Auto-Scaling Lab

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# **Auto-Scaling Lab for Liberty**

Auto scaling provides an autonomic scaling capability of Liberty servers. The auto scaling functionality is enabled by two Liberty features, **scaling controller** and **scaling member**. Auto scaling dynamically adjusts the number of Java virtual machines (JVMs) used to service your workload. This feature provides operational agility and decreases administrative overhead to enhance the resiliency of your middleware environment.

The conditions for auto scaling are defined by scaling policies. These conditions include the minimum or maximum number of server instances and the threshold values for each of the server resources.

In this lab exercise, you will learn:

* How to use the auto-scaling feature that automatically starts and stops JVM instances based on scaling policy.

This lab runs only on the Windows amf Linux platform as only those versions of the web server and plugin are included. You may tailor this lab to run with other platforms by downloading the correct version of the Apache web server, and the WebSphere Plugin.

You can download the trial version of the plugin here:

<http://www.ibm.com/developerworks/downloads/ws/wasnetwork/>

As prerequisites, you should:

* Complete **Admin Center lab** to set up the collective controller. Or execute the buildCollective.sh script for Linux or Mac.
  + cd {LAB\_HOME}/lab/management/ 4\_AutoScaling\_<timestamp>
  + ./buildCollective.sh –d {LAB\_HOME} –h <hostname> -u <rpcUser> -p <prcUserPassword>
    - If running on MAC, edit the script to remove –-hostJavaHome= from the updateHost command, which is the last line in the script.
  + This will build out, create packagedServer directory, copy dynamic\* folders and start the adminCenterController server.
* **(Optional)** Complete the **Dynamic Routing lab**. Even though this lab does not use dynamic routing to demonstrate auto-scaling, dynamic routing is required in a production environment to route requests correctly as the auto-scaling feature adjusts the number of running JVM instances.

To run this lab, your workstation must meet the following requirements:

* Approximately 8GB of storage available for the Windows 7 virtual image
* Approximately 3 GB of memory free to run the developer workbench and the server
* Connectivity to the internet is NOT required
* Please refer to the following table for file and resource location references on different operating systems.

|  |  |  |
| --- | --- | --- |
| Location Ref. | OS | Absolute Path |
| *{LAB\_HOME}* | Windows | C:/WLP\_<version> |
| Linux | ~/WLP\_<version> |
| Mac OSX |  |

## Enable Auto Scaling

The auto scaling functionality is enabled by two Liberty features, **scaling controller** and **scaling member.**

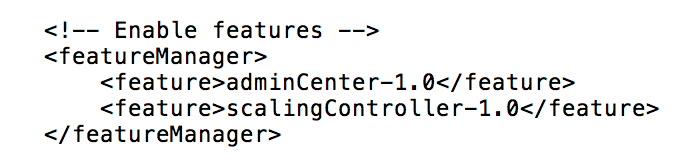
1. **scalingController-1.0**: The scaling controller feature decides when to expand or contract an auto scaling cluster. Collective controllers are required because they provide administration functionality that leverages the ability of the collective controller to manage the scaling controller. Only one of the running scaling controllers can make decisions.

Note: The scaling controller keeps the last known state of the scaling members. Stopping the scaling controller and changing the state of the scaling members may cause some invalid actions at the scaling controller restart, until the scaling controller has gathered the latest scaling member state.

1. **scalingMember-1.0 :**The scaling member feature monitors the workload within the server and its host, and when needed, it sends this information back to the scaling controller. The scaling member feature must be enabled as a collective member in a collective.

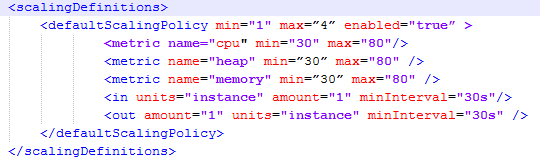
**Note:** All scaling member servers must also belong to a cluster because all policy information is applied at the cluster member.

1. Copy the following files from **{LAB\_HOME}\labs\management\4\_AutoScaling\_<timestamp>** to **{LAB\_HOME}\wlp\usr\servers\adminCenterController**
   1. server.xml
   2. scalingpolicy.xml
2. Review the server.xml file. Notice the following new addtions
   1. <feature>scalingController-1.0</feature>



* 1. <include location="${server.config.dir}/scalingpolicy.xml"/>

1. The scalingpolicy.xml file includes the scaling definitions. These values could be added directly to the server.xml, but for clarity it was separated out.



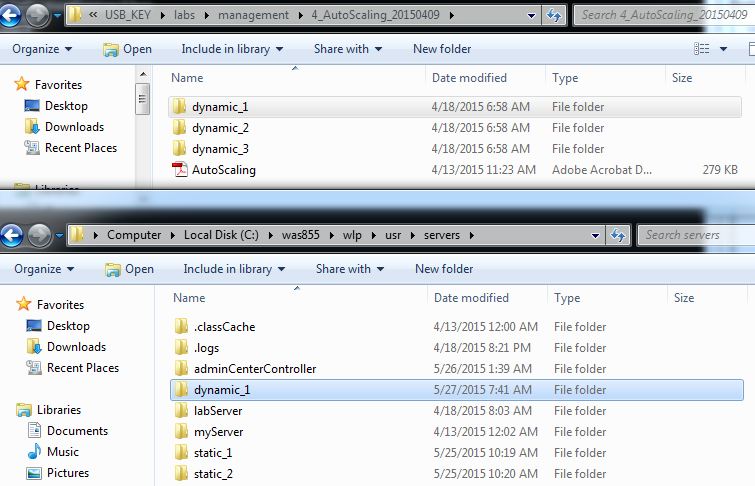
Note that this policy definition overrides the default policy as follows:

* + - 1. If the host CPU or host memory exceed 80% utilization, a new JVM instance is started on another host. [ **We will not demonstrate this function in this lab, which only uses a single host ]**
      2. If the instance heap exceeds 80% utilization, a new JVM instances is started on the same or different host depending on capacity.
      3. If host CPU, host memory, and one JVM heap fall below 30% utilization, the JVM instance is stopped.
      4. Policy decisions are made every 30 seconds.

## Package and Deploy Dynamic Cluster

A packaged server contains **server.xml,** application, and optionally the Liberty runtime. The Admin Center currently only supports packaged server deployment with packages that also contain the runtime. To create a packaged server :

1. Copy **{LAB\_HOME}\labs\management\4\_AutoScaling\_<timestamp>\dynamic\_1** directory to **{LAB\_HOME}\wlp\usr\servers directory.**



1. Examine the **server.xml** and notice that they include the following features and configuration.
   1. **collectiveMember-1.0:** allows the server to be managed by the controller.
   2. **clusterMember-1.0**: allows the server to be a member of a cluster.
   3. **scalingmember-1.0:** allows to monitor the workload within the server and its host.
   4. **restConnector-1.0:** required for the controller to push policy information down to the application servers**.**
   5. **hostSingleton** definition: By specifying the same port number for all scaling members on the same host, a member is automatically elected as a singleton to gather metrics on the other members on the same host, to send to the scaling controller. If the member acting as the singleton is stopped, another member automatically takes over.

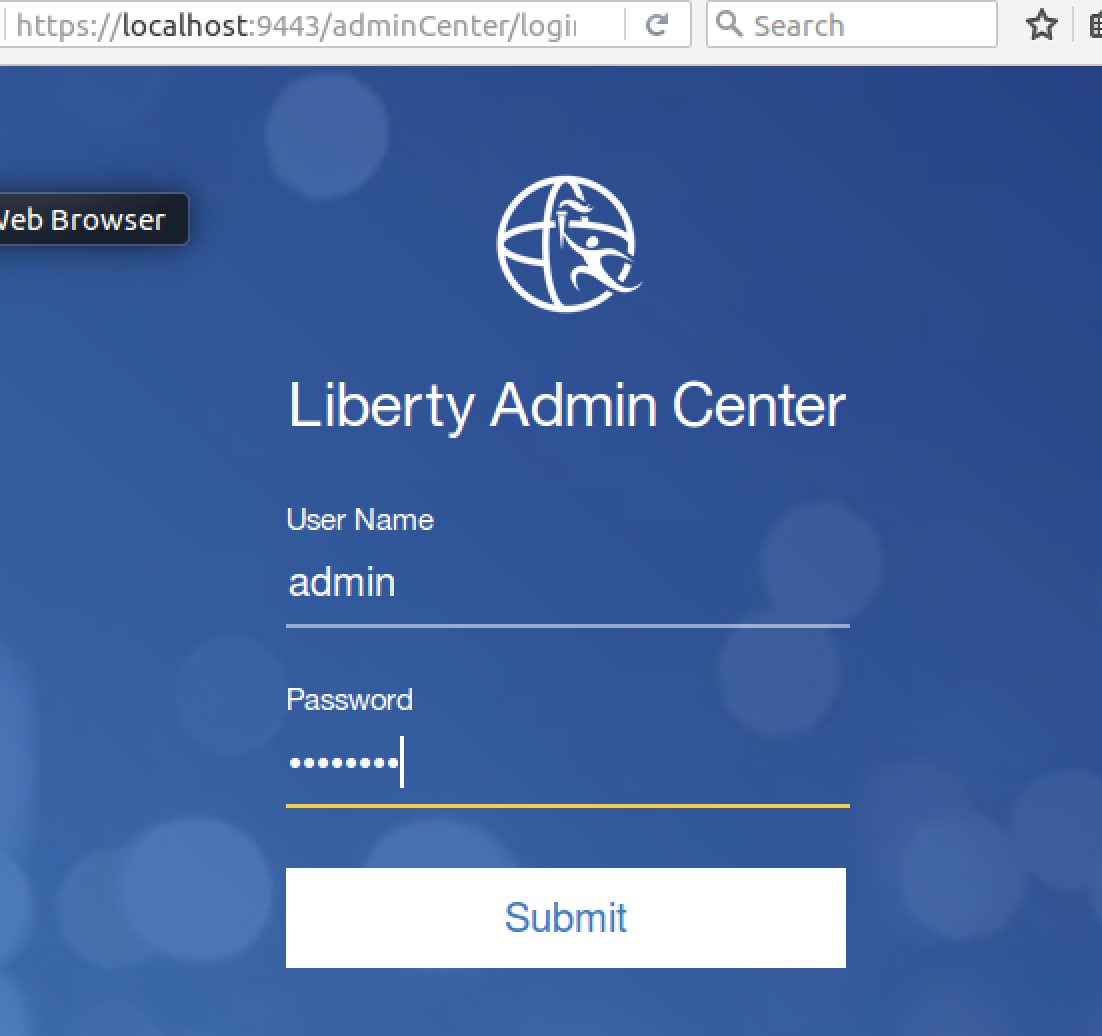


* 1. Use of environment variable **${env.COMPUTERNAME}** to match the hostname.

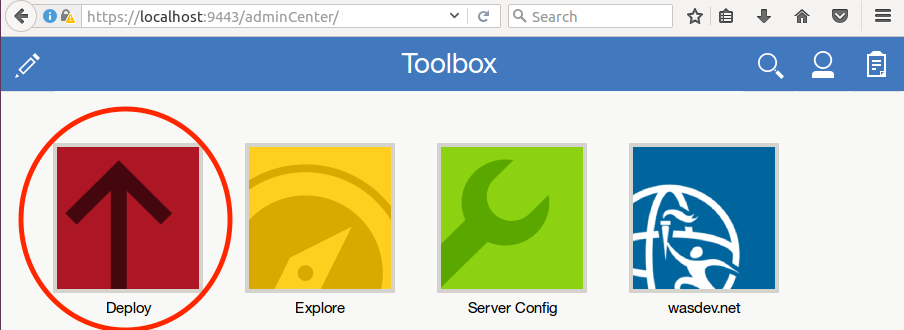
1. Run the following command to package the server. This creates a **dynamic\_1.zip** in the server’s directory. The **minify** option includes only the required features rather than the entire Liberty runtime.

server package dynamic\_1 --include=all

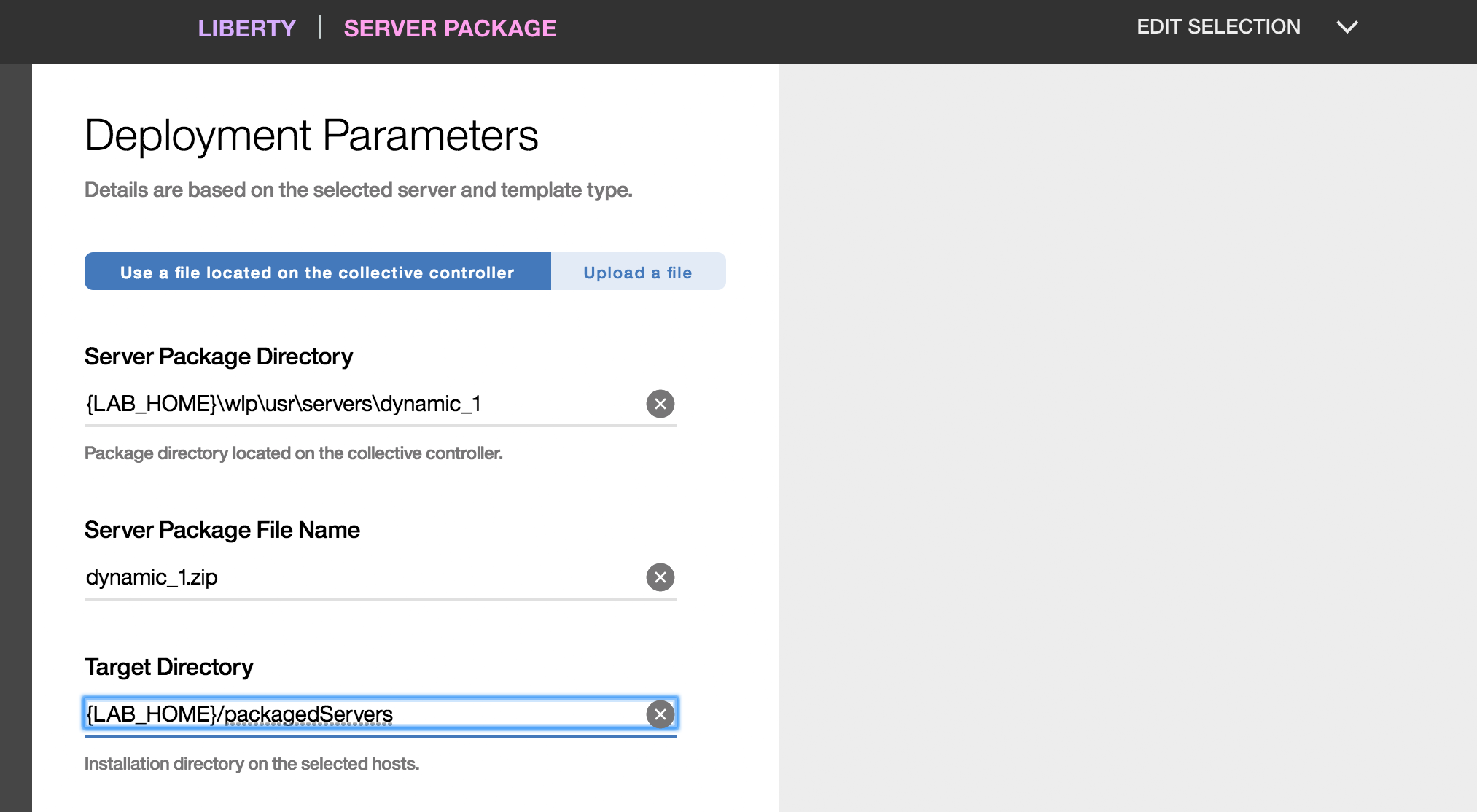
1. Ensure that the Admin Controller server is started. If it is not started, execute the following command in a command prompt window: **server start adminCenterController**. Point your browser to <http://localhost:9080/adminCenter>
2. Login to the **Admin Center** with user **admin**, and password **adminpwd.** Click **Submit**



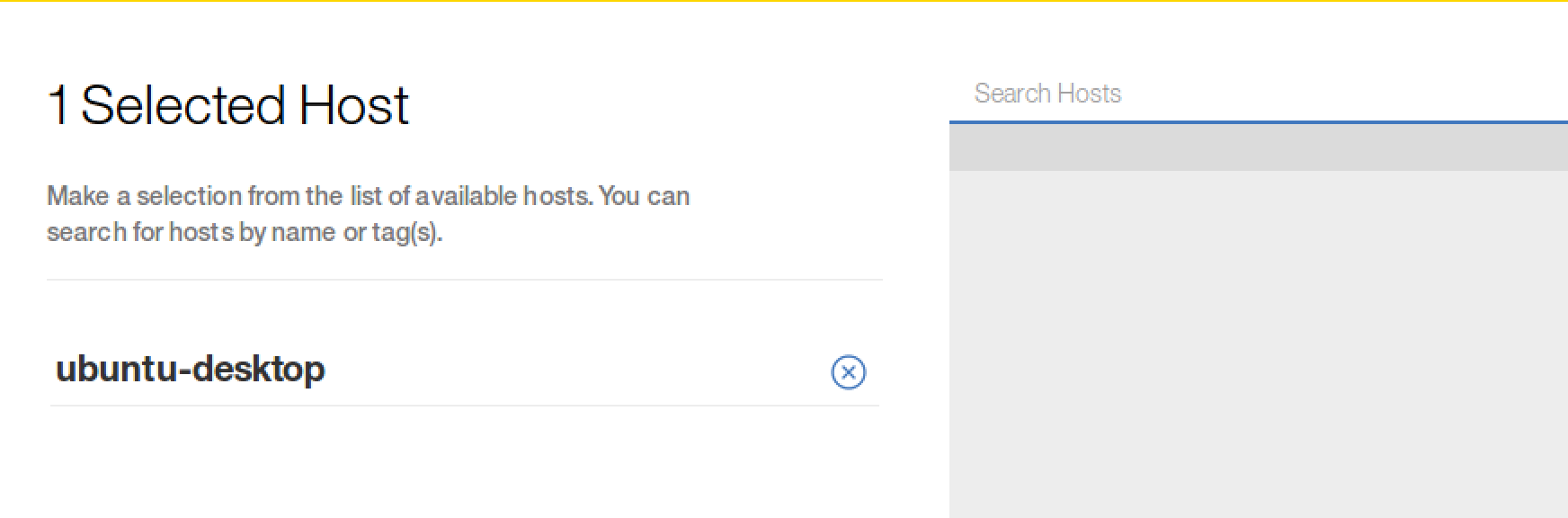
1. Click the **Deploy** icon



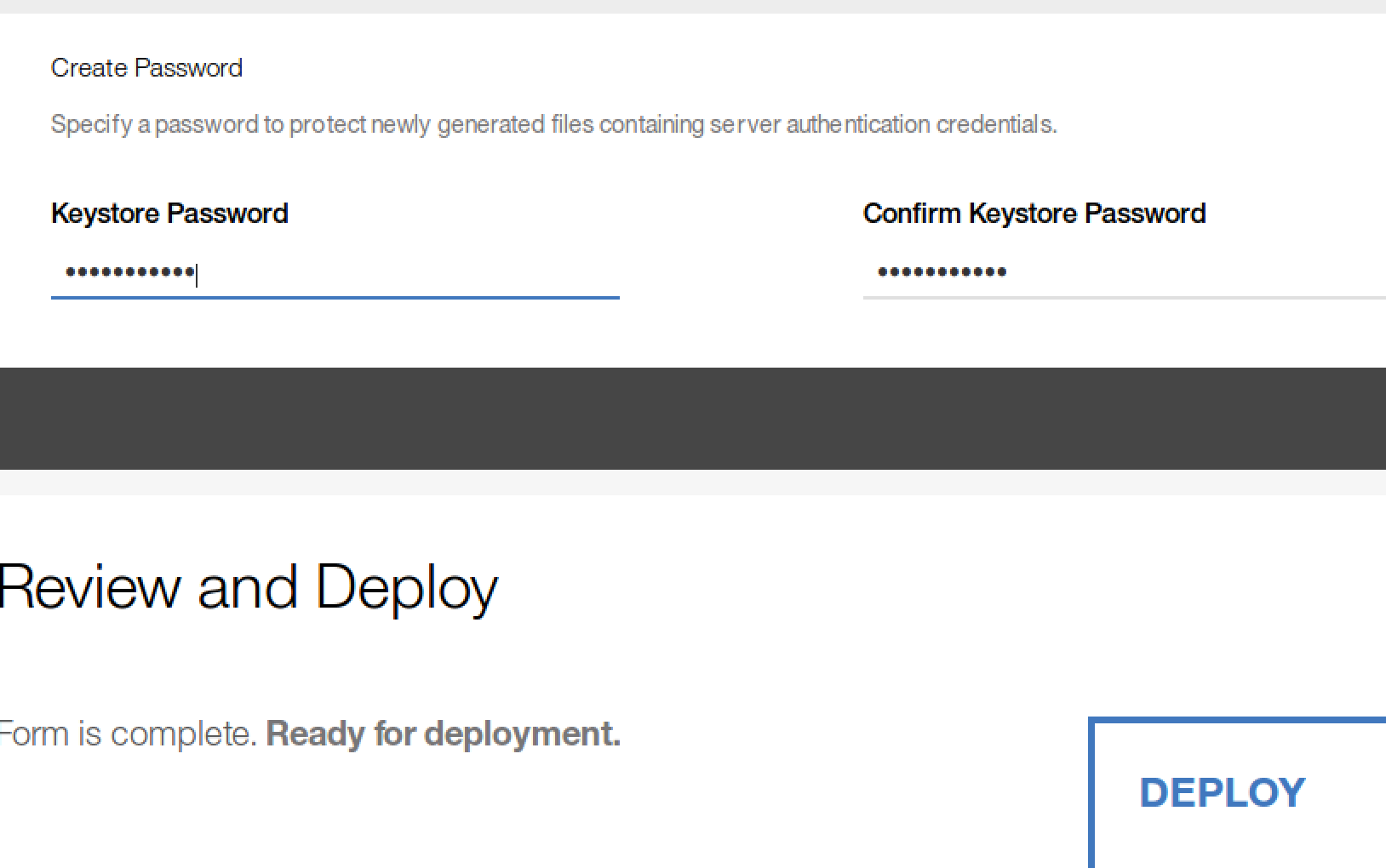
1. On the Deployment Parameters screen, enter the following: NOTE: Currently the Browse button is only functioning for server packages less than 200MB. Because we package the JRE with the server package the Browse button will fail with a file too big. This is slated to be fixed in 17.0.0.3.
   1. Package directory: ***{LAB\_HOME}*\wlp\usr\servers\dynamic\_1**
   2. Server Package File: **dynamic\_1.zip**
   3. Target Directory: ***{LAB\_HOME}/*packagedServers** Recall that earlier we ran a **collective updateHost** command to inform the controller what directory we are able to deploy to.



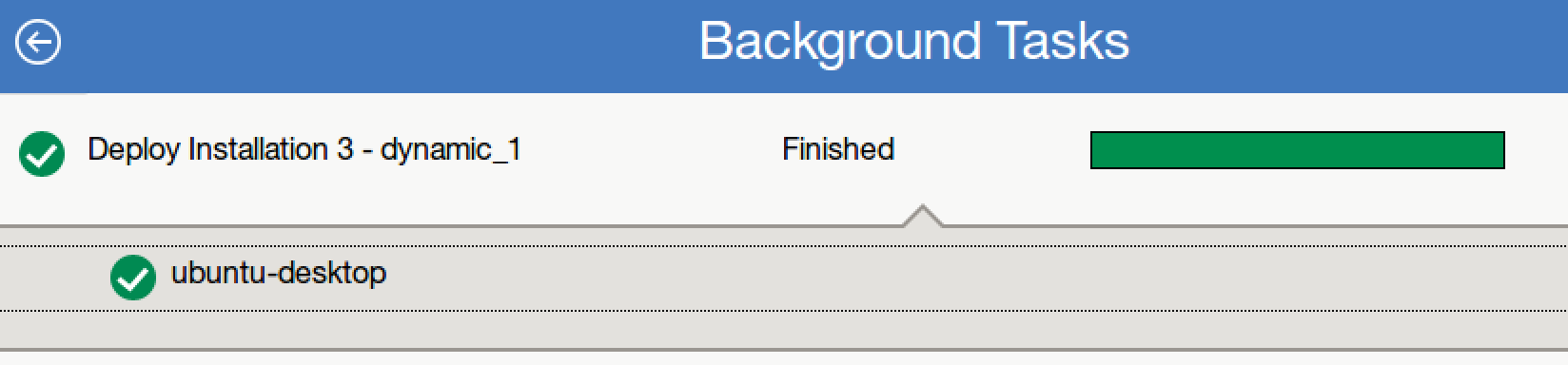
1. Scroll down to select the host. On the right-hand side, click on the appropriate hostname. If you have many hosts, use the search host bar. For this lab, it should be the same as the COMPUTERNAME environment variable that you set. Once clicked it will move to the left and change to 1 selected host



1. Scroll down and enter **labPassword** into the **Keystore Password** and **Confirm Keystore Password** then click the **Deploy** button.



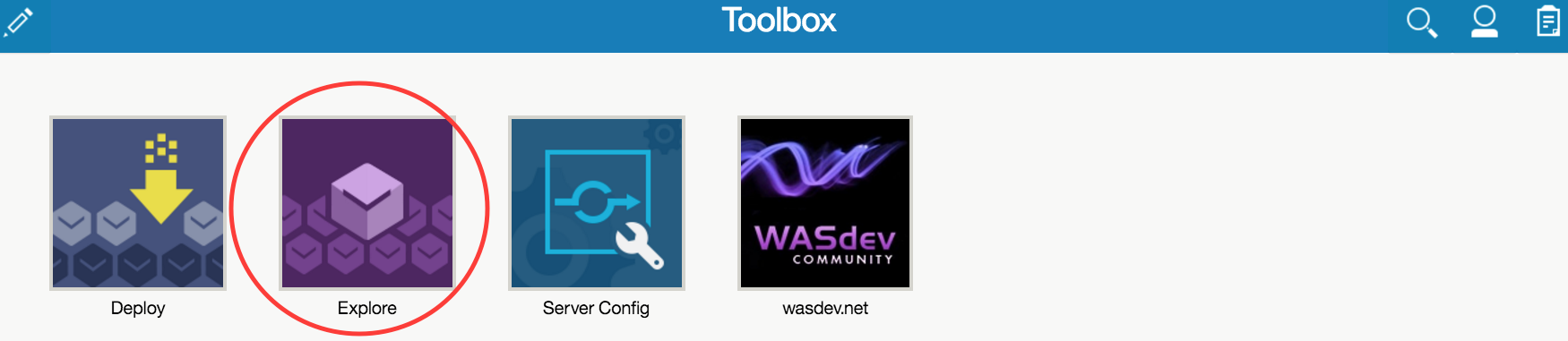
1. Wait for the upload to complete, then click the clipboard icon at the upper-right corner of the window to get to the Task History. Click **Task Details and History** to see the status of the deployment.
2. Problem Determination:
   1. If you get this message: **“CWWKX7204E: Cannot connect to host <host name> with the credentials provided”,** ensure you entered the correct user ID and password. Also ensure you have enabled File and Print Sharing for your network adapter.
   2. If you get a **CWWKX0262E** message, ensure you specified the correct hostReadPath and hostWritePath options when running the **“collective updateHost**” command above. You may re-run the command again with the correct values. Also ensure you specified **{LAB\_HOME}/packagedServers/dynamic\_1** as the destination directory.
3. A Successful deployment looks like:



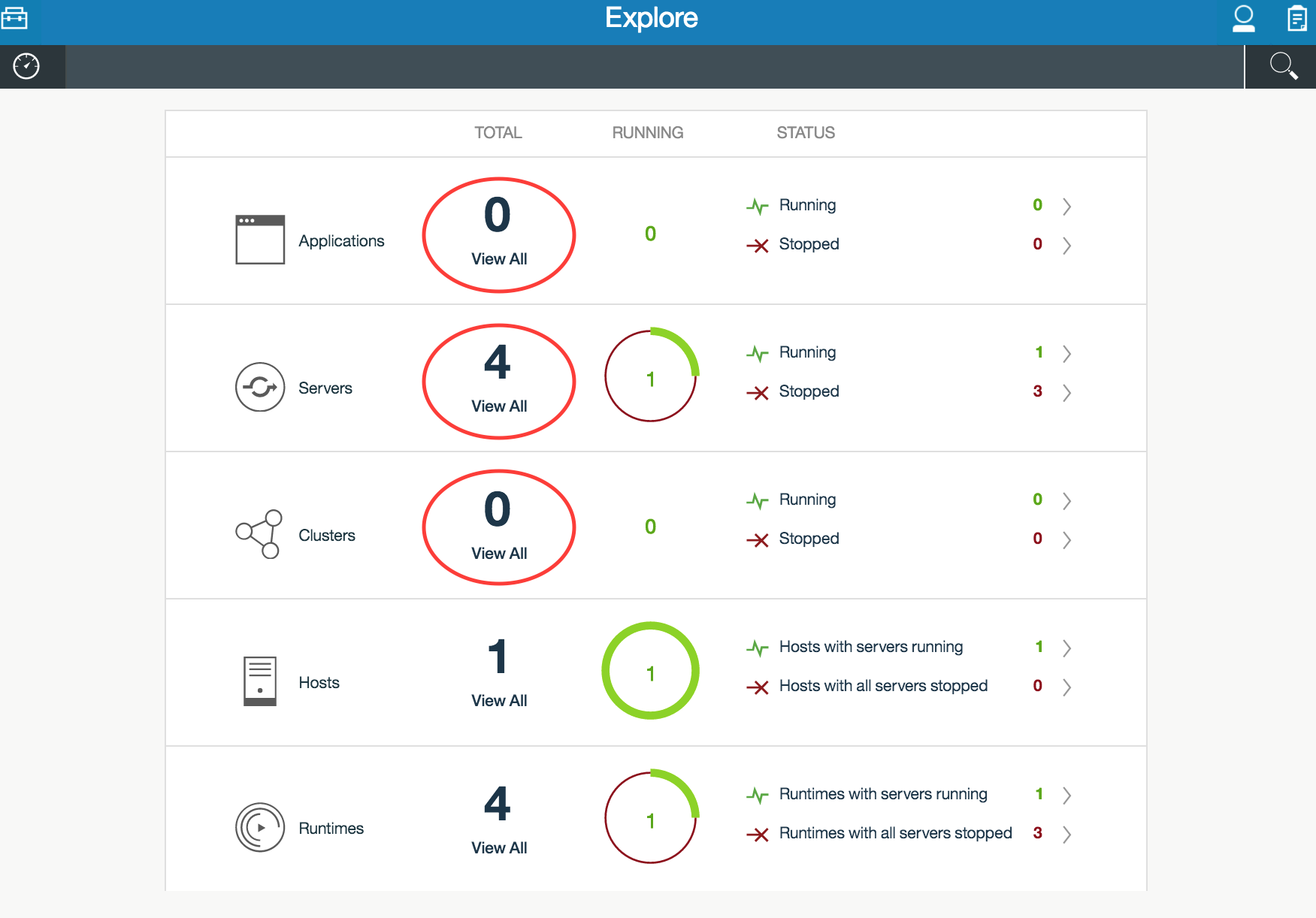
1. Examine what has been deployed by the AdminCenter:
   1. Look at the files in the {LAB\_HOME}\packagedServers\dynamic\_1\wlp\usr\servers\dynamic \_1 directory.
   2. Note that the collective controller creates the configDropins/defaults/additionalConfig.xml that allows the member to join with the controller.
2. Repeat **Step 3** to **Step 19** for **dynamic\_2** directory
3. Repeat **Step 3** to **Step 19** for **dynamic\_3** directory

## Testing Auto Scaling

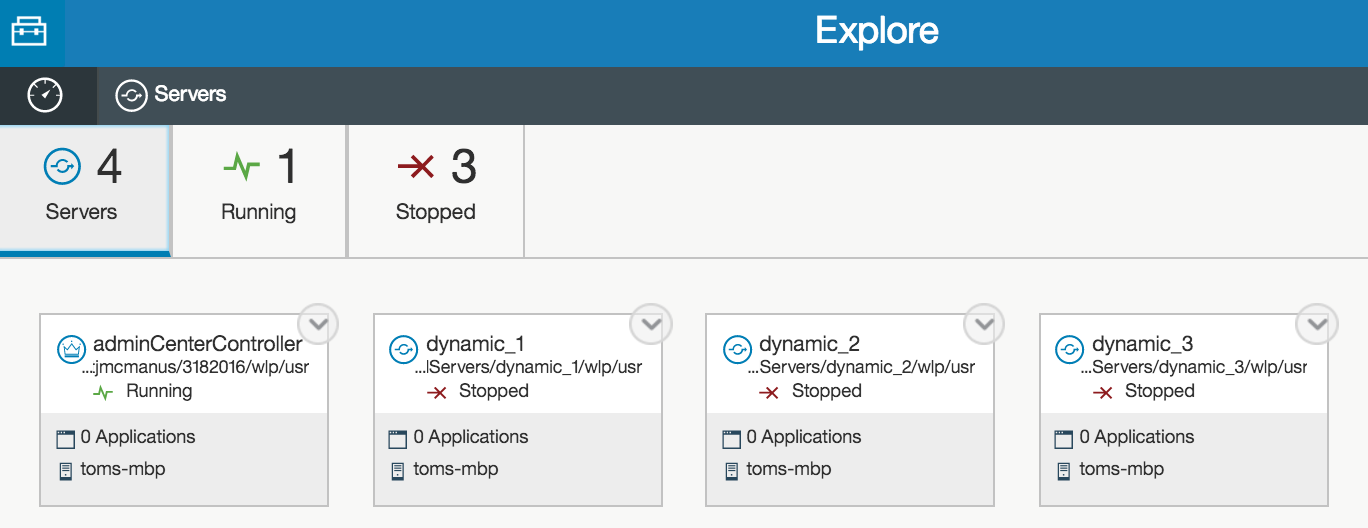
1. Go back to the **Explore** view.



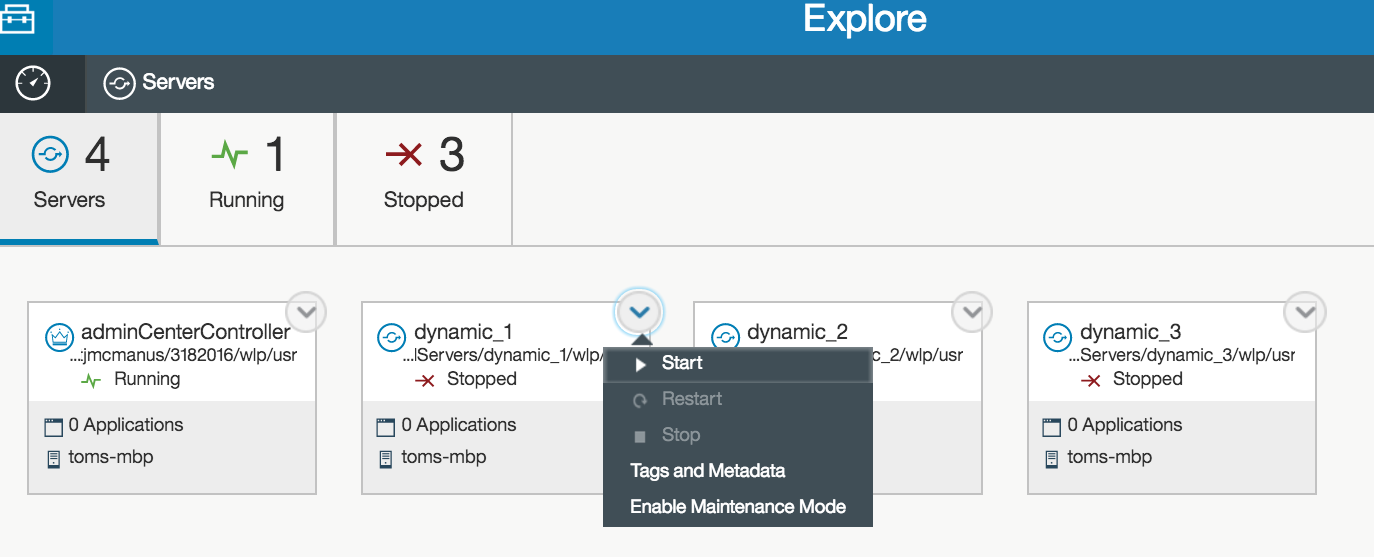
1. Notice that there are now three new servers. However, no cluster has been detected yet.



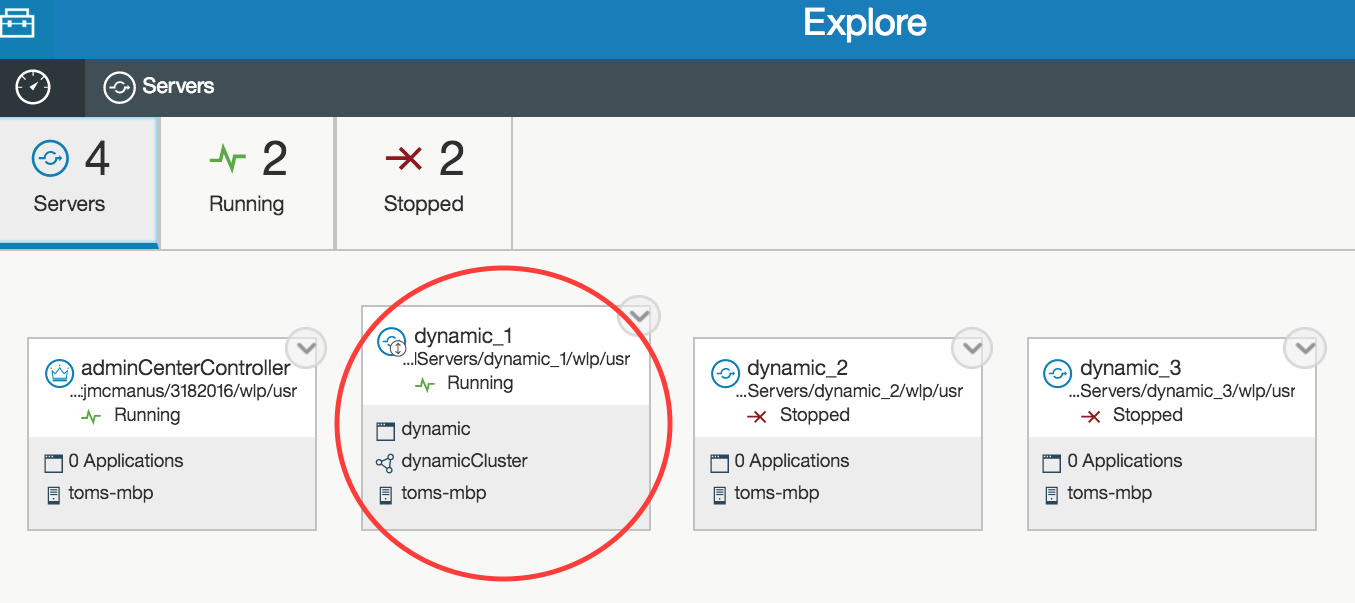
1. Click the **Servers** panel. You should see dynamic\_1, dynamic\_2 and dynamic\_3 in Stopped state.



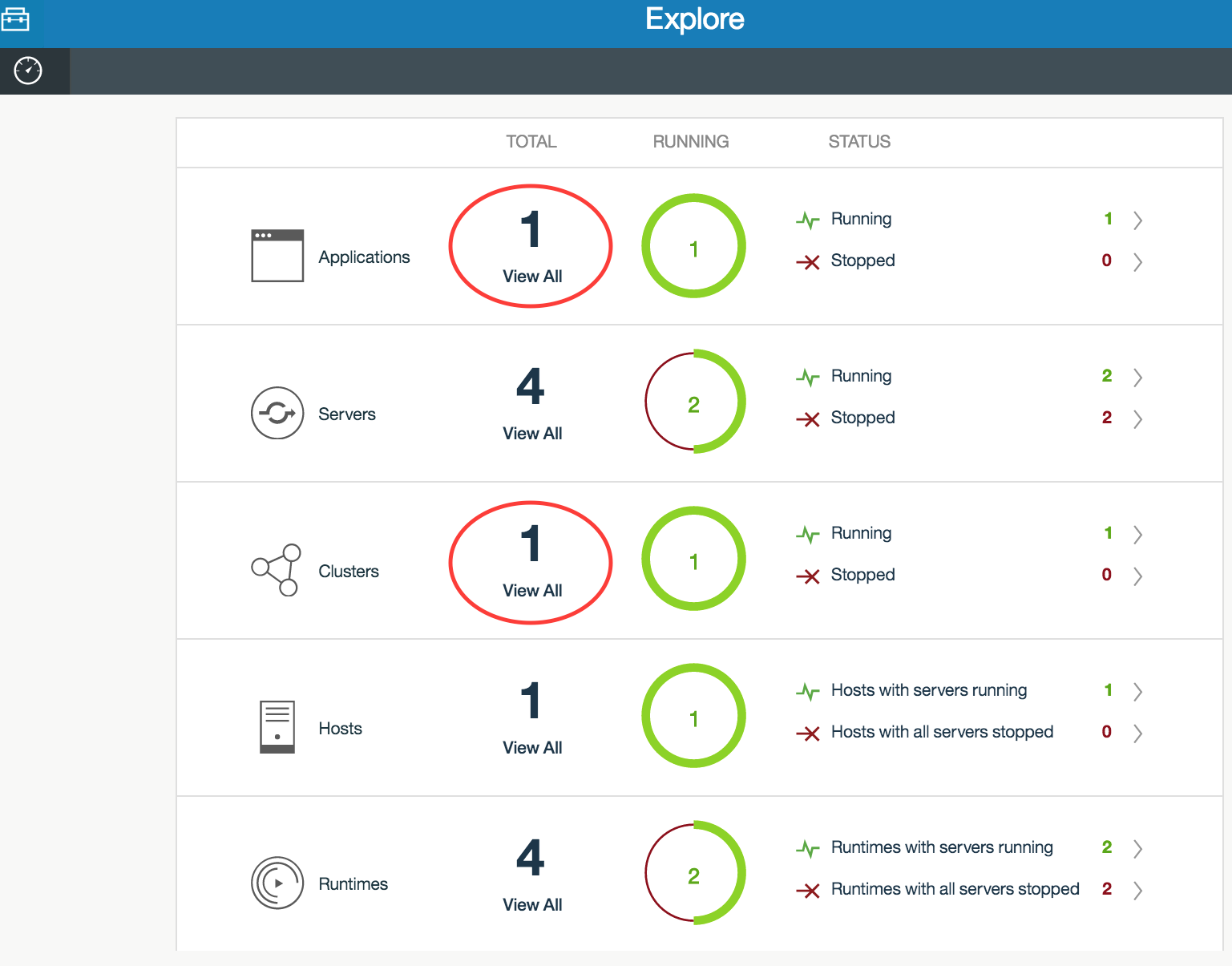
1. Click the  icon on the top-right of the dynamic\_1 server box, then click on **Start**



1. Shortly the server status will change to **Running**



1. Note that a cluster is now detected and the application is running



1. Similarly try startingthe servers **dynamic\_2** and **dynamic\_3**
2. Note that some of the servers may not be started/stopped because of policy breach. However, the breach may not occur on your machine depending on the hardware you have.

For the controller to stop the application server on your hardware based on the policy we have defined, you must have:

* + - * 1. Less than 30% heap being used by the application server
        2. Less than 30% cpu utilization on the host
        3. Less than 30% total memory utilization used on the host

1. To determine whether or not the controller has taken a policy action, look in the **messages.log** file of **adminCenterController**. If it has taken action, the log entries look like :

[5/28/15 6:32:57:385 EDT] 00000061 com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0115I: The scaling controller is stopping server dynamic\_2 in user directory C:/wlp\_pot/packagedServers/dynamic\_2/wlp/usr on host win7-x64 to reduce capacity in cluster dynamicCluster.

[5/28/15 6:33:30:635 EDT] 00000061 com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0114I: The scaling controller has successfully stopped server dynamic\_2 on host win7-x64.

[5/28/15 6:33:30:344 EDT] 0000002e com.ibm.ws.scaling.controller.topology.RepositoryMonitor I CWWKV0121I: The server dynamic\_3 in user directory C:/wlp\_pot/packagedServers/dynamic\_3/wlp/usr on host win7-x64 has been defined as a scaling member in cluster dynamicCluster.

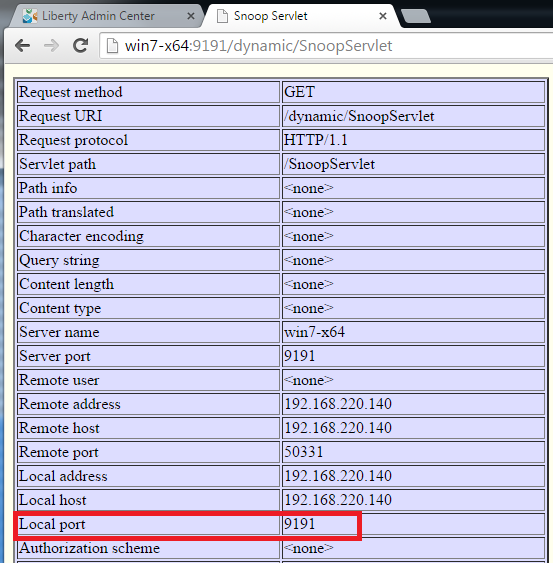
[5/28/15 6:33:30:344 EDT] 0000002e com.ibm.ws.scaling.controller.topology.RepositoryMonitor I CWWKV0121I: The server dynamic\_3 in user directory C:/wlp\_pot/packagedServers/dynamic\_3/wlp/usr on host win7-x64 has been defined as a scaling member in cluster dynamicCluster.

1. Ensure that the cluster dynamicCluster is running with at least one server.
2. Ensure you can access at least one of the pages.

http://<host>:9191/dynamic/SnoopServlet

http://<host>:9192/dynamic/SnoopServlet

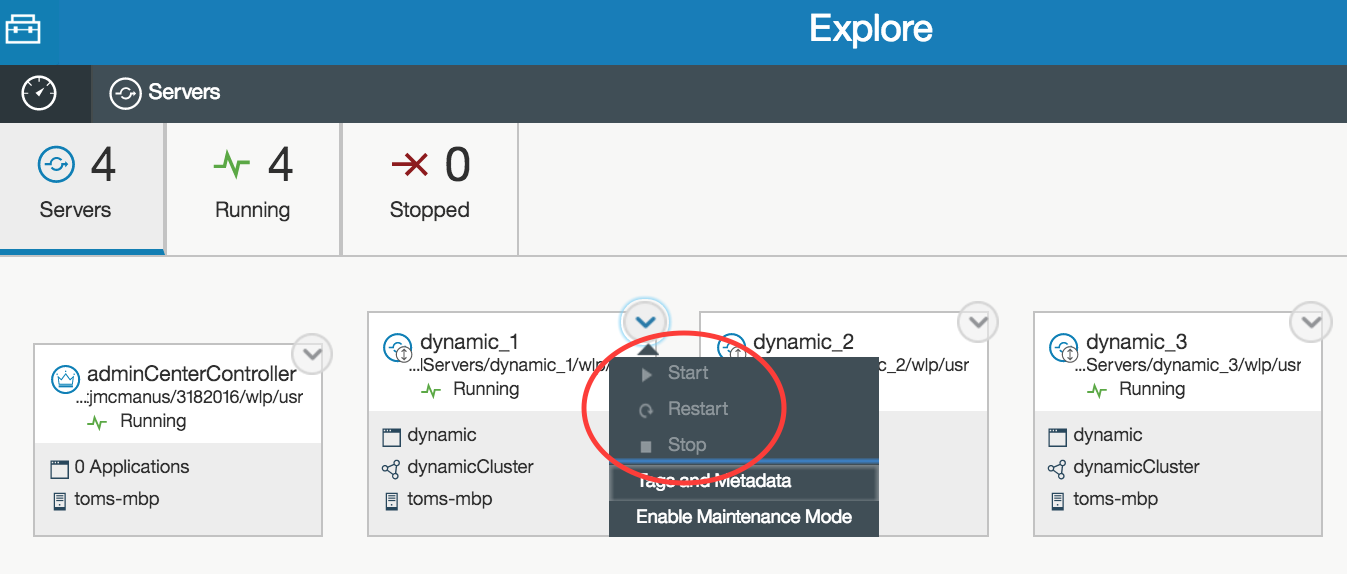
http://<host>:9193/dynamic/SnoopServlet



## Changing Scaling Policy

In this section we will demonstrate auto-scaling by changing the scaling policy.

1. From the admin center, navigate to the **Servers** page.
2. Note that you are unable to **start/stop** the servers for dynamic clusters from the admin center. The reason is that you should only have to define the policy and let the scaling controller adjust the number of JVMs.

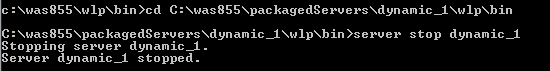


### Test minimum number of servers:

We will test whether the controller maintains a minimum number of servers to be running by stopping all the servers in the dynamic cluster via command line.

|  |  |
| --- | --- |
| sign-info | **Note :**  Some of the servers may already have been stopped by the controller if there was a policy breach for your environment. |

1. Stop dynamic\_1
2. Change directory to {LAB\_HOME}\packagedServers\dynamic\_1\wlp\bin
3. Run the command server stop dynamic\_1



1. Stop server dynamic\_2
   1. Change directory to {LAB\_HOME}\packagedServers\dynamic\_2\wlp\bin
   2. Run the command server stop dynamic\_2
2. Stop server dynamic\_3
   1. Change directory to {LAB\_HOME}\packagedServers\dynamic\_3\wlp\bin
   2. Run the command server stop dynamic\_3
3. Wait at least 30 seconds and verify the controller has started one instance. You can check status of the server in the admin center, and verify the action in messages.log of the controller:

[5/28/15 7:25:00:572 EDT] 000001fd com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0111I: The scaling controller is starting server dynamic\_2 in user directory C:/wlp\_pot/packagedServers/dynamic\_2/wlp/usr on host win7-x64 to meet the minimum instances for cluster dynamicCluster.

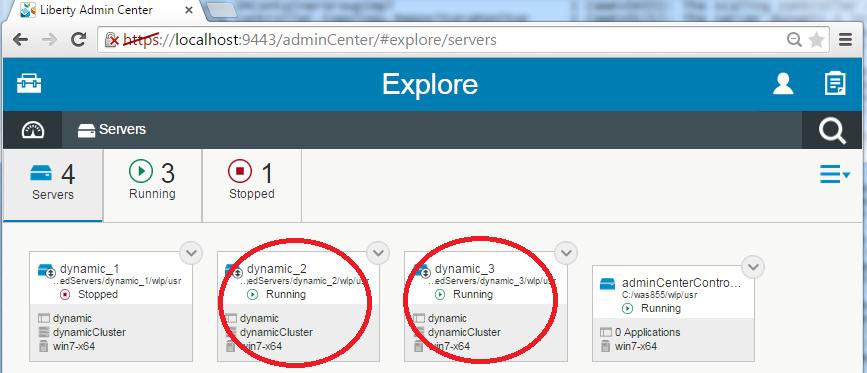
[5/28/15 7:25:14:417 EDT] 000001fd com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0112I: The scaling controller has successfully started server dynamic\_2 on host win7-x64.

1. Change minimum instances:
   1. Start a text editor and edit saclingpolicy.xml of **adminCenterController.**
   2. Change the minimum instance to 2.

<defaultScalingPolicy min="**2**" max=”4” enabled="true” >

* 1. Save the changes.

1. Verify one more instance has been started by the controller:



### Testing Scaling-in.

1. If the controller has not previously reduced the number of running instances, it is because one of the following conditions apply to your hardware:
   1. CPU > 30% or
   2. Total memory in use > 30%, or
   3. Heap size of every instance > 30%
2. We can demonstrate scale in by defining an artificial policy designed to force the controller to scale in. Listed below new policy, which sets minimum instance back to **1**, and the minimum CPU/Heap/Memory to be **98%** for scale-in to take place

<scalingDefinitions>

<defaultScalingPolicy min="1" max="4" enabled="true" >

<metric name="cpu" min="98" max="99"/>

<metric name="heap" min="98" max="99" />

<metric name="memory" min="98" max="99" />

<in units="instance" amount="1" minInterval="30s"/>

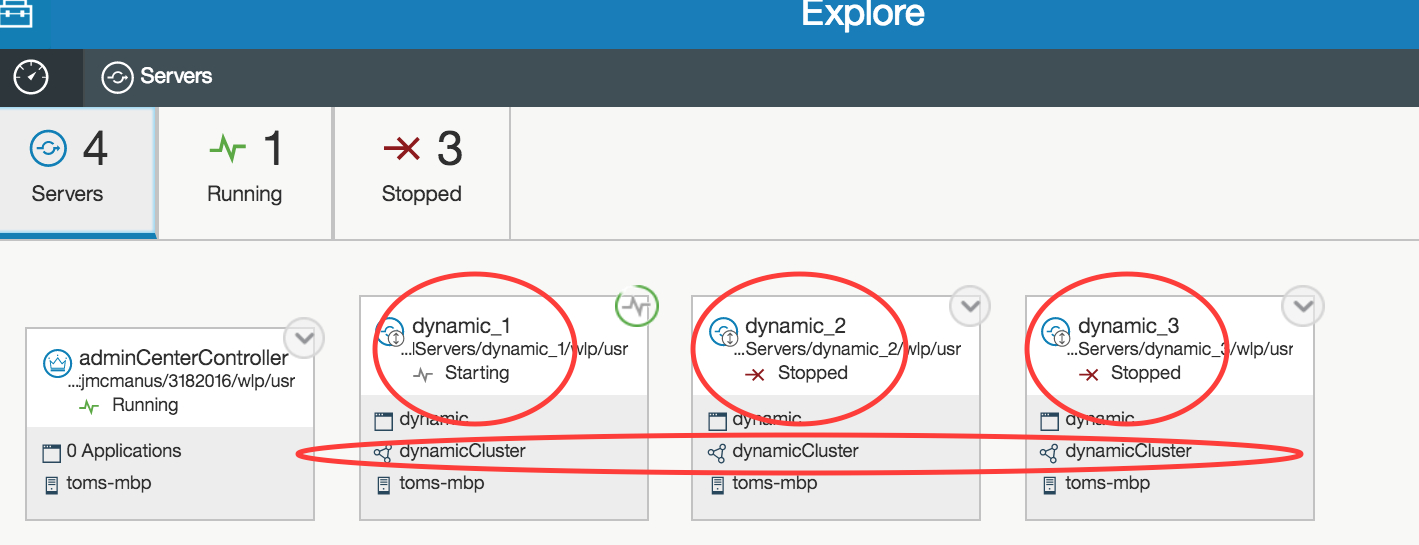
<out amount="1" units="instance" minInterval="30s" />

</defaultScalingPolicy>

</scalingDefinitions>

|  |  |
| --- | --- |
| sign-info | **Note :**  **The artificial policy is not normally a policy we would define in a working environment** |

1. Save the changes and ensure the controller has taken action to stop one more instance.



### Test Scale-out:

1. In a normal environment, increasing user workload will increase CPU, total memory, and heap usage to drive a policy breach and cause the controller to start another instance on the same or different hosts.

Due to the constraints of our lab environment, we need to again define an artificial policy to cause a policy breach to scale out. This time, we will make the minimum heap 1%, and maximum heap 2%, which should cause the controller to start more JVM instances:

<scalingDefinitions>

<defaultScalingPolicy min="1" max="4" enabled="true" >

<metric name="cpu" min="30" max="80"/>

<metric name="heap" min="**1**" max="**2**" />

<metric name="memory" min="30" max="80" />

<in units="instance" amount="1" minInterval="30s"/>

<out amount="1" units="instance" minInterval="30s" />

</defaultScalingPolicy>

</scalingDefinitions>

1. Ensure the controller has taken action to start one more instance. This may take up to 30 seconds based on the policy. If you wait 30 seconds longer, the controller should start all the instances as well, as each will be using more than 2% heap.

[5/29/15 3:02:52:059 EDT] 000000c2 com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0113I: The scaling controller is starting server dynamic\_2 in user directory C:/wlp\_pot/packagedServers/dynamic\_2/wlp/usr on host win7-x64 to increase capacity in cluster dynamicCluster. **The average heap utilization in the cluster is 2.428 percent.**

[5/29/15 3:03:10:220 EDT] 000000c2 com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0112I: The scaling controller has successfully started server dynamic\_2 on host win7-x64.

[5/29/15 3:03:22:075 EDT] 000000c9 com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0113I: The scaling controller is starting server dynamic\_3 in user directory C:/wlp\_pot/packagedServers/dynamic\_3/wlp/usr on host win7-x64 to increase capacity in cluster dynamicCluster. **The average heap utilization in the cluster is 4.857 percent.**

[5/29/15 3:03:36:115 EDT] 000000c9 com.ibm.ws.scaling.controller.internal.ScalingExecutorImpl I CWWKV0112I: The scaling controller has successfully started server dynamic\_3 on host win7-x64.

### Test Cold Start

1. Logout of **admin center** from the browser
2. Stop the **adminCenterController** from command line



1. Stop all the **servers** from the command line.





1. Edit **scalingpolicy.xml** of the controller and reset the scaling policy to the initial one used for this lab.

<scalingDefinitions>

<defaultScalingPolicy min="1" max="4" enabled="true" >

<metric name="cpu" min="30" max="80"/>

<metric name="heap" min="30" max="80" />

<metric name="memory" min="30" max="80" />

<in units="instance" amount="1" minInterval="30s"/>

<out amount="1" units="instance" minInterval="30s" />

</defaultScalingPolicy>

</scalingDefinitions>

1. Save the changes.
2. Start the **adminCenterController**
3. Login to the admin center. Note that it reports the status of all the servers as running. This is the due to the admin center retaining the cached status of the members when it was stopped. Wait a few minutes for the admin center to discover the members are not actually running and update display.
4. Verify that the controller starts at least one member.
5. Try to use cluster specific policy. Note that min has been set to 2 to force minimum of 2 members for dynamicCluster to demonstrate it has taken effect.

<scalingDefinitions>

<scalingPolicy min="2" max="4" enabled="true" >

<bind clusters="dynamicCluster" />

<metric name="cpu" min="30" max="80"/>

<metric name="heap" min="30" max="80" />

<metric name="memory" min="30" max="80" />

<in units="instance" amount="1" minInterval="30s"/>

<out amount="1" units="instance" minInterval="30s" />

</scalingPolicy>

</scalingDefinitions>

## Clean up

Follow the steps in the sections below to clean up the environment and continue with the remaining labs.

1. Disable the policy for the dynamic cluster:

<scalingPolicy min="2" max="4" enabled="false" >

1. Stop all the servers **dynamic\_1, dynamic\_2**, and **dynamic\_3**
2. Un-deploy each server using the instructions in the “**Cleanup”** section of the Admin Center lab.

## Summary

In this lab you have learned:

* How to use the auto-scaling feature on Liberty by editing the scaling policy to :
  + - Maintain minimum number of servers
    - Scale-in
    - Scale-out
    - Cold restart.

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