEuY29tMIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEA
     ugxQGqHAXpjVQZwsO9n8l8bFCoEevH3AZbz7568XuQm6MK6h7/O9wB4C5oUYddemt5t2Kc8GRhf3
     BDXX5MVZ8G9AUpG1MSqe1CLV2J96rMnwMIJsKeRXr01LYxv/J4kjnktpOC389wmcy2fE4RbPoJne
     P4u2b32c2/V7xsJ7UEjPPSD4i8l2QG6qsUkkx3AyNsjo89PekMfm+Iu/dFKXkdjwXZXPxaL0HrNW
     PTpzek8NS5M5rvF8yaD+eE1zS0I/HicHbPOVvLal0JZyN/f4bp0XJkxZJz6jF5DvBkwIs8/Lz5GK
     nn4XW9Cqjk3equSCJPo5o1Msj8vlLrJYVarqhwIDAQABMA0GCSqGSIb3DQEBCwUAA4IBAQC26kYe
     LgqjIkF5rvxB2QzTgcd0LVzXOuiVVTZr8Sh57l4jJqbDoIgvaQQrxRSQzD/X+hcmhuwdp9s8zPHS
     JagtUJXiypwNtrzbf6M7ltrWB9sdNrqc99d1gOVRr0Kt5pLTaLe5kkq7dRaQoOIVIJhX9wgynaAK
     HF/SL3mHUytjXggs88AAQa8JH9hEpwG2srN8EsizX6xwQ/p92hM2oLvK5CSMwTx4VBuGod70EOwp
     6Ta1uRLQh6jCCOCWRuZbbz2T3/sOX+sibC4rLIlwfyTkcUopF/bTSdWwknoRskK4dBekFcvN9N+C
     p/qaHYcQd6i2vyor888DLHDPXhSKWhpG
     </ds:X509Certificate>
     </ds:X509Data>
     </ds:KeyInfo>
     </md:KeyDescriptor>
```

```
        <md:NameIDFormat>urn:oasis:names:tc:SAML:1.1:nameid-format:unspecified</md:Nam
eIDFormat>
        <md:NameIDFormat>urn:oasis:names:tc:SAML:1.1:nameid-format:emailAddress</md:N
ameIDFormat>
        <md:SingleSignOnService Binding="urn:oasis:names:tc:SAML:2.0:bindings:HTTP-POS
T"
        Location="https://dev-771202.oktapreview.com/app/ibmdev771202_turbo2_1/exkex
l6xc9MhzqiC30h7/sso/saml"/>
        <md:SingleSignOnService Binding="urn:oasis:names:tc:SAML:2.0:bindings:HTTP-Red
irect"
        Location="https://dev-771202.oktapreview.com/app/ibmdev771202_turbo2_1/exkex
l6xc9MhzqiC30h7/sso/saml"/>
        </md:IDPSSODescriptor>
        </md:EntityDescriptor>
```

Setting Up OpenID Authentication

According to the OpenID Foundation, "OpenID Connect 1.0 is a simple identity layer on top of the OAuth 2.0 protocol". OpenID Connect enables clients to verify user identity via a given authentication server. Turbonomic supports OpenID authentication through the following providers:

- Google
- IBM-MCM
- Okta

Logging In to Turbonomic With OpenID

When you configure OpenID in Turbonomic, the platform registers the OpenID clients that you specify. To log in through of these OpenID clients, you manually navigate to a URL that tells Turbonomic which client to use. It then redirects to the OpenID login screen for that given client.

The URL that you provide is in the form:

```
https://${hostname}/vmturbo/oauth2/authorization/${openIdClients}
```

Where:

- `${hostname}` is the host address for your installation of Turbonomic
- `${openIdClients}` is the is the client name of the OpenID provider you want to use

  You specify this as the `openIdClients` property when you configure OpenID.

For example, assume your Turbonomic host address is 10.10.12.34, and you configured an Okta OpenID client. In that case, when the Turbonomic login screen appears, you would navigate to:

```
https://10.10.12.34/vmturbo/oauth2/authorization/okta
```

After you navigate to that URL, the browser redirects to the OpenID login screen, where you can enter credentials for a single user or a user group.

NOTE:
To authenticate a user group, the group must be configured on the OpenID provider, and also on Turbonomic. The group name must be identical in both configurations.

On the OpenID provider, the client that you are using should include groups scope values that give specific names for user groups. Contact your OpenID administrator to get the group names. Then, on Turbonomic you should create user groups that use the same names.

For example, assume the OpenID ID token includes the following groups claim:

```
{
  "sub": "1234567890",
  "name": "My_User_Name",
  "iat": "12121212",
  "groups": "My_Special_User_Group"
}
```

To use the group `My_Special_User_Group` for authentication, you must create a user group in Turbonomic with the name `My_Special_User_Group`. Any members of that group will then get the role you have assigned to that user group.

Configuring OpenID on Turbonomic

To configure Turbonomic to authenticate via OpenID:

1. (Required) Ensure that chrony is configured and the system time on your Turbonomic instance is correct.

   For instructions, see Synchronizing Time *(on page 20)*.
2. Obtain the necessary data from your OpenID provider.

   Contact your security administrator to obtain the data from the provider. You will use this data to configure SSO in the Turbonomic CR file located at:

   `/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml`

   The data you need and the properties you declare in the CR file will differ depending on the OpenID provider you want to use:

   - Google:

CR Fields:	Description:
`openIdClients`	`google` The name of the OpenID client you are using to perform authentication.
`openIdClientId`	The OAuth2 Client Identifier for the OpenID client that you are using.
`openIdClientSecret`	The OAuth2 Client Secret for the OpenID client that you are using.

- IBM-MCM:

CR Fields:	Description:
`openIdClients`	`ibm` The name of the OpenID client you are using to perform authentication.
`openIdClientAuthentication`	`post` The client authentication method.
`openIdUserAuthentication`	`form` The user authentication method.
`openIdClientId`	The OAuth2 Client Identifier for the OpenID client that you are using.
`openIdClientSecret`	The OAuth2 Client Secret for the OpenID client that you are using.
`openIdAccessTokenUri`	The URI the login process will use to get an Access Token.
`openIdUserAuthorizationUri`	The URI to the Authorization Endpoint for OpenID Connect.
`openIdUserInfoUri`	The URI to the OpenID Connect UserInfo endpoint.
`openIdJwkSetUri`	The URI to get the JSON Web Key set that can verify the Access Token.

- Okta:

CR Fields:	Description:
`openIdClients`	`okta` The name of the OpenID client you are using to perform authentication.
`openIdClientId`	The OAuth2 Client Identifier for the OpenID client that you are using.
`openIdClientSecret`	The OAuth2 Client Secret for the OpenID client that you are using.
`openIdAccessTokenUri`	The URI the login process will use to get an Access Token.
`openIdUserAuthorizationUri`	The URI to the Authorization Endpoint for OpenID Connect.
`openIdUserInfoUri`	The URI to the OpenID Connect UserInfo endpoint.
`openIdJwkSetUri`	The URI to get the JSON Web Key set that can verify the Access Token.

3. Update the Turbonomic CR file with your configuration data.

   You now have the data that you need to configure SSO via OpenID. You will edit the `cr.yaml` file that configures your Turbonomic node, and then deploy or restart the node.

   - Open the CR file for editing.

     In a shell, cd to the deploy/crds directory in the Turbonomic VM:

     ```
     cd /opt/turbonomic/kubernetes/operator/deploy/crds
     ```

     Then open the CR file for editing. For example, to open the file in VI:

```
vi charts_v1alpha1_xl_cr.yaml
```

As you edit this file, you will refer to the dat that you obtained from your authentication provider.

- In the CR file, navigate to the entry for the API component.

  In the CR file search for or scroll to the entry:

  ```
  apiVersion: charts.helm.k8s.io/v1alpha1
  ```

  You will make changes to this component spec, under `spec:properties:api:`
- Turn on the OpenID feature.

  For the first API property, set the following:

  ```
  openIdEnabled: true
  ```

  The file should be similar to:

  ```
  apiVersion: charts.helm.k8s.io/v1alpha1
  kind: Xl
  metadata:
    name: xl-release
  spec:
    properties:
      api:
        openIdEnabled: true
  ```

- Enter the relevant OpenId data for your authentication provider. The CR file should be similar to these examples, depending on which provider you use:
  - Google:

    The file should be similar to:

    ```
    apiVersion: charts.helm.k8s.io/v1alpha1
    kind: Xl
    metadata:
      name: xl-release
    spec:
      properties:
        api:
          openIdEnabled: true
          openIdClients: google
          openIdClientId: xxxx-4vinrdgllag5p84jjebc6xxxxxx5u.apps.googleusercon
    tent.com
          openIdClientSecret: xxxxxhGcdFEjQa-xxxxxxxx
    ```

  - IBM-MCM:

    The file should be similar to:

    ```
    apiVersion: charts.helm.k8s.io/v1alpha1
    kind: Xl
    metadata:
      name: xl-release
    spec:
    ```

```
  properties:
    api:
      openIdEnabled: true
      openIdClients: ibm
      openIdClientAuthentication: post
      openIdUserAuthentication: form
      openIdClientId: turbonomic-mcm-demo
      openIdClientSecret: "xxxxxxvZ2ZscDhtOFVxxxxxxU3d6cXR4cTZhb2xxxxxxRT0K"
      openIdAccessTokenUri: https://icp-console.apps.blue-13.dev.multicloudo
ps.io/idprovider/v1/auth/token
      openIdUserAuthorizationUri: https://icp-console.apps.blue-13.dev.multi
cloudops.io/idprovider/v1/auth/authorize
      openIdUserInfoUri: https://icp-console.apps.blue-13.dev.multicloudo
ps.io/v1/auth/userInfo
      openIdJwkSetUri: https://icp-console.apps.blue-13.dev.multicloudops.io/
oidc/endpoint/OP/jwk
```

- Okta

  The file should be similar to:

```
apiVersion: charts.helm.k8s.io/v1alpha1
kind: Xl
metadata:
  name: xl-release
spec:
  properties:
    api:
      openIdEnabled: true
      openIdClients: okta
      openIdClientId: xxxxxxxxxh1xhQnSKxxxx
      openIdClientSecret: xxxxxxxxxxtIhVCIRUnhq4xxxxxxxDdhLdqx0
      openIdAccessTokenUri: https://vmturbo.okta.com/oauth2/v1/token
      openIdUserAuthorizationUri: https://vmturbo.okta.com/oauth2/v1/authori
ze
      openIdUserInfoUri: https://vmturbo.okta.com/oauth2/v1/userinfo
      openIdJwkSetUri: https://vmturbo.okta.com/oauth2/v1/keys
```

4. Save your changes to the CR file.
5. Apply the modified cr.yaml file.

   Execute the command:

```
kubectl apply -f /opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alp
ha1_xl_cr.yaml
```

6. Restart the API component to load the new spec.
   a. Open an SSH terminal session to your Turbonomic instance.
   b. Restart the API component.

```
kubectl delete api
```

7. Verify that the configuration is successful.
   a. Navigate to the Turbonomic User Interface.

You will be automatically redirected to your authentication provider for authentication.

b. Log in with the username that is a member of the external group or external user that you previously configured.

c. Verify that the system time on your Turbonomic instance is correct.

   If the time is not synchronized, this might cause an `HTTP Status 401 -authentication failed` exception in the browser.

d. If the configuration is not successful, look for an `HTTP Status 500` exception in the product log. If this exception exists, review your CR file for invalid entries.

Disabling Single Sign-On

If for some reason you no longer want to use SSO, you can disable it for your Turbonomic installation. To disable Single Sign-On, perform these steps:

1. Update the SSO configuration to disable it.

   a. Open an SSH terminal session to your Turbonomic instance.

   b. Open the CR file for editing.

      In a shell, cd to the deploy/crds directory in the Turbonomic VM:

      ```
      cd /opt/turbonomic/kubernetes/operator/deploy/crds
      ```

      Then open the CR file for editing. For example, to open the file in VI:

      ```
      vi charts_v1alpha1_xl_cr.yaml
      ```

   c. In the CR file, navigate to the entry for the API component.

      In the CR file search for or scroll to the entry:

      ```
      apiVersion: charts.helm.k8s.io/v1alpha1
      ```

      You will make changes to this component spec, under `spec:properties:api:`

   d. Turn off the SSO feature.

      The entry to set to fals is different depending on whether you use SAML or OpenID authentication:

      - SAML Authentication:

        Find the `samlEnabled:` property to `false`. It should appear as follows:

        ```
        samlEnabled: false
        ```

      - OpenID Authentication:

        Find the `openIdEnabled:` property to `false`. It should appear as follows:

        ```
        openIdEnabled: false
        ```

   e. Save your changes to the CR file.

2. Restart the API component.

In the same SSH terminal session that you opened to edit the CR file:

a. Use sudo as root.

```
sudo bash
```

b. Restart your API component.

```
kubectl delete api
```

3. Verify that the configuration is successful.

a. Navigate to the Turbonomic User Interface.

You will no longer be redirected to your IdP for authentication. You will be redirected to the default Turbonomic login screen.

b. Log in with a local account or an Active Directory (AD) account.

Updating Turbonomic to a New Version

> **NOTE:**
> If you are updating from Turbonomic version 7.21.x, or 7.17.x, please contact your Technical Support representative.

Turbonomic continually and rapidly innovates and improves all aspects of this product. This means that Turbonomic periodically releases newer versions of this product. You should check regularly to see if a new version is available.

When a new version is available, it is important to properly update your existing installed instance, rather than just install new VM image for the latest version. When you first installed Turbonomic, you put into place sophisticated data collection and analysis processes. Internal to the installation is an integrated database that retains performance data from across your virtual environment. Turbonomic uses this historical data for right-sizing, projecting trends, and other analysis. This means that the database is important to Turbonomic *and becomes more so over time*. Properly updating your installation of Turbonomic preserves the database for continued use.

Before you begin the update procedure:

- Make sure you have the email that Turbonomic sent to you with links to the Turbonomic 0VA file and to the ISO image.
- For on-prem installations, make sure that the physical machine hosting the VM meets the minimum requirements (see Minimum Requirements *(on page 6)*).
- Ensure you are running the correct version of the historical database.

  For its default historical database, Turbonomic currently supports MariaDB version 10.5.12. This support includes comprehensive testing and quality control for Turbonomic usage of the historical database.

  For more information, see Verifying your MariaDB Version. *(on page 22)*
- Execute the `upgrade-precheck.sh` script.

  You can use this script to make sure that your current installation of Turbonomic is ready to update. We strongly recomend that you run this script before going on to update your installation (see Checking Before Updating *(on page 80)*).

You can update your Turbonomic VM using either of the following methods:

- Online method, if you have access to the internet:

  See Online Update *(on page 84)*
- Offline method, via a downloaded ISO image:

  See Offline Update *(on page 88)*

Checking Before Updating

Before you perform an update of your Turbonomic instance, you should execute the script, `upgrade-precheck.sh`. This script inspects your installation to check for the following:

- Sufficient free disk space
- For online updates, access to required endpoints (index.docker.to, github.com, etc.)
- The MariaDB service is running

  Note that this check is for the default installation of the MariaDB service, only. For example, the script does not check an external installation of MySQL or MariaDB, if that is the historical database you have configured. In that case, the script will indicate that your MariaDB service is not running. For an external database deployment, this is a normal result.
- The Kubernetes service is running
- The necessary Kubernetes certificates are valid

  If the certificates are not valid, you can run the `kubeNodeCertUpdate.sh` script to correct the issue. This script should be located on your installation at `/opt/local/bin`. For more information, contact your support representative.
- Root password is not set to expire
- Time sync is enabled, and current if running
- All Turbonomic pods are running

To execute this script:

1. Download the latest version of the script.
   a. Log in to the Turbonomic VM.

      Use SSH to log in to the Turbonomic VM using the turbo account and password.
   b. Change to the scripts directory.

      ```
      cd /opt/local/bin
      ```
   c. Get the latest version of the script.

      ```
      curl -O --proxy PROXY_NAME_IP:PORT \
      https://\
      raw.githubusercontent.com/turbonomic/t8c-install/master/bin/upgrade-precheck.sh
      ```

      Where `--proxy PROXY_NAME_IP:PORT` is an optional specification to execute the download through a proxy.
   d. Save the script to the location:

      ```
      /opt/local/bin/upgrade-precheck.sh
      ```
   e. Make the script executable.

      ```
      chmod +x upgrade-precheck.sh
      ```
2. Execute the script.

   ```
   ./upgrade-precheck.sh
   ```

   As the script executes, it identifies any issues that you should address before you execute an update.

External DBs and Turbonomic Updates

If you have deployed Turbonomic with an external database server, for some updates you might need to manually create a new database and user for that deployment. This is important if your external database server is multi-tenant, or if your deployment does not grant administrative privileges to Turbonomic.

> **NOTE:**
> *If your external database server is multi-tenant, or if your database server does not grant administrative privileges to Turbonomic, then you must continue with this configuration requirement*.
>
> Azure database services are multi-tenant. If you deployed an external database on Azure, this configuration requirement applies to you.
>
> If you deployed your database server in a way that grants Turbonomic privileges to create new databases and new users, then a product update will automatically create the required database. This configuration requirement does not apply to you and you do not need to take any action.

For some Turbonomic updates, the updated version includes new databases on the historical database server. If you are updating to one of these versions, then you must *first* create the new database, and a user account with privileges to access that database.

This table lists the Turbonomic versions that require new databases. If you are updating from a version earlier than one of these, you must create the indicated new databases. For example, if you are updating from version 8.0.0 to 8.2.0, then you must create the `repository` database and the `market` database.

Turbonomic Version:	New Databases:	Notes:
8.2.5	`api`	If you are updating from a version earlier than 8.2.5, you must create a new database named `api`, and a user account named `api`.
8.1.1	`market`	If you are updating from a version earlier than 8.1.1, you must create a new database named `market`, and a user account named `market`.
8.0.1	`repository`	If you are updating from a version earlier than 8.0.1, you must create a database named `repository`, and a user account named `repository`.

> **NOTE:**
> If you have already updated to one of these versions of Turbonomic, and you did not perform the steps to update your external DB, please contact your support representative.

To create the databases and users, you will:

- Manually create each required database

  This includes creating the database in your DB instance, creating a user to access the database, and granting privileges to the user.

- Manually add the each required database to your cr.yaml file

  The cr.yaml file declares entries for each component database. Each entry names the component, and gives the user and password that the component can use to access that database. You must add a new entry for each new database.

To create a new database:

1. Connect to your external DB using a global account.

   The account must have privileges to create databases and users. If you have specified `dbRootUsername` in the cr.yaml file, you can use that account.
2. Create the database, where **<New_Database>** matches the database name in the table above:

   ```
   create database <New_Database>;
   ```

   For example, to create a new `api` database, execute:

   ```
   create database api;
   ```
3. Create the account that Turbonomic will use to access the database where **<New_Database>** matches the database name in the table above:

   ```
   create user '<New_Database>'@'%' identified by 'vmturbo';
   ```

   For example, to create a user for the `api` database, execute:

   ```
   create user 'api'@'%' identified by 'vmturbo';
   ```

   > **NOTE:**
   > The value **vmturbo** is the default password that Turbonomic uses for all component database accounts. If you have manually created accounts with different credentials, you can do so for this database as well.
4. Set the user account privileges for the new user account, where **<New_Database>** matches the database name in the table above:

   ```
   GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, REFERENCES, INDEX, ALTER, CREAT
   E TEMPORARY TABLES, LOCK TABLES, EXECUTE, CREATE VIEW, SHOW VIEW, CREATE ROUTINE, A
   LTER ROUTINE, EVENT, TRIGGER ON <New_Database>.* TO '<New_Database>'@'%';
   ```

   For example, to set account privileges for the `api` user, execute:

   ```
   GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, REFERENCES, INDEX, ALTER, CREAT
   E TEMPORARY TABLES, LOCK TABLES, EXECUTE, CREATE VIEW, SHOW VIEW, CREATE ROUTINE, A
   LTER ROUTINE, EVENT, TRIGGER ON api.* TO 'api'@'%';
   ```
5. Flush privileges to make the privileges take effect:

   ```
   flush privileges;
   ```

Now that the new database is created in your external DB service, you must declare access to it the Turbonomic cr.yaml resource.

1. Open the .cr file for editing. The location of the file depends on the type of Turbonomic installation you are configuring.

VM Image installation of Turbonomic:	Turbonomic on a Kubernetes node or node cluster:
Open a SSH terminal session on your Turbonomic instance Log in with the System Administrator that you set up when you installed Turbonomic: • Username: `turbo` • Password: `[your_private_password]` Then edit the file: `/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml`	Open the following file for editing: `deploy/crds/charts_v1alpha1_xl_cr.yaml`

2. Add the credentials for the matching pod to access the new database.

   Add the entry to the `properties:` section of the cr.yaml file, where **`vmturbo`** is the password that you assigned to that user account, **`yourDB`** is the qualified name of your external DB or your multi-tenant DB partition, and **`<New_Database>`** is the name of your new database. Declare the following in the entry you add:

   ```
   <New_Database>:
     <New_Database>DbUsername: <New_Database>@yourDB
     <New_Database>DbPassword: vmturbo
   ```

   For example, if you added the `api` database, the resulting cr.yaml file should be similar to:

   ```
   properties:
       global:
         enableSecureDBConnection: true
         sqlDialect: MYSQL
         dbRootPassword: yourAdminPassword
         dbRootUsername: xladmin@yourDB
         #dbUserPassword:
         #dbUsername:
       action-orchestrator:
         actionDbUsername: action@yourDB
         actionDbPassword: yourPassword
       auth:
         authDbUsername: auth@yourDB
         authDbPassword: yourPassword
       clustermgr:
         clustermgrDbUsername: clustermgr@yourDB
         clustermgrDbPassword: yourPassword
       cost:
         costDbUsername: cost@yourDB
         costDbPassword: yourPassword
       group:
         groupComponentDbUsername: group_component@yourDB
         groupComponentDbPassword: yourPassword
   ```

```
history:
  historyDbUsername: history@yourDB
  historyDbPassword: yourPassword
plan-orchestrator:
  planDbUsername: plan@yourDB
  planDbPassword: yourPassword
topology-processor:
  topologyProcessorDbUsername: topology_processor@yourDB
  topologyProcessorDbPassword: yourPassword
repository:
  repositoryDbUsername: repository@yourDB
  repositoryDbPassword: yourPassword
market:
  marketDbUsername: market@yourDB
  marketDbPassword: yourPassword
api:
  apiDbUsername: api@yourDB
  apiDbPassword: yourPassword
```

After you have done this, you can update to the latest version of Turbonomic. (Note that upgrading applies changes to the version information in this file.)

Online Update

Online updates assume that you have direct access to the Internet or access to the Internet through a proxy server.

Connection Requirements

If you are installing from behind a firewall, make sure you have full access to the Docker Hub services that deliver the Turbonomic components. Addressing for these services can be different depending on details of your current environment. Note that Turbonomic has no control over these endpoints. As of this writing, we can say you need access to the following:

- `https://index.docker.io`
- `https://auth.docker.io`
- `https://registry-1.docker.io`
- `https://production.cloudflare.docker.com`
- `https://raw.githubusercontent.com`
- `https://github.com`
- `https://download.vmturbo.com`
- `https://yum.mariadb.org`
- `https://packagecloud.io`

- `https://download.postgresql.org`
- `https://yum.postgresql.org`

If your environment supports access through a proxy, you can set up the Docker daemon to use that proxy via the `HTTP_PROXY`, `HTTPS_PROXY`, and `NO_PROXY` environment variables. Create the file:

```
/etc/systemd/system/docker.service.d/http-proxy.conf
```

Configure the proxies in the `[Service]` section of the file, where `NO_PROXY` specifies hosts to exclude from proxying:

```
[Service]
Environment="HTTP_PROXY=http://proxy.example.com:80"
Environment="HTTPS_PROXY=https://proxy.example.com:443"
Environment="NO_PROXY=localhost,127.0.0.1,docker-registry.example.com,.corp"
```

Then reload the daemon and restart Docker:

```
sudo systemctl daemon-reload
sudo systemctl restart docker
```

For more information, see the Docker documentation at https://docs.docker.com/config/daemon/systemd/

If none of these options work, then you should perform an offline update.

Performing an Online Update

To perform an online update of your Turbonomic installation:

1. Download the current update script.

   You must download the update script that matches the version you are updating to.

   > **NOTE:**
   > Scripted online updates support updates to version 8.0.6 or later.

   a. Log in to the Turbonomic VM.

      Use SSH to log in to the Turbonomic VM using the turbo account and password.

   b. Change to the scripts directory.

      ```
      cd /opt/local/bin
      ```

   c. Get the script for your update version.

      ```
      curl -O --proxy PROXY_NAME_IP:PORT \
      https://download.vmturbo.com/appliance/download/updates/{VNUM}/onlineUpgrade.sh
      ```

      Where:

      - `--proxy PROXY_NAME_IP:PORT` is an optional specification to execute the download through a proxy.
      - **`{VNUM}`** is the version you are updating to. The version must be 8.0.6 or later.

   d. Save the script to the location:

      ```
      /opt/local/bin/onlineUpgrade.sh
      ```

e. Make the script executable.

```
chmod +x onlineUpgrade.sh
```

2. Save a snapshot of your current Turbonomic VM.

   Before updating, you should properly shut down (not power off) the Turbonomic VM. To do so, type:

   ```
   sudo init 0
   ```

   Then, perform a snapshot (or clone the VM). This provides a reliable restore point you can turn to in the event that trouble occurs during the update. After you have the snapshot, bring the VM back online.

3. Optionally, enable new probes in your environment.

   > **NOTE:**
   > As Turbonomic evolves, the set of delivered probes can change. Also, from one version to the next, the set of probes that are enabled by default can change. However, when you update to a new version, the update does not change your probe configuration. An update to a newer version does not automatically enable any new probes in your deployment. If you want to take advantage of new probes in an update, then you must enable them manually.

   For steps to enable new probes in your updated version, see Enabling and Disabling Probe Components *(on page 63)*. Use these steps to edit the platform's cr.yaml file, but *do not* apply those changes yet, via `kubectl`.

4. Start the online update.

   Execute the update script:

   - If you are not already in the `/opt/local/bin` directory:

     ```
     cd /opt/local/bin
     ```

   - Execute the update script:

     ```
     ./onlineUpgrade.sh {Update_Version}
     ```

     Where **`{Update_Version}`** is the version you are updating to.

     > **NOTE:**
     > Be sure that you give the version that you are updating to, and be sure that it matches the version of the update script that you downloaded.
     >
     > Also, you cannot use this script to move to an earlier version.

   - Wait until the script completes its execution.

5. Verify that the Turbonomic application installed correctly.

   To verify the installation of the application, execute the command:

   ```
   kubectl get pods -n turbonomic
   ```

   After all of the pods start up, the READY column should read `1/1` and the STATUS column should read `Running` for each pod.

NOTE:
Under rare circumstances the downloads from DockerHub can fail. This occurs when the limit on image downloads has been exceeded. As a result, one or more pods can show `ImagePullBackOff` as the pod STATUS.

If you encounter this STATUS, you can wait until the limitation period expires. At that time, the download of pods will continue, and the platform should start up normally.

As an alternative, you can register your own DockerHub account in the CR file, and apply those changes:

- Edit the registry in the cr.yaml file:

```
registry: index.docker.io
    imageUsername: Your_Username
    imagePassword: Your_User_Password
```

- Execute the kubectl apply command:

```
kubectl apply -f \
/opt/turbonomic/kubernetes/operator/deploy/crds/charts_v1alpha1_xl_cr.yaml
```

- Verify that the application installed correctly:

```
kubectl get pods -n turbonomic
```

6. Verify that you are running the correct version of MariaDB.

   For this version of the product, Turbonomic supports MariaDB, version 10.5.12. Even after updating to this Turbonomic version, it is possible that your installation is running an earlier version of MariaDB.

   While still in the SSH session, check the MariaDB version:

```
mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'version';"
```

   The output should be similar to:

```
+---------------+-----------------+
| Variable_name | Value           |
+---------------+-----------------+
| version       | 10.5.12-MariaDB |
+---------------+-----------------+
```

   If the MariaDB version is earlier than 10.5.12, you should update your MariaDB. For complete instructions and information, see Verifying your MariaDB Version *(on page 22)*.

7. Clear your browser data and refresh your browser.

   After clearing the browser data and refreshing your browser, you have full access to Turbonomic features. However, features that rely on current analysis data will not be available until after a full market cycle — usually 10 minutes. For example, the Pending Actions charts will not show any actions until after a full market cycle.

8. Notify other users to clear their browser data and refresh their Turbonomic browser sessions.

Offline Update

To perform an offline update of your Turbonomic installation:

1. Save a snapshot of your current Turbonomic VM.

   Before updating, you should properly shut down (not power off) the Turbonomic VM. To do so, type:

   ```
   sudo init 0
   ```

   Then, perform a snapshot (or clone the VM). This provides a reliable restore point you can turn to in the event that trouble occurs during the update. After you have the snapshot, bring the VM back online.
2. Download and mount the ISO image.

   Refer to the email you received from Turbonomic for links to the Turbonomic 0VA file and to the ISO image.

   Download the ISO image to a loaction that is available to the VM that runs Turbonomic. Then mount the image as a CD drive.

   For example, if you run the Turbonomic VM in vCenter Server:

   a. In vCenter, navigate to the Turbonomic VM.
   b. Right-click the VM and choose **Edit Settings**.
   c. In the CD/DVD Drive drop-down menu:
      i. Choose **Datastore ISO**.
      ii. Browse to the Turbonomic update ISO image and choose it.
   d. Ensure that the **Connect at power on** checkbox is selected.
3. Open an SSH terminal session to your Turbonomic instance.

   After you have made a snapshot or clone of your current Turbonomic VM, open an SSH session. Log in with the System Administrator that you set up when you installed Turbonomic:

   - Username: `turbo`
   - Username: `[your_private_password]`
4. Get the script for your update version.

   On your local machine, navigate to where you want to download the script. Then execute the command:

   ```
   curl -O --proxy PROXY_NAME_IP:PORT \
            https://download.vmturbo.com/appliance/download/updates/{VNUM}/isoUpda
   te.sh
   ```

   Where:

   - `--proxy PROXY_NAME_IP:PORT` is an optional specification to execute the download through a proxy.
   - **`{VNUM}`** is the version you are updating to. The version must be 8.2.5 or later.
5. Upload th script to your Turbonomic instance.

   Execute a file transfer from your local machine to the Turbonomic server. Save the script to `/opt/local/bin/` on the VM that runs Turbonomic.
6. Make the script executable.

   ```
   chmod +x /opt/local/bin/isoUpdate.sh
   ```

7. Execute the offline installation.

```
/opt/local/bin/isoUpdate.sh
```

As the script executes, it:

- Backs up the old scripts in your installation
- Updates the configuration and code assets in your installation
- Updates the platform to the new version
- Updates custom resources
- Updates the MariaDB configuration
- If you have enabled Embedded Reports or Data Export, installs the Embedded Reports and Data Export database (Postgres and TimescaleDB)
- Scales down the t8c-operator and the Turbonomic components
- Executes the final updates for this version
- Scales up the t8c-operator, which then restarts the Turbonomic components

8. Verify that the Turbonomic application installed correctly.

After the script is finished updating your platform, you should give it enough time for all the components to start up again.

To verify the installation of the application, execute the command:

```
kubectl get pods -n turbonomic
```

After all of the pods start up, the READY column should read `1/1` and the STATUS column should read `Running` for each pod.

You should see output similar to the following:

```
NAME                                          READY   STATUS    RESTARTS
action-orchestrator-b6454c9c8-mfl85           1/1     Running   0
api-7887c66f4b-shndq                          1/1     Running   0
arangodb-7f646fc5fc-zhcwf                     1/1     Running   0
auth-5b86976bc8-vxwz4                         1/1     Running   0
clustermgr-85548678d9-r5wb8                   1/1     Running   0
consul-7f684d8cb8-6r677                       1/1     Running   0
cost-5f46dd66c4-6d6cb                         1/1     Running   0
extractor-5f41dd61c4-4d6lq                    1/1     Running   0
group-5bfdfbc6f8-96bsp                        1/1     Running   0
history-5fc7fbc855-6zslq                      1/1     Running   0
kafka-74cc77db94-dfrbl                        1/1     Running   0
market-5f54699447-z4wkm                       1/1     Running   0
mediation-actionscript-57b4fc6df-4lzfv        1/1     Running   0
mediation-appdynamics-6d65f8766f-kb44l        1/1     Running   0
mediation-hpe3par-d7c475c4c-v8ftc             1/1     Running   0
mediation-hyperv-6bd8c94df5-4dbzx             1/1     Running   0
mediation-netapp-7f8fc955d9-4kkdl             1/1     Running   0
mediation-oneview-7dbd7b54cf-7rfqp            1/1     Running   0
mediation-pure-58c4bd8cd9-8n256               1/1     Running   0
mediation-ucs-6f4bb9889-9rnqk                 1/1     Running   0
mediation-vcenter-5bc4f5fbd4-nzm4j            1/1     Running   0
mediation-vcenterbrowsing-5c5987f66c-bfjq4    1/1     Running   0
mediation-vmax-6c59969b89-28t9j               1/1     Running   0
mediation-vmm-9c4878cf9-rfxnl                 1/1     Running   0
nginx-5b775f498-sm2mm                         1/1     Running   0
```

```
plan-orchestrator-6dffc4c9b6-p5t5n          1/1     Running   0
reporting-b44fbdfb4-8fjv5                   1/1     Running   0
repository-6d555bb4bf-fxldh                 1/1     Running   0
rsyslog-fd694878c-5tb2c                     1/1     Running   0
t8c-operator-558bcc758d-5h8mp               1/1     Running   0
topology-processor-b646b786b-9skp7          1/1     Running   0
zookeeper-5f65b5bf69-nnmbt                  1/1     Running   0
```

9. Clear your browser data and refresh your browser.

   After clearing the browser data and refreshing your browser, you have full access to Turbonomic features. However, features that rely on current analysis data will not be available until after a full market cycle — usually 10 minutes. For example, the Pending Actions charts will not show any actions until after a full market cycle.

10. Optionally, enable new probes in your environment.

> **NOTE:**
> As Turbonomic evolves, the set of delivered probes can change. Also, from one version to the next, the set of probes that are enabled by default can change. However, when you update to a new version, the update does not change your probe configuration. An update to a newer version does not automatically enable any new probes in your deployment. If you want to take advantage of new probes in an update, then you must enable them manually.

   For steps to enable new probes in your updated version, see Enabling and Disabling Probe Components *(on page 63)*. Use these steps to edit the platform's cr.yaml file, but *do not* apply those changes yet, via `kubectl`.

11. Notify other users to clear their browser data and refresh their Turbonomic browser sessions.

Appendix: What Are the Typical Settings for an IdP?

Before you begin configuring Single Sign-On (SSO), you need to make sure the IdP is set up for SSO.

Here are typical settings for a public Okta IdP which may be useful when you set up your IdP.

SAML Settings: GENERAL	
Setting	**Example**
Single Sign On URL (where **<hostname>** is the host that Turbonomic runs on, and **<samlRegistrationID>** is the Registration ID that you got from your SSO provider)	`https://<hostname>/vmturbo/saml2/sso/<samlRegistrationID>`
Recipient URL (where **<hostname>** is the host that Turbonomic runs on, and **<samlRegistrationID>** is the Registration ID that you got from your SSO provider)	`https://<hostname>/vmturbo/saml2/sso/<samlRegistrationID>`
Destination URL (where **<hostname>** is the host that Turbonomic runs on, and **<samlRegistrationID>** is the Registration ID that you got from your SSO provider)	`https://<hostname>/vmturbo/saml2/sso/<samlRegistrationID>`
Audience Restriction	`urn:test:turbo:markharm`
Default Relay State	
Name ID Format	`Unspecified`
Application username	The username for the account that is managed by Okta
Response	`Signed`

SAML Settings: GENERAL	
Setting	**Example**
Assertion Signature	`Signed`
Signature Algorithm	`RSA_SHA256`
Digital Algorithm	`SHA256`
Assertion Encryption	`Unencrypted`
SAML Single Logout	`Enabled`
Single Logout URL (where **<hostname>** is the host that Turbonomic runs on)	`https://<hostname>/vmturbo/rest/logout`
SP Issuer	`turbo`
Signature Certificate	`Example.cer (CN=apollo)`
authnContextClassRef	`PasswordProtectedTransport`
Honor Force Authentication	`Yes`
SAML Issuer ID	`http://www.okta.com/$(org.externalKey)`

SAML Settings: GROUP ATTRIBUTE STATEMENTS		
Name	**Name Format**	**Filter**
`group`	`Unspecified`	`Matches regex:.*admin.*.`

Appendix: Step-wise Platform Deployment

After you have installed the Turbonomic VM that will host the platform, you can install the platform components, as follows:

1. Optionally, configure Single Sign-On Authentication (SSO) for this installation.

   If you plan to use SSO to authenticate your Turbonomic users, you can configure it now. To configure SSO you will edit the `charts_v1alpha1_xl_cr.yaml` file. You can edit it now, before you complete the installation, or you can edit it later and restart the affected components. For more information, see Single Sign-On Authentication *(on page 67)*.

2. Deploy Turbonomic Kubernetes nodes.

   When you deploy Turbonomic on Kubernetes, you deploy one Kubernetes node as a VM that will host pods to run the Turbonomic components. The script to deploy and initialize the Kubernetes node also deploys the Kubernetes pods that make up the Turbonomic application.

   Start a secure session (SSH) on your Turbonomic VM as the turbo user and perform the following steps:

   a. Initialize the Kubernetes node and deploy the pods.

      Execute the script: `/opt/local/bin/t8c.sh`

      Do not specify `sudo` when you execute this script.

      The script should take up to 20 minutes to complete.

      > **NOTE:**
      > You can specify the host name for the Turbonomic deployment.
      >
      > By default, the Turbonomic platform deploys to a host named `node1`. To specify a different host name, execute the script with the `-h` flag as follows:
      >
      > `/opt/local/bin/t8c.sh -h <MyHostName>`
      >
      > Where `<MyHostName>` is the host name that you want.

   b. Verify that the the deployment succeeded.

      At the end of the script output, in the summary section, verify that no errors are reported. If any errors are reported, contact Turbonomic Support.

   c. Verify that the Turbonomic application installed correctly.

To verify the installation of the application, execute the command:

```
kubectl get pods -n turbonomic
```

After all of the pods start up, the READY column should read `1/1` and the STATUS column should read `Running` for each pod.

You should see output similar to the following:

```
NAME                                          READY   STATUS    RESTARTS
action-orchestrator-b6454c9c8-mfl85           1/1     Running   0
api-7887c66f4b-shndq                          1/1     Running   0
arangodb-7f646fc5fc-zhcwf                     1/1     Running   0
auth-5b86976bc8-vxwz4                         1/1     Running   0
clustermgr-85548678d9-r5wb8                   1/1     Running   0
consul-7f684d8cb8-6r677                       1/1     Running   0
cost-5f46dd66c4-6d6cb                         1/1     Running   0
extractor-5f41dd61c4-4d6lq                    1/1     Running   0
group-5bfdfbc6f8-96bsp                        1/1     Running   0
history-5fc7fbc855-6zslq                      1/1     Running   0
kafka-74cc77db94-dfrbl                        1/1     Running   0
market-5f54699447-z4wkm                       1/1     Running   0
mediation-actionscript-57b4fc6df-4lzfv        1/1     Running   0
mediation-appdynamics-6d65f8766f-kb44l        1/1     Running   0
mediation-hpe3par-d7c475c4c-v8ftc             1/1     Running   0
mediation-hyperv-6bd8c94df5-4dbzx             1/1     Running   0
mediation-netapp-7f8fc955d9-4kkdl             1/1     Running   0
mediation-oneview-7dbd7b54cf-7rfqp            1/1     Running   0
mediation-pure-58c4bd8cd9-8n256               1/1     Running   0
mediation-ucs-6f4bb9889-9rnqk                 1/1     Running   0
mediation-vcenter-5bc4f5fbd4-nzm4j            1/1     Running   0
mediation-vcenterbrowsing-5c5987f66c-bfjq4    1/1     Running   0
mediation-vmax-6c59969b89-28t9j               1/1     Running   0
mediation-vmm-9c4878cf9-rfxnl                 1/1     Running   0
nginx-5b775f498-sm2mm                         1/1     Running   0
plan-orchestrator-6dffc4c9b6-p5t5n            1/1     Running   0
reporting-b44fbdfb4-8fjv5                     1/1     Running   0
repository-6d555bb4bf-fxldh                   1/1     Running   0
rsyslog-fd694878c-5tb2c                       1/1     Running   0
t8c-operator-558bcc758d-5h8mp                 1/1     Running   0
topology-processor-b646b786b-9skp7            1/1     Running   0
zookeeper-5f65b5bf69-nnmbt                    1/1     Running   0
```

d. Synchronize the system clock.

To ensure correct display of data, and to support Single Sign-On (SSO) authentication, you need to synchronize the system clock.

For information, see Synchronizing Time *(on page 20)* and Single Sign-On Authentication *(on page 67)*.

e. Verify that the Load Balancer has installed correctly.

To verify the presence of the Load Balancer, execute the command:

```
kubectl get services -n turbonomic | grep LoadBalancer
```

You should see output similar to the following:

```
nginx   LoadBalancer   10.10.10.10   10.10.10.11   443:32669/TCP,80:32716/TCP   17h
```

f. Configure mediation.

The installation script automatically enables a default set of mediation probes. After installation completes, you can change the set of enabled mediation probes (see Enabling and Disabling Probe Components *(on page 63)*).

For Turbonomic to manage your IT environment, it must attach to targets in your environment so it can perform discovery and execute actions. The combination of the processes of discovery and action execution is *mediation*. This release of Turbonomic supports mediation through the following targets. If you need to use additional targets that are not in this list, contact Turbonomic Support.

- Applications and Databases
  - Apache Tomcat 7.x, 8.x, and 8.5.x
  - AppDynamics 4.1+
  - AppInsights
  - Dynatrace 1.1+
  - IBM WebSphere Application Server 8.5+
  - Instana
  - JBoss Application Server 6.3+
  - JVM 6.0+
  - Microsoft SQL Server 2012, 2014, 2016, 2017, and 2019
  - MySQL 5.6.x and 5.7.x
  - NewRelic
  - Oracle 11g R2 and 12c
  - Oracle WebLogic 12c
- Cloud Native
  - Kubernetes
  - OpenShift 3.3+
- Fabric and Network
  - Cisco UCS Manager 3.1+
  - HPE OneView 3.00.04+
- Guest OS Processes
  - SNMP
  - WMI: Windows versions 2019, 2016, 2012 / 2012 R2, 2008 R2, 10, 8 / 8.1, and 7
- Hyperconverged
  - Nutanix Community Edition
  - VMware vSAN
- Hypervisors
  - Citrix XenServer 5.6.x and 6.x
  - Microsoft Hyper-V 2008 R2, Hyper-V 2012/2012 R2, Hyper-v 2016, Hyper-v 2019
  - VMware vCenter 6.0, 6.5, 6.7, and 7.0+

- Orchestrator
  - Action Script
  - ServiceNow
- Private Cloud
  - Microsoft System Center 2012/2012 R2 Virtual Machine Manager and System Center 2016 Virtual Machine Manager
- Public Cloud
  - Amazon AWS
  - Amazon AWS Billing
  - Google Cloud Platform (GCP)
  - Google Cloud Platform (GCP) Billing
  - Microsoft Azure Service Principal
  - Microsoft Enterprise Agreement
- Storage
  - EMC ScaleIO 2.x and 3.x
  - EMC VMAX using SMI-S 8.1+
  - EMC VPLEX Local Architecture with 1:1 mapping of virtual volumes and LUNs
  - EMC XtremIO XMS 4.0+
  - HPE 3PAR InForm OS 3.2.2+, 3PAR SMI-S, 3PAR WSAPI
  - IBM FlashSystem running on Spectrum Virtualize 8.3.1.2 or later (8.4.2.0 or later recommended)
  - NetApp Cmode/7mode using ONTAP 8.0+ (excluding AFF and SolidFire)
  - Pure Storage F-series and M-series arrays
- Virtual Desktop Infrastructure
  - VMware Horizon

For information about these targets, see the *Turbonomic Target Configuration Guide*.

3. Log in to the Turbonomic user interface and set the administrator user account password.

> **IMPORTANT:**
> You should wait until all the platform components have started up, are running, and are fully ready before your first login. If you try to add a license or add a target to the platform before the components are all ready, the platform can fail to initialize correctly. For more information, see Verify that the Turbonomic application installed correctly *(on page 93)*.

After the components start up, in your Web browser, type the static IP address of your Turbonomic VM. Your browser redirects the login page for Turbonomic users.

Turbonomic includes a default user account named `administrator` which has an `ADMINISTRATOR` role. As you log in for the first time, you must set your own password for that account. You can create or delete other accounts with the `ADMINISTRATOR` role, but your installation of Turbonomic must always have at least one account with that role.

In the login page, enter the information as required, and make a note of it.

- Use the default credential for **USERNAME**: `administrator`.
- Type a password for **PASSWORD**.

The new password must comply with the strong password policy (a mixture of upper- and lower-case letters, numbers, and a symbol). Only you will know this new password.

- Type the password again to verify it for **REPEAT PASSWORD**.
- Click **CONFIGURE**.

This is the account you will use to access the Turbonomic user interface with administrator permissions. *Be sure to save the user interface administrator account credentials in a safe place.*

> **NOTE:**
> The initial login is always for the `administrator` account. This is an administration *user* account. Do not confuse this with the Turbonomic System Administrator account that you previously set up to log into shell sessions on the VM itself.

4. After you have logged in as `administrator`, you can create other user accounts, and you can give them various roles. For more information about user accounts and roles, see the *Turbonomic User Guide*.

Appendix: Step-wise Offline Update

To perform a stepwise offline update of your Turbonomic installation:

1. Save a snapshot of your current Turbonomic VM.

   Before updating, you should properly shut down (not power off) the Turbonomic VM. To do so, type:

   ```
   sudo init 0
   ```

   Then, perform a snapshot (or clone the VM). This provides a reliable restore point you can turn to in the event that trouble occurs during the update. After you have the snapshot, bring the VM back online.
2. Download and attach the ISO image to the VM that runs Turbonomic.

   Refer to the email you received from Turbonomic for links to the Turbonomic 0VA file and to the ISO image.
3. Mount the ISO image by logging in to vCenter.
   a. In vCenter, navigate to the Turbonomic VM.
   b. Right-click the VM and choose **Edit Settings**.
   c. In the CD/DVD Drive drop-down menu:
      i. Choose **Datastore ISO**.
      ii. Browse to the Turbonomic update ISO image and choose it.
   d. Ensure that the **Connect at power on** checkbox is selected.
4. Log in to the Turbonomic VM.

   Use SSH to log in to the Turbonomic VM using the turbo account and password.
5. Mount the ISO image.

   Type:

   ```
   sudo mount /dev/cdrom /mnt/iso
   ```

6. Verify the correct version of the ISO image is mounted.

   Type: `ls /mnt/iso`

   Verify that the ISO image contains the correct version for your update.
7. Load the latest Docker images.

Type: `sudo /mnt/iso/turboload.sh`

This script loads all the images to the Turbonomic instance. If the load is successful, it displays a message simiar to:

```
The t8c upgrade iso has been mounted
Image check:
============
**************************
All images have been loaded
**************************
```

If the load does not succeed, the script will list any images that did not load, along with instructions to load them manually.

8. Execute these commands to update Turbonomic.

   - `/mnt/iso/turboupgrade.sh | tee \`
     `/opt/turbonomic/t8c_upgrade_$(date +%Y-%m-%d_%H_%M_%S).log`

   Wait until the script is finished.

9. Verify that you are running the correct version of MariaDB.

   For this version of the product, Turbonomic supports MariaDB, version 10.5.12. Even after updating to this Turbonomic version, it is possible that your installation is running an earlier version of MariaDB.

   While still in the SSH session, check the MariaDB version:

   ```
   mysql -u root --password=vmturbo -e "SHOW VARIABLES LIKE 'version';"
   ```

   The output should be similar to:

   ```
   +---------------+-----------------+
   | Variable_name | Value           |
   +---------------+-----------------+
   | version       | 10.5.12-MariaDB |
   +---------------+-----------------+
   ```

   If the MariaDB version is earlier than 10.5.12, you must update your MariaDB. For complete instructions and information, see Verifying your MariaDB Version *(on page 22)*.

10. Unmount the ISO image.

    Enter the command:

    ```
    sudo umount /dev/cdrom
    ```

11. Clear your browser data and refresh your browser.

    After clearing the browser data and refreshing your browser, you have full access to Turbonomic features. However, features that rely on current analysis data will not be available until after a full market cycle — usually 10 minutes. For example, the Pending Actions charts will not show any actions until after a full market cycle.

12. Optionally, enable new probes in your environment.

> **NOTE:**
> As Turbonomic evolves, the set of delivered probes can change. Also, from one version to the next, the set of probes that are enabled by default can change. However, when you update to a new version, the update does not change your probe configuration. An update to a newer version does not automatically enable any new probes in your deployment. If you want to take advantage of new probes in an update, then you must enable them manually.

For steps to enable new probes in your updated version, see Enabling and Disabling Probe Components *(on page 63)*. Use these steps to edit the platform's cr.yaml file, but *do not* apply those changes yet, via `kubectl`.

13. Optionally, enable Turbonomic on Turbonomic.

    For updates from versions earlier than 7.22.4

    In Turbonomic, the supply chain can model your deployment as a Business Application. For updates from versions earlier than 7.22.4, you must enable the components that implement this feature.

    For steps to enable these components in your updated version, see Enabling and Disabling Probe Components *(on page 63)*. Use these steps to edit the platform's cr.yaml file, but *do not* apply those changes yet, via `kubectl`.

    When you update the components in your cr.yaml file, specify the following:

```
kubeturbo:
 enabled: true
prometheus-mysql-exporter:
 enabled: true
 mysql:
  user: root
  pass: vmturbo
prometheus:
 enabled: true
prometurbo:
 enabled: true
```

14. Verify that the Turbonomic application installed correctly.

    To verify the installation of the application, execute the command:

    ```
    kubectl get pods -n turbonomic
    ```

    After all of the pods start up, the READY column should read `1/1` and the STATUS column should read `Running` for each pod.

15. Notify other users to clear their browser data and refresh their Turbonomic browser sessions.

Appendix: Migrating Turbonomic From Classic to XL

Turbonomic is proud to introduce the XL family of the Turbonomic platform. XL comprises the 7.x and 8.x versions of Turbonomic. Also note that the 6.4.x versions of Turbonomic are referred to as *Classic*.

The XL family of Turbonomic is a new platform to manage application performance to the same standards you are used to with the Classic version family. It introduces a component-based architecture that can manage larger environments, as well as enhancements to the supply chain and user interface that emphasize the management and performance of your applications.

Because of these changes, you must *migrate* to the XL version family – You cannot perform a simple update like you would to update to a later version of the same family. A migration transfers your target, group, policy, and other data from your Classic installation, into the XL installation.

Turbonomic provides a tool to perform the migration automatically. You set the IP addresses of your Classic installation and of your XL installation in the tool. It then discovers the data that it can migrate, and loads that data into the XL installation. The tool currently migrates:

- Target configurations
- Policies and schedules
- Templates
- Custom groups
- Discovered groups used to scope policies and targets
- Users and user groups, including Local and Active Directory user accounts

> **NOTE:**
> As of this writing, we have not tested migration of all target types. This is because of limited access to some target types in our testing lab.

Limitations

Please be aware of the following limitations to the migration tool:

- *Always migrate to a Quarterly Release of XL*

We deliver quarterly releases and bi-weekly releases of Turbonomic. We test the migration script against each quarterly release.

When you migrate from Classic to XL, you should always migrate to the latest *quarterly* release of XL. If you want to use a later bi-weekly release, migrate to the quarterly release first, and then update to the later bi-weekly release after you have completed the migration.

- You should not migrate multiple instances of Classic installations to a single XL installation. You should only migrate a single Classic instance to a single XL instance. If you want to migrate multiple instances of Classic, please contact your support representative.
- For AWS targets, the XL instance uses a separate target to manage billing. The tool does migrate the Classic AWS targets, but it does not create the separate billing target in the XL instance. For AWS environments, after you migrate to XL, you should manually configure the appropriate AWS Billing target.
- The tool does not migrate the following:
  - Your current license
  - Historical data
  - Dashboards and charts
  - Plans
  - Placements and reservations
  - Billing and cost configuration
  - Action scripts and orchestration configurations
  - Email and trap notification configuration
  - Reports and report templates
  - Data retention configuration
  - Email server configuration
  - HTTP Proxy configuration
  - SSO configurations
  - Logging levels
  - Support options

Preparing your Turbonomic Instances

Before you can migrate, you must prepare the Classic and the XL instances for the migration. They must be updated to the correct versions, and you must have access to them via a secure shell session (SSH).

- Update your Classic instance to 6.4.22 or later

  The tool requires that your Classic instance is no earlier than 6.4.22.
- Install the latest quarterly release of Turbonomic

  This will be your XL instance. Install this instance on your network at the location you desire. The version you migrate to must be 8.1.6 or later.

> **NOTE:**
> When you install the XL instance, consider the following:
>
> - *Always migrate to a Quarterly Release of XL*
>
> We deliver quarterly releases and bi-weekly releases of Turbonomic. We test the migration script against each quarterly release.
>
> When you migrate from Classic to XL, you should always migrate to the latest *quarterly* release of XL. If you want to use a later bi-weekly release, migrate to the quarterly release first, and then update to the later bi-weekly release after you have completed the migration.
> - It is best to migrate to a newly installed XL instance. You must be careful if you use the tool to migrate your Classic instance onto a XL instance that already has targets, discovered entities and groups, or policies.
> - If you want to migrate to a previously installed version of Turbonomic, you must update that version to the latest quarterly release.
> - If you need to migrate multiple Classic instances to a single XL instance, please contact your support representative.

- Gather addresses and credentials to access both instances of Turbonomic

  Ensure that you know:

  - The IP address used to access both SSH (putty) and the UI of the Classic instance
  - SSH login credentials for the Classic instance
  - The IP address used to access the UI of the XL instance
  - UI administrator credentials for both the Classic and XL instances
  - Ensure that you have credentials for an Administrator user account through the user interfaces of the Classic and the XL instances of Turbonomic
- Ensure that you have a valid license on the XL instance.

  If you do not have a valid license on the XL version, then the migration tool cannot execute.
- Double-check your access to the Turbonomic instances

  Ensure that you can:

  - Log into a secure shell session (SSH) on the Classic instance
  - Access the REST API of the XL instance from the classic instance

    To test this access, log into SSH on the Classic instance and execute the command:

    ```
    curl -k https://XL_INSTANCE_IP/vmturbo/rest/cluster/isXLEnabled && echo
    ```

    If you can connect with the XL REST API, the command output should be `true`.
  - Log in to the UI of both the Classic and XL instances of Turbonomic via the administrator account.
- If you have deployed Kubeturbo in your Classic environment, deploy Kubeturbo for XL.

  The tool does not migrate Kubeturbo deployments. This stage in the migration process is the perfect time to deploy Kubeturbo to operate with your XL installation. For more information, see the Kubeturbo github repository, located at https://github.com/turbonomic/kubeturbo.

  If you declared (on your Classic instance) groups or policies that rely on the topology that Kubeturbo discovers, then you should manually create them in the XL instance. Note that the XL instance creates different entity types for your container infrastructure. Your associated groups and policies will use this new topology model.
- Ensure that all the targets in your environment are in a *Valid* state.

The migration tool will configure targets on the XL instance, to match the targets you have configured on your Classic instance. Before running the migration, you should ensure that all the targets validate. Either correct the issue, or delete the target.

If the migration encounters targets that do not validate, then it will post a failure error, and it will not migrate that target.

If you delete a target before migrating, of if the target migration fails, then the migration will not contain any groups that Turbonomic discovers to support that target. As a result, if you have any policies that rely on these discovered groups for scope, that scope will no longer exist. You should understand how policies use the given target's scope, and clean up or delete any policies that will have en empty scope because the target was removed.

- Impose an effective *freeze* on the configurations of your Classic and XL instances.

  Once you start the migration process, you should not make any configuration changes to either the XL instance or the Classic instance.

  There are two exception to this rule:

  - Under some circumstances the tool can encounter a situation that requires you to abort a given step and make some changes. When the tool instructs you to make configuration changes, you can do so.

    For example, if you want to migrate a target type that is not currently enabled in the XL instance, the tool will tell you to abort, enable the target on the XL instance, and resume the migration.
  - Similarly, if your deployed Kubeturbo in your Classic instance, you will need to manually deploy Kubeturbo in the XL instance. The instructions include a step in the process where you can do that.

Installing the Migration Tool

To run the migration, install the tool on your Classic instance of Turbonomic.

1. Download the tool.

   For access and download instructions, navigate to https://github.com/turbonomic/tbmigrate/blob/master/DOWNLOAD.md. Scroll to the section, *Downloading TbMigrate*.

   > **NOTE:**
   > Be sure to download the latest version of the the migration tool.
2. Log in to the Classic instance using "putty" or another SSH client (if you have not done so already).
3. Expand the archive file onto your Turbonomic instance.

   Execute the commands:

   - `cd $HOME`
   - `tar xvfz /tmp/tbmigrate-VERSION_NUMBER.tgz --no-same-owner`

Running the Migration

To run a migration you will open the Migration Tool Interactive Menu, and then execute the commands in order.

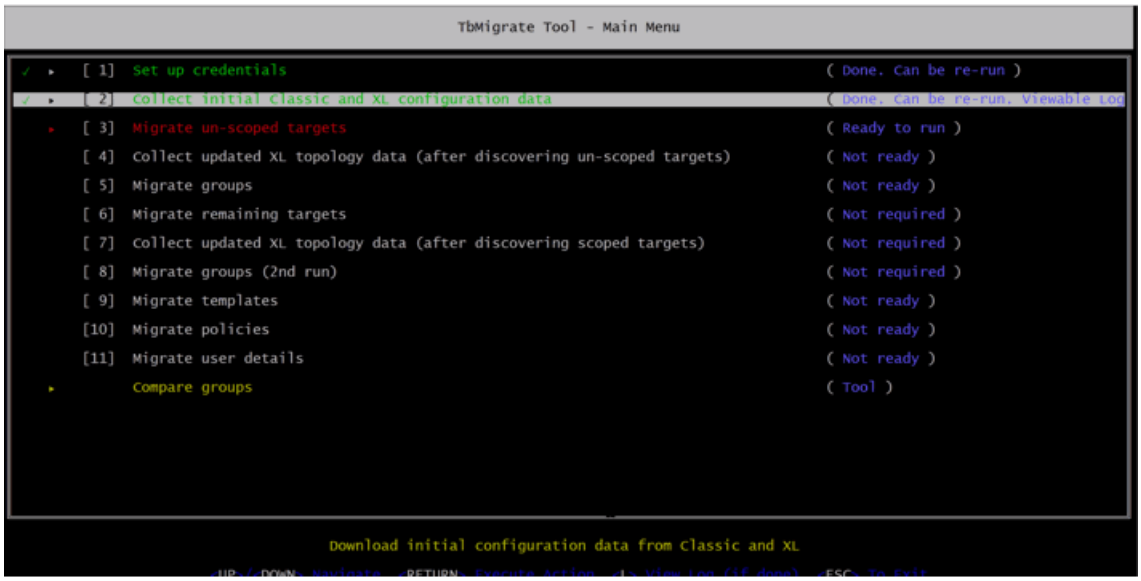
> **NOTE:**
> When using the Classic to XL migration tool, you must run the steps in order. If you run steps *after* the Migrate Targets step, and then backtrack to run the Migrate Targets step again, the tool loses the record of any steps that you ran after the initial execution of Migrate Targets.
>
> We recommend that you carefully review the results of each step that you complete, before moving on to the next one. This can make it unnecessary for you to backtrack.
>
> For example, assume you ran the tool all the way through the migration. Then you want to see how the tool calculated the target migration so you run Migrate Targets again. After that, the tool assumes you have not finished the migration, and will not let you review the steps subsequent to Migrate Targets. If you had closely reviewed the Migrate Targets result right after you executed that step, then you would not have needed to go back and run it again.

Open the Migration Tool Interactive Menu

While still logged in to the Classic instance, navigate to the migration tool location, and launch the Interactive Menu. Execute the commands:

- `cd $HOME/tbmigrate`
- `sh menu.sh`

The Interactive Menu displays in your shell window.



The menu gives you the migration steps you should perform, in order. In the menu:

- Each step has a status:
  - Ready to run – You should run steps in order.
  - Not ready – You must run previous steps before running this step.
  - Done – You can rerun some completed steps. For some completed steps, you can navigate to the step and then display logs.
  - Not required – Optional steps to migrate or collect data a second time.
- Use up and down arrows to navigate to different steps.

- For a selected step, you can:
  - Execute the menu command – Press RETURN to execute the selected step.
  - Display associated logs – Press the "L" key to view logs for completed steps.
  - Exit the step – Pres ESC to exit the step

Executing the Migration Commands

> **NOTE:**
> As you execute the migration commands, they write output to `.log` files in the `$HOME/tbmigrate/logs` directory.
>
> You should review these logs carefully to ensure that you don't see negative impacts from any elements the tool could not migrate completely. You should review the logs when the migration is finished, and you can review them at different stages of the migration process.

To run the migration, you will step through the menu commands in order, and execute them. The following steps describe each menu command.

1. Set up credentials.

   This step configures credentials for both instances. Execute the command, and then provide the information that the tool requests.

   As part of the credential setup, this step prompts you with the **Target Password Migration** option:

   - **YES** – The migration tool collects your encrypted target passwords, and uses them to configure and validate the targets that you migrate to the XL instance. You will not have to enter those passwords yourself during various stages of the target migration phase.
   - **NO** – The migration tool does *not* collect your encrypted passwords. If you do not migrate passwords, you will see prompts to enter passwords at various stages during the target migration process.
2. Collect initial Classic and XL configuration data.

   Collect the current configuration from your Classic installation.

   This step collects configuration data from your instances. The migration process will use the collected data.

   When this step completes, it generates a log of the actions it performed. You should review the log to be sure there are no errors.
3. Migrate un-scoped targets.

   This step migrates all the targets that are not scoped to groups.

   You should know that scoped targets can only migrate *after* Turbonomic has created the groups that define the scope. Turbonomic cannot create those groups until after the un-scoped targets have been configured, validated, and have discovered their entities. You will migrate scoped targets in a later step.

   When you execute this step, the tool displays an interactive list of targets. (There can be a brief delay.) This list shows which targets *can* migrate (with a tick on the left), and which targets *cannot* migrate (marked with an X). Use this list to migrate your targets:

> **NOTE:**
> If you are migrating targets to an XL instance that *already has targets installed*, you must be sure that you do not create duplicate targets. This can happen if one of the XL targets is the same as a target in the interactive list.
>
> The list will identify duplicates and disable their migration if the target names are identical, including case. However, it cannot identify duplicates if the names are spelled differently in any way.
>
> *If you are migrating to a XL instance that already has targets running on it, review this list carefully to make sure there is no duplicate target in the list.*

- Navigate in the list

  Use the UP and DOWN arrow keys to move from target to target and view the message shown at the bottom of the screen for each one.

  Take a note of any targets that need to have their supporting mediation pod enabled on the XL instance. You will need to enable those probes on the XL instance later, and then perform the target migration step again.

  For any target you do not want to migrate, navigate to that entry and press the space bar to deselect it.
- Exit the list of targets.

  When you have finished viewing and selecting the targets to migrate, press the ESC key to exit the list.

  The tool gives you a `Yes/No` option to continue with the migration. You must decide whether to continue or abort the target migration.

  - If you need to install missing probes on the XL instance, install them now.

    Choose `No` to abort the migration. Then start a session on the XL instance to install the missing probes that you noted. For instructions, see the Installation Guide.

    After you install the missing probes on the XL instance, return to the Classic instance and execute the **Migrate Unscoped Targets** command again.
  - If you do not need to install any missing probes on the XL instance, proceed with the migration.

    Choose `Yes`. The tool will migrate the targets that you have selected in the list.
- Confirm that the target migration does not report any errors.
- Take a note of the whether the tool output ends with the message, `There are some scoped targets to be migrated later`.

Wait for the migrated targets to validate and discover their topology.

You can monitor the discovery in the XL instance by logging into its user interface. Alternatively, you can use the following commands from the SSH on the Classic instance to see reports of the supply chain and the target status on the XL instance:

- `bin/tbutil @xl list supplychain` to see the supply chain
- `bin/tbutil @xl list targets -l` to list target status

You can use the "watch" tool to re-run either of these tools repeatedly. For example:

```
watch -n 10 bin/tbutil @xl list supplychain
```

When finished with the "watch" session, press Control-C to stop the command.

Some tips for waiting for the migration to complete:

- The message `WOOPS! Supplychain object not found` indicates that no entities have been discovered. Assuming one or more targets have validated, this means that discovery has not yet generated any topology.

- Be aware that the numbers shown may increase over time as more targets complete their discovery. You should wait until all discovery is complete.
- The numbers in the "Minor", "Major" and "Critical" columns should all be zero. This is because actions are disabled globally for the XL instance, and so there are no actions in the system. You will enable actions for the XL instance when you cut your management over to that new instance.
- If you see target validation issues on the XL instance, you can log into the XL user interface and change the credentials or other settings for the target configuration. Then you can trigger re-validation and re-discovery for the affected targets.

Once all the targets are validated and discovery is complete, you can continue to the next step.

4. Collect updated XL topology data.

   The topology of the XL instance has changed since you did the original "Collect" step (Step 2). You must repeat the "Collect" step now. Execute the step, and when it completes review the log to make sure there are no errors.

5. Migrate groups.

   This step migrates your custom groups. It also migrates *scope* groups that can be created from the un-scoped targets. This enables the eventual migration of scoped targets.

   Note that this step does not migrate most discovered groups. The XL instance will discover groups according to its own rules.

   Execute the step, and when it completes review the log to make sure there are no errors.

6. Migrate remaining targets.

   If the earlier "Migrate un-scoped targets" step displayed the message `There are some scoped targets to be migrated later`, then you must migrate them now. If that step reported the message, `There are no outstanding scoped targets`, then you can skip the next few steps, and jump to "Migrate templates".

   Executing this step is the same as the "Migrate un-scoped targets" step, except that it now migrates the scoped targets. It displays the same interactive list of targets to migrate. It also identifies any probes that you need to install on the XL instance. For full details, please refer to the "Migrate un-scoped targets" step, above.

   > **NOTE:**
   > If you are migrating targets to an XL instance that *already has targets installed*, you must be sure that you do not create duplicate targets. This can happen if one of the XL targets is the same as a target in the interactive list.
   >
   > The list will identify duplicates and disable their migration if the target names are identical, including case. However, it cannot identify duplicates if the names are spelled differently in any way.
   >
   > *If you are migrating to a XL instance that already has targets running on it, review this list carefully to make sure there is no duplicate target in the list.*

   Briefly, to migrate any scoped targets, execute the step, and then:

   - Answer any questions that the tool asks you. Use the UP and DOWN arrow keys to navigate the list. Press the space bar to select or deselect a target in the list.
   - Take a note of any targets that need to have their supporting mediation pod enabled on the XL instance. You will need to exit this migration step, enable those probes on the XL instance, and then perform this target migration step again.

     To abort this migration step, press ESC, and then choose `No`.
   - If you do not need to install any missing probes on the XL instance, proceed with the migration.

     Press ESC and then choose `Yes`. The tool will migrate the targets that you have selected in the list.
   - Confirm that the target migration does not report any errors.

Wait for the migrated targets to validate and discover their topology.

You can monitor the discovery in the XL instance by logging into its user interface. Alternatively, you can use the following commands from the SSH on the Classic instance to see reports of the supply chain and the target status on the XL instance:

- `bin/tbutil @xl list supplychain` to see the supply chain
- `bin/tbutil @xl list targets -l` to list target status

7. Collect the updated XL topology data.

   The topology of the XL instance has changed again. You must repeat the "Collect" step now. Execute the step, and when it completes review the log to make sure there are no errors.

8. Migrate groups.

   Migrate additional groups that are related to the scoped targets.

   This step updates the groups to use the new topology that has been discovered by the scoped targets. Execute the step, and when it completes review the log to make sure there are no errors.

9. Migrate templates.

   This step migrates the templates you have defined in the Classic instance. It does not migrate generated templates such as average cluster templates, nor does it migrate discovered templates. Execute the step, and when it completes review the log to make sure there are no errors.

10. Migrate policies.

    This step migrates your Placement Policies, and your default and custom Automation Policies.

    For Automation Policies, this step copies automation settings from classic to XL that meet all of the following criteria:

    - The setting had been changed in the Classic instance.

      In other words, the setting has a value that is different from its default.
    - There is an equivalent setting in the XL instance.

      Note that not all settings in Classic have been replicated in XL. On the other hand, XL introduces new settings that do not exist in Classic.

    This step also migrates Placement Policies.

    If the migration encounters settings in Classic that cannot migrate into XL (or vice versa), the tool writes a suitable warning to the log. Examples include:

    - Action policies for entity types that do not map to the XL supply chain. For example, *Application* in Classic entities are *Application Component* entities in XL.
    - Settings do not match. For example, in Classic you can set SLA Capacity for a Business Application, XL does not include that setting.
    - Settings that are specified by a different mechanism. For example, settings for Action Scripts are specified differently in XL.

    Execute the step, and when it completes review the log to make sure there are no errors.

11. Migrate user details.

    This step migrates:

    - Local Users – The migration includes all the user details (Role, scope, etc.) *except* the user's password. The migration creates an arbitrary and complex password for each user in the XL installation. The Turbonomic

administrator can edit each local user account, and work with the individual user to manually update the password.

- LDAP Users – The migration includes all the user's details.
- LDAP User Group – The migration includes all the group details
- Active Directory Configuration – The migration includes the AD settings that you had specified in the Classic installation

This completes the migration process.

You should review the tool outputs to ensure there are no errors. If the tool did log errors, you can review them to determine corrective actions you can take in the XL instance. The tool writes output to `.log` files in the `$HOME/tbmigrate/logs` directory.

Once all the above steps are complete, the XL instance is configured to be as similar as possible to the Classic instance, but you should verify that the configuration is as you expect. In particular, review the warnings and errors that the tool logged for any of the migration steps above. You should consider whether these warnings or errors can have an impact on your environment. If necessary, you can log into the XL user interface and make corrections there.

Switching to the New Version

After you have completed the migration, you should plan your change over from the Classic version of Turbonomic to the XL version.

Letting the Migration "Settle In"

After running the migration process, the XL instance discovers your environment, creates groups, and begins its market analysis. However, actions are disabled globally for the XL instance. This is important – You must not have two instances that actively manage the same environment at the same time. By disabling actions in the XL instance, the migration process ensures that it does not execute actions until you are ready for it to.

It is a good practice to leave the XL instance running with actions disabled for a period of time. You should let it run in parallel with the Classic instance, and keep actions enabled on the Classic instance. In this way, you let the XL instance catch up, while the Classic instance continues to manage your environment:

- XL Instance (actions disabled): This instance builds up historical data that Turbonomic analysis uses to generate resizing actions.
- Classic Instance (actions enabled): This instance continues to manage your environment while the XL instance "settles in".

You can use this time to check that your XL instance is discovering utilization and capacity metrics correctly, and to set up policies and other business rules. This is also a good time to address any configuration settings that the tool did not migrate. For example, you can go over the **Limitations** section above to address the items the tool did not migrate.

> **NOTE:**
> As a rule, you should allow the migration to settle in for 30 to 90 days. This should be sufficient for the XL instance to collect the historical data it needs to properly work with cloud costs and percentile-based analysis.

Cutting Management Over to the XL Instance

When you are sure that the XL instance has collected sufficient historical data, and that the configuration of the XL instance is correct, then you can switch the management of your environment over from Classic to XL.

There are two steps to this process, and the order is important:

1. Turn on **Disable All Actions** in the Classic instance and wait for all actions to clear.

   Navigate to **Settings > Policies**. Then in the Search box for the Policies list, type *global* to find the **Global Defaults** policy. Click to edit that policy. Under ACTION CONSTRAINTS, turn on the **Disable All Actions** option. Then click **SAVE AND APPLY**.

   After you have disabled actions, wait for the Pending Actions list to clear so that it shows no actions.

2. Turn *off* **Disable All Actions** in the XL instance.

   navigate to the **Global Defaults** policy and turn off the **Disable All Actions** option. The XL instance should begin generating actions, and you can use it to manage your environment.