

**F5[®] BIG-IQ[®] Centralized Management:
Upgrading a 5.1 Logging Node Cluster to
the Latest Version with Minimal Downtime**

Version 5.4



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Logging Node Cluster Upgrade Overview

What is a minimal downtime upgrade?

The minimal downtime upgrade process significantly reduces the amount of time your cluster is offline while you are upgrading to the latest version. The degree to which your cluster can maintain complete online function during upgrade depends on which BIG-IP services and what kind of data you collect.

- Operators using the BIG-IQ to review alerts and events may notice slightly slower performance during the upgrade. Data may take a bit longer to refresh and searches may take a little more time to execute.
- You should not lose any ASM events and FPS alerts during the upgrade.
- There is a brief (approximately 5 seconds) downtime when the master node is upgraded.
- There is another short (less than a minute) downtime when the secondary BIG-IQ is paired with the primary.

Decide which upgrade guide to use

There are a number of different upgrade guides you can use to upgrade the BIG-IQ® Centralized Management logging node cluster to the latest version. To decide which guide to use, you need to consider a number of factors. First, consider which version you are upgrading from. Then use the appropriate table to determine which guide is most appropriate for your business needs.

Upgrading from version 5.0

To upgrade from version 5.0, use the guide on support.f5.com titled: *F5 BIG-IQ Centralized Management: Upgrading Logging Nodes to Version 5.1*. When a task instructs you to download and install a v5.1.0 file, download and install a v5.4.0 file instead.

Additionally, after the upgrade is complete, you need to use the 5.4.0 user interface to configure an external storage location for the snapshots created for this cluster. To configure the external storage, you will need the IP address, storage file path, domain name, user name, and password for the location you plan to configure. To access the External Storage screen, click **System > BIG-IQ DATA COLLECTION > Big-IQ Data Collection Cluster > Configuration > External Storage & Snapshots** and then click **Configure**. For additional details, refer to *Define external storage snapshots location* on support.f5.com.

Upgrading from version 5.1

Before you upgrade BIG-IQ from version 5.1, you need to answer a couple of questions.

- Do you need to preserve the data on your logging node cluster?
- If so, can you allow your logging node cluster to go offline for an extended period during the upgrade?

Depending on your answers, select one of the following scenarios for further instructions:

I do not need to preserve my data

Use the guide titled: *F5 BIG-IQ Centralized Management: Upgrading Logging Nodes to Version 5.2 Without Preserving Existing Data*. When a task instructs you to download and install a v5.2.0 file, download and install a v5.4.0 file instead.

I need to preserve my data and I can take my logging node cluster offline during upgrade

Use the guide titled: *F5 BIG-IQ Centralized Management: Upgrading Logging Nodes to Version 5.2 While Preserving Existing Data*. When a task instructs you to download and install a v5.2.0 file, download and install a v5.4.0 file instead.

I need to preserve my data, I have at least 3 logging nodes, and I need to minimize logging cluster downtime during upgrade

Use the guide titled: *F5 BIG-IQ Centralized Management: Upgrading a Logging Node Cluster from 5.1 to Version 5.4 with Minimal Downtime*.

Regardless of which guide you use, after the upgrade is complete, you need to use the 5.4.0 user interface to configure an external storage location for the snapshots created for this cluster. To configure the external storage, you will need the IP address, storage file path, domain name, user name, and password for the location you plan to configure. To access the External Storage screen, click **System > BIG-IQ DATA COLLECTION > Big-IQ Data Collection Cluster > Configuration > External Storage & Snapshots** and then click **Configure**. For additional detail, refer to *Define external storage snapshots location* on support.f5.com.

Upgrading from version 5.2 or 5.3

To decide which guide to use when you upgrade from BIG-IQ[®] version 5.2 or 5.3, the main question to answer is whether you can allow your data collection device (DCD) cluster to go offline for an extended period during the upgrade. If you can afford the downtime, the workflow is much more straightforward and takes significantly less effort on your part.

I can take my DCD cluster offline during upgrade

Use the guide titled: *F5 BIG-IQ Centralized Management: Upgrading a Data Collection Cluster to Version 5.4*

I need to preserve my data, I have at least 3 DCDs, and I need to minimize logging cluster downtime during upgrade

Use the guide titled: *F5 BIG-IQ Centralized Management: Upgrading a Data Collection Device Cluster from 5.2 or 5.3 to Version 5.4 with Minimal Downtime*

How do I upgrade my logging node cluster to the latest version with minimal downtime?

A *logging node cluster* is made up of all of your logging nodes, the BIG-IQ[®] Centralized Management device you use to manage them, and an optional BIG-IQ peer device. To avoid taking the logging node cluster offline for an extended time during upgrade, you require a specific workflow.

The diagram illustrates the task sequence for the minimal downtime workflow.

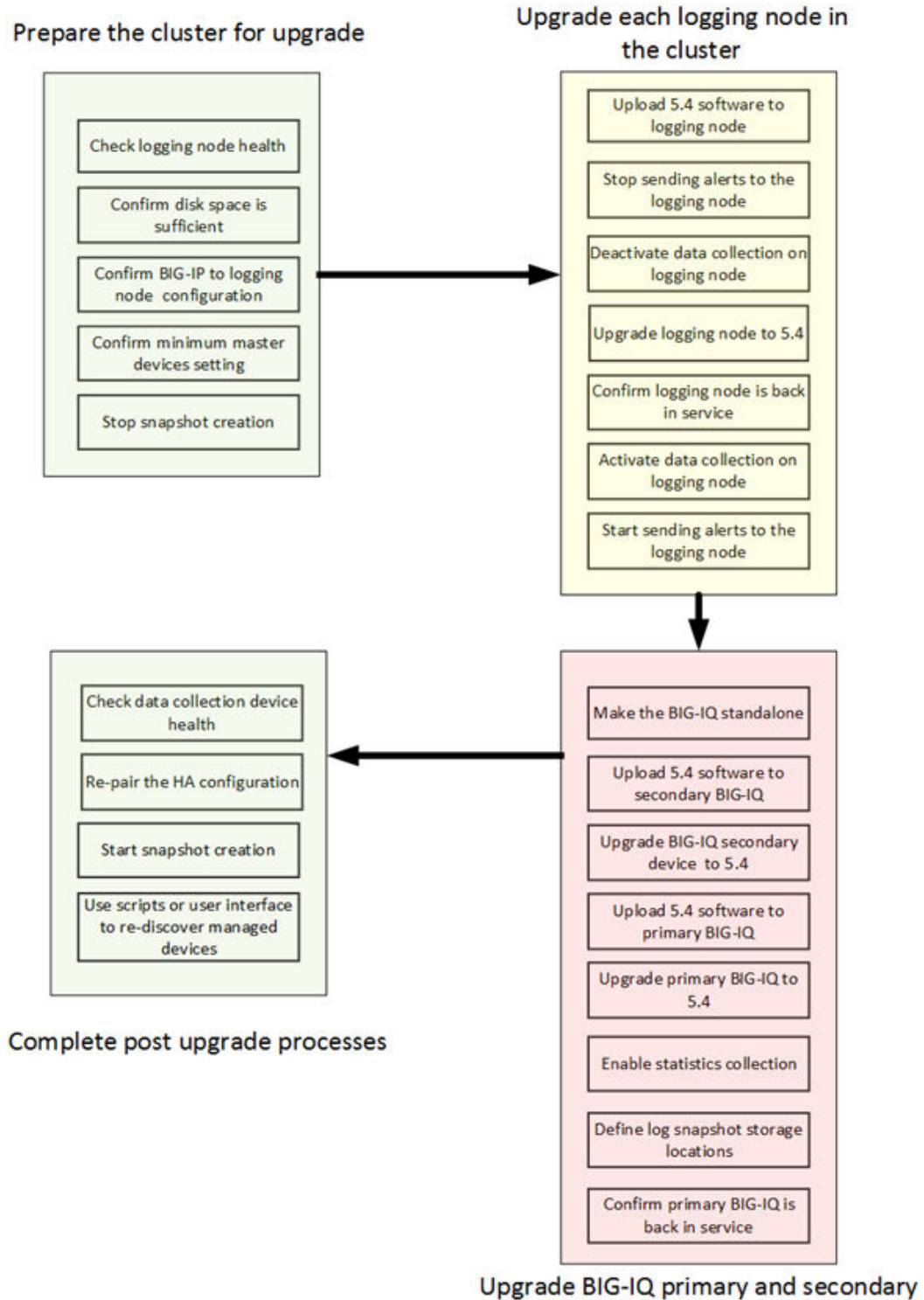


Figure 1: logging node cluster minimal downtime upgrade

Note: To upgrade the logging node cluster successfully with minimal downtime, it is essential that you perform the tasks in the sequence detailed here. You cannot perform these tasks in parallel.

Logging node cluster update requirements

There are a number of items that you need to have ready access to, before you can successfully complete the logging node cluster update. It might be helpful to use the following table to record the values, so you have them at hand when needed.

Device	Information needed	Information Recorded
Primary BIG-IQ Centralized Management device	Management IP address admin user name and password root access password	
Secondary BIG-IQ device	Management IP address root access password admin user name and password	
Logging nodes	Management IP address root access password	

Prepare for Logging Node Upgrade with Minimal Downtime

Preparing the logging node cluster for upgrade with minimal downtime

If you choose the minimal downtime method, you can upgrade your logging node cluster minimizing the time that the cluster is offline.

***Important:** You cannot perform the minimal downtime upgrade unless you have at least 3 logging nodes in your cluster.*

Check Logging Node health

You can use the Logging Configuration screen to review the overall health and status of the Logging Nodes you've configured. You can use the data displayed on this screen both before and after an upgrade to verify that your Logging Node cluster configuration is as you expect it to be.

***Note:** Perform this check on the BIG-IQ[®]; not on the Logging Node.*

1. At the top of the screen, click **System Management**.
2. At the top of the screen, click **Inventory**.
3. On the left, expand **BIG-IQ LOGGING** and then select **Logging Configuration**.
The Logging Configuration screen opens to display the current state of the logging node cluster defined for this device.
4. Record these Logging Node cluster details as listed in the Summary area.
 - Logging Nodes in Cluster
 - Nodes in Cluster

This information provides a fairly detailed overview that describes the Logging Node cluster you have created to store alert or event data. After you complete an upgrade, you can check the health again, and use this information to verify that the cluster restored successfully.

5. If there are any cluster health issues, resolve those issues and then repeat the process until the cluster health is as expected.

Confirm disk space is sufficient for upgrade with minimal downtime

As part of preparing to upgrade your logging node with minimal downtime, you must confirm that there is sufficient disk size in the cluster so that when you take a logging node offline, there is room for its data on other devices in the cluster. If the amount of free space in the cluster is less than the amount of data on any one node, then there is insufficient space to upgrade without downtime. If this is the case, you need to either add logging nodes or increase storage space on the existing logging nodes.

1. Use SSH to log in to a device in the cluster.
You must log in as `root` to perform this procedure.
2. Determine the storage space requirement for your logging node cluster using the following command:

```
curl localhost:9200/_cat/allocation?v
```

```
shards disk.indices disk.used disk.avail disk.total disk.percent host ip node
57 397.5mb 2gb 7.8gb 9.8gb 20 10.10.10.5 10.10.10.5 8637c04c-1b83-4795-b1f0-347ac733fd10
56 471.7mb 2.2gb 7.5gb 9.8gb 23 10.10.10.3 10.10.10.3 9d718ba7-5bb9-4866-9aa3-4677a1f60e46
56 393mb 2.1gb 7.7gb 9.8gb 21 10.10.10.2 10.10.10.2 8c4e58b4-a005-404f-9a53-6e318ec0e381
57 444.2mb 2gb 7.8gb 9.8gb 20 10.10.10.10 10.10.10.10 11ac40f9-5b13-4f9a-a739-0351858ba571
```

3. Analyze the storage space requirement for your logging node to determine if there is sufficient disk space.

In the previous example, there is plenty of space. The logging node consuming the most data is only consuming 2.2 GB, and each of the other logging nodes has almost 8 GB free. So when that logging node goes offline to upgrade, the system can move the 2.2 GB of data to the remaining 15.5 GB of free space. If these numbers were reversed, so that the logging node consuming the most storage had 7.8 GB of data, and the remaining logging nodes only had 6.3 GB free, there would be insufficient space to move the data when that logging node went offline.

If there is sufficient space, you can proceed. Otherwise, you need to either add logging nodes, or add logging node storage space.

Confirm that BIG-IP logging node configuration is correct

In preparing to upgrade your logging node with minimal downtime, you must confirm that the BIG-IP[®] device to logging node configuration is correct, so that when a particular logging node is upgraded, data that was being routed to it is automatically routed to another logging node in the cluster. There are two settings of particular concern:

- Confirm that data sent from the BIG-IP devices is not being sent to just one logging node. Each BIG-IP device must be configured to send data to multiple logging nodes.
- Confirm that the BIG-IP devices are configured with appropriate monitors that allow for traffic to switch to a different logging node when one logging node is taken offline.

1. Analyze the data routing configuration for all of the BIG-IP devices that send data to your logging node cluster.

2. If you find a BIG-IP device that is configured to send data to only one logging node, change that configuration before proceeding.

Refer to the BIG-IP documentation on support.f5.com for details on how to configure the BIG-IP to logging node routing.

3. Analyze the monitor configuration for all of the BIG-IP devices that send data to your logging node cluster. Make sure that each device is configured to send data to an alternate logging node if one logging node goes offline.

4. If you find a BIG-IP device that is not configured with appropriate monitors, change that configuration before proceeding.

Refer to the BIG-IP documentation on support.f5.com for details on how to configure BIG-IP monitors correctly.

Stop snapshot creation

Because of the mixed software version environment that occurs during the upgrade process, if snapshot schedules are configured for the cluster, you should stop creating snapshots before you begin the upgrade to prevent possible issues with your data.

1. Use SSH to log in to the primary BIG-IQ system for this cluster.

You must log in as `root` to perform this procedure.

2. Retrieve the list of scheduled snapshots using the following command: `restcurl cm/shared/esmgmt/es-snapshot-task | grep task-scheduler`

```
config # restcurl cm/shared/esmgmt/es-snapshot-task | grep task-scheduler
"link": "https://localhost/mgmt/shared/task-scheduler/scheduler/0fdf50ec-8a17-3da9-b717-
c63637ccc68a"
"link": "https://localhost/mgmt/shared/task-scheduler/scheduler/
0af33352-2f33-32b3-85cb-1281bb88c249"
"link": "https://localhost/mgmt/shared/task-scheduler/scheduler/2ad770a8-
bdb0-3383-99a9-300846eb0972"
```

In the example here, there are 3 snapshots scheduled.

3. Stop each of the schedules using the following command: `restcurl -X PATCH -d '{"status":"DISABLED"}' shared/task-scheduler/scheduler/<SNAPSHOT ID>`

```
#restcurl -X PATCH -d '{"status":"DISABLED"}'
shared/task-scheduler/scheduler/0af33352-2f33-32b3-85cb-1281bb88c249
{ "id": "0af33352-2f33-32b3-85cb-1281bb88c249", "status":"DISABLED", ...}
```

After you run the command for each scheduled snapshot, no more snapshots are created.

Upgrade the Logging Nodes in Your Cluster with Minimal Downtime

Before you upgrade the logging node from version 5.1 to the latest version

Before upgrading the F5® BIG-IQ® Centralized Management logging node, perform these tasks.

Tasks	Additional information
Reactivate the BIG-IQ system license.	You must do this for each logging node in the cluster. For specific instructions about how to reactivate a license, refer to the <i>F5® BIG-IQ® Central Management: Licensing and Initial Setup</i> guide.
Decide which disk volume to install the upgrade on. At least two volumes are required to upgrade BIG-IQ.	If the machine you are upgrading does not have two volumes, you must create one using a CLI command. The upgrade task provides options for either case.

Upgrade the logging nodes to the latest version

After you prepare the logging node cluster for upgrade, use these procedures to upgrade the logging nodes in your cluster. Perform the following tasks for each logging node in the cluster.

1. Upload the latest version of the BIG-IQ software image.
2. From the BIG-IP device(s), take the logging node out of the alert-traffic flow.
3. Deactivate data collection services.
4. Upgrade the logging node to the latest version.
5. Confirm that the logging node is back in service.
6. Reactivate data collection services.
7. From the BIG-IP device(s), bring the logging node back online.

Important: To successfully upgrade your logging node cluster with minimal downtime, it is critical that you perform this sequence of tasks to each logging node in the cluster serially, not in parallel.

Upload the latest version of the BIG-IQ software image

Download the software image from the F5 Downloads site.

You upload the latest version of the BIG-IQ® software image to your logging node to make it available for this upgrade.

1. At the top of the screen, click **System Management**.
2. At the top of the screen, click **Inventory**.
3. Click the **Upload Image** button.
4. Click the **Choose File** button and go to the location to which you downloaded the image, and click the **Open** button to upload it to BIG-IQ.
5. Click the **Upload** button.

The screen refreshes to display the progress of the upload.

When the image is done uploading, it shows in the Available Images list.

Stop sending alerts to the logging node

To upgrade your logging node cluster with minimum downtime, before you begin the process of updating your logging nodes, you must complete the upgrade preparation described in *Prepare for Logging Node Upgrade With Minimal Downtime*.

This is the first task you must perform on each logging node in the cluster to make sure that you do not lose any data during the upgrade. When you take the logging node that you are about to upgrade offline, the BIG-IP® device routes the data to another logging node in the cluster.

Log in to each BIG-IP device that sends data to your logging node cluster, and revise the configuration so that the data it sends to the cluster does not include the particular logging node that you are preparing to upgrade.

Note: The process for stopping data collection for one logging node in the cluster depends on the kind of data that you collect.

Option	Description
If you collect FPS alerts or IPsec events:	<ol style="list-style-type: none">1. On the BIG-IP device, select Local Traffic > Pools > Pool List.2. Select the pool that sends alerts and events to the logging node.3. Click Members.4. Select the pool member that sends alerts to the target logging node, and disable it.
If you collect ASM® events:	<ol style="list-style-type: none">1. On the BIG-IP device, select Local Traffic > Pools > Pool List.2. Select the pool that contains the members that send events to the logging node.3. Click Members.4. Select the pool member that sends alerts to the target logging node, and disable it.
If you collect APM® events:	You don't need to disable the logging node from the BIG-IP device. All you need to do is deactivate the service.

Deactivate data collection services for version 5.1

You must perform this task for each logging node in the cluster to make sure that you minimize data loss during the upgrade. When you take the logging node that you are about to upgrade off line, the BIG-IP® device routes the data to another logging node in the cluster.

1. Log in to the BIG-IQ primary to deactivate services.
2. At the top of the screen, click **System Management**.
3. At the top of the screen, click **Inventory**.
4. On the left, expand **BIG-IQ LOGGING** and then select **Logging Configuration**.
The Logging Configuration screen opens to display the current state of the logging node cluster defined for this device.
5. Select the device name of the first logging node in your cluster.
The Properties screen for the selected logging node opens.
6. On the left, select **Services**.

7. For each active service, click **Deactivate**.

Important: Before you exit this screen, make a note of the Listener Address for this logging node. You will need it later in the upgrade process.

8. Click **Cancel**.
The screen closes and BIG-IQ deactivates your services.

Upgrade the logging nodes to the latest version

Note: If the machine you are upgrading does not have two volumes, you must create one using a CLI command. The following steps provide options for either case.

Before upgrading the logging node, you must have downloaded the latest version of the BIG-IQ® .iso image from the F5 downloads site.

The upgrade process installs the new version of the software on each logging node in your cluster.

1. Log in to the logging node with your admin user name and password.
2. At the top of the screen, click **System Management**.
3. At the top of the screen, click **Inventory**.
4. On the left, click **BIG-IQ DEVICES > BIG-IQ HA**.
5. On the left, click **Software Version**.
6. Click the **Update** button.
7. From the **Software Image** list, select the image you want to install.
8. From the **Target Volume** list, select the volume you want to install the image on.

Note: If the Target Volume list is empty, the machine you are upgrading does not have a second volume available for you to install the upgrade. You must create one to proceed.

- If you selected a target volume, complete the remaining steps to finish the upgrade.
 - If you do not have a second volume, use the following procedure to install the upgrade for this machine:
 - Use SSH to log in to the machine you want to upgrade. You must log in as `root` to perform this procedure.
 - Navigate to the folder where you install software using the command: `cd /shared/images`
 - Install the upgrade to a new volume by running one of the following commands:
 - If you are upgrading a virtual machine: `tmsh install sys software image <full name of the iso file> volume hd1.2 create-volume reboot`
 - If you are upgrading a BIG-IQ 7000 series platform: `tmsh install sys software image <full name of the iso file> volume md1.2 create-volume reboot`
 - While the system installs the upgrade to the new volume, you can check on the status of the upgrade using the command: `tmsh show sys software status`.
 - When the upgrade finishes installing, the machine reboots. Proceed to the next to the last (login) step in this task.
9. To prompt the logging node to reboot into the new software installation volume, select the **Reboot into Target Volume** check box.
 10. Click the **Apply** button.
A popup screen opens, prompting you to confirm the installation.
 11. Click the **Continue** button.
 12. Wait while the logging node loads the new software and reboots.

Depending on your configuration and the number of devices you are managing, this could take up to 15 minutes. During this time, it is important that you do not interrupt the installation process by restarting services or the server.

13. Log back in to the logging node and complete the setup wizard to confirm that the upgrade succeeded.

Note: To complete the setup task, you must supply a master key pass phrase that all devices in the logging node cluster must share. Make note of the phrase you use. Each logging node, as well as the primary and secondary BIG-IQ systems must use this phrase before they can join the cluster.

14. If needed, extend the `/var` partition.

The default size of the `/var` file system in a newly installed or upgraded node is 30 GB. This amount of available storage might not be enough to store your data. If you previously extended your disk space, you'll need to do it again after you upgrade, as explained in *K16103: Extending disk space on BIG-IQ Virtual Edition*.

Important: Upgrading a node requires at least two volumes, so be sure you can extend the `/var` file system on both volumes to the same size; otherwise, upgrades might fail.

Important: In the unlikely event that you are unable to log in to a BIG-IQ® 7000 series platform after you upgraded it, refer to SOL40338232: The BIG-IQ system interface might be inaccessible after the BIG-IQ system is upgraded from BIG-IQ Centralized Management version to 5.2.0 at support.f5.com/kb/en-us/solutions/public/k/40/sol40338232.html for more information.

Confirm that the upgraded logging node is back in service

After you upgrade a logging node as part of the minimum downtime workflow, you need to confirm that the logging node is back in service before you proceed with upgrading the next logging node in the cluster.

Note: In the upgraded user interface, logging nodes are referred to as a data collection devices (DCDs).

1. Log in to the BIG-IQ® system primary with your admin user name and password.
2. At the top of the screen, click **System Management**.
3. On the left, expand **BIG-IQ LOGGING** and then select **Logging Nodes**.
4. Note the status icon color for the DCD that you just upgraded. If it is not green yet, wait until it turns to green before proceeding.

When the icon turns green, it indicates that the primary BIG-IQ system and the DCD are communicating.

5. Use SSH to log in to the DCD you just upgraded.
You must log in as `root` to perform this procedure.

Important: It is critical that you log in to the correct device. Log in to the DCD, not the primary BIG-IQ.

6. Determine whether the DCD cluster service restarted, using the following command:
`bigstart status elasticsearch`

In this example, the DCD cluster has been up and running for less than an hour.

```
elasticsearch run (pid 5110) .5 hours
```

7. Determine whether this DCD has rejoined the DCD cluster, using the following command:
`curl localhost:9200/_cat/nodes?v`

In the following example, the recently upgraded DCD (10.11.0.96) has rejoined the cluster (three other DCDs, the primary BIG-IQ, and the secondary BIG-IQ).

```
curl localhost:9200/_cat/nodes?v
host      ip          heap.percent ram.percent load node.role master
name
10.11.0.96 10.11.0.96      2           63 0.01 d       m       d6211
10.11.0.97 10.11.0.97      2           63 0.01 d       m       d6212
10.11.0.98 10.11.0.98      2           63 0.01 d       m       d6213
10.11.0.99 10.11.0.99      2           63 0.01 d       m       d6214
10.144.73.126 10.144.73.126 22          45 0.04 -       *       09020
b0c-7021-458f-89f4-5e89faf64670
10.144.73.127 10.144.73.127 22          45 0.05 -       m       09020
c0c-2235-234a-54b2-2f45fab3233b
```

8. If the DCD did not rejoin the cluster, restart the cluster service using this command:
`bigstart restart elasticsearch`
 The cluster service restarts, and the DCD rejoins the cluster. Repeat step 7 to confirm.
9. Log in to the BIG-IQ system primary again with your admin user name and password.
10. At the top of the screen, click **System Management**.
11. On the left, expand **BIG-IQ LOGGING** and then select **Logging Nodes**.
12. Click **Settings**.
 The Properties screen for the logging node cluster opens.
13. Note the Data Cluster Status icon color. If it is not green yet, wait until it turns to green before proceeding.
 When the icon turns green, it indicates that data is again distributed to all members of the DCD cluster.

The DCD cluster is now fully restored to service.

Now that the cluster is functioning again, you need the upgraded DCD to start collection data again.

Reactivate data collection services from 5.1 upgrade

After you upgrade a data collection device (DCD) and it is again a fully functioning member of the DCD cluster, you need it to start collecting data again.

1. Log in to the BIG-IQ® system primary with your admin user name and password.
2. At the top of the screen, click **System Management**.
3. At the top of the screen, click **Inventory**.
4. On the left, expand **BIG-IQ LOGGING** and then select **Logging Nodes**.
5. Click the device name of the DCD you just upgraded.
 The Properties screen for the selected DCD opens.
6. On the left, click **Services**.
7. For each service that you deactivated previously, click **Activate**.

Important: Use the Listener Address that you noted when you deactivated services for this DCD.

8. Click **Cancel**.
 The screen closes and BIG-IQ activates your services.

Bring the logging node back online

After you upgrade a logging node to a data collection device (DCD), and reactivate data collection services, you need to start sending data to the DCD again.

Upgrade the Logging Nodes in Your Cluster with Minimal Downtime

Log in to each BIG-IP® device that sends data to your logging node cluster, and revise the configuration so that the data it sends to the cluster includes the logging node you just upgraded.

Note: The process for starting data collection for one logging node in the cluster depends on the kind of data you collect.

Option	Description
If you collect FPS alerts:	<ol style="list-style-type: none">1. On the BIG-IP device, select Local Traffic > Pools > Pool List > .2. Select the pool that sends alerts and events to the logging node.3. Click Members.4. Select the pool member that sends alerts to the target logging node, and enable it.
If you collect ASM® events:	<ol style="list-style-type: none">1. On the BIG-IP device, select Local Traffic > Pools > Pool List.2. Select the pool that contains the members that send events to the logging node.3. Click Members.4. Select the pool member that sends alerts to the target logging node, and enable it.
If you collect APM® events:	You don't need to enable the logging node from the BIG-IP device. All you need to do is activate the service.

Now that the upgraded logging node has rejoined the cluster, the services are reactivated, and the BIG-IP devices are sending data again, you can upgrade the next logging node in the cluster.

Upgrading BIG-IQ Centralized Management with Logging Nodes to the Latest Version

What you need to do before you upgrade BIG-IQ from version 5.1 to the latest version

Before upgrading F5® BIG-IQ® Centralized Management, perform the following tasks.

Tasks	Additional information
Reactivate the BIG-IQ system license.	You must do this on both the active and the secondary BIG-IQ if they are running in an HA pair. For specific instructions about how to reactivate a license, refer to the <i>F5® BIG-IQ® Central Management: Licensing and Initial Setup</i> guide.
Create a backup of the BIG-IQ system's current compressed user configuration set (UCS) and store it on a remote server.	The UCS file includes: system-specific configuration files; license, user account and password information; and SSL certificates and keys. You can use this backup if you want to restore to the previous version of BIG-IQ.
Decide which disk volume to install the upgrade on. At least two volumes are required to upgrade BIG-IQ.	If the machine you are upgrading does not have two volumes, you must create one using a CLI command. The upgrade task provides options for either case.

Gather the following information:

Required information	For my configuration
<p>You'll need to create a passphrase for the Master Key. The passphrase must contain:</p> <ul style="list-style-type: none"> at least 16 characters at least 1 capital letter at least 1 lowercase letter at least 1 number at least 1 special character <hr/> <p>Important: You must use the same Master Key Passphrase for each BIG-IQ system in an HA pair and every device in a logging node cluster. The upgrade will complete without it, but the HA pair or logging node cluster will not function if the pass phrases don't match.</p> <hr/>	
Get the discovery address you specified on the BIG-IQ system during setup. This is the same IP address that the peers in a high availability confirmation use to communicate. You can find this IP address on the BIG-IQ HA screen.	

Required information	For my configuration
Get your BIG-IQ administrator and root passwords.	
Get the name for the secondary HA BIG-IQ system if configured in an HA pair.	

If you're currently running a version of BIG-IQ prior to version 5.0, you must first upgrade to version 5.0 before you can upgrade to the latest version. For more information, refer to the guide titled, *F5 BIG-IQ Centralized Management: Upgrading BIG-IQ to Version 5.0*.

Remove the secondary BIG-IQ from the HA pair

If the F5® BIG-IQ® Centralized Management system is configured in an HA pair, you must remove the secondary BIG-IQ system before you upgrade it.

1. Log in to the primary BIG-IQ system with your administrator user name and password.
2. At the top left of the screen, select **System Management** from the BIG-IQ menu.
3. At the top of the screen, click **Inventory**.
4. On the left, click **BIG-IQ HA**.
5. Select the check box next to the secondary BIG-IQ, and click the **Remove Device** button.
A dialog box opens, prompting you to confirm that you want to remove the peer device from this group.
6. Click **Delete** in the dialog box to confirm the removal.
The system logs you out of the BIG-IQ while it removes the secondary device
7. Log back in to the primary BIG-IQ with your admin user name and password.
For a while, both the primary and the secondary BIG-IQ devices continue to display. After a few minutes, the screen updates to display a single standalone device.

Upload the latest version of the BIG-IQ software image

Download the software image from the F5 Downloads site.

Upload the latest version of the BIG-IQ software image to your secondary BIG-IQ system to make it available for this upgrade.

1. At the top of the screen, click **System Management**.
2. At the top of the screen, click **Inventory**.
3. On the left, click **THIS DEVICE > SOFTWARE MANAGEMENT > Available Images**.
4. Click the **Upload Image** button.
5. Click the **Choose File** button and go to the location to which you downloaded the image, and click the **Open** button to upload it to BIG-IQ.
6. Click the **Upload** button.
The screen refreshes to display the progress of the upload.

When the image is done uploading, it shows in the Available Images list.

Install the latest version of BIG-IQ software on the HA peer

Note: If the machine you are upgrading does not have two volumes, you must create one using a CLI command. The following steps provide options for either case.

Install the latest version of the BIG-IQ software on the peer BIG-IQ system so it will be running the same version as the primary BIG-IQ system you are upgrading.

1. Log on to the system you are going to establish as the secondary BIG-IQ system's command line as **root** and type the following command: `/usr/bin/clear-rest-storage`.
Although this step is not required, it clears the database storage on the system so the upgrade goes more quickly. After you upgrade both peer systems and re-establish the HA pair, the peer BIG-IQ will synchronize its database with this BIG-IQ system and repopulate the database.
2. Log on to the system you are going to establish as the secondary BIG-IQ system's user interface.
3. If you ran the `clear-rest-storage` command, complete the setup wizard. Otherwise, continue to the next step.
4. At the top of the screen, click **System Management**.
5. On the left, click **BIG-IQ DEVICES > BIG-IQ HA**.
6. On the left, click **Software Version**.
7. Click the **Update** button.
8. From the **Software Image** list, select the image you want to install.
9. From the **Target Volume** list, select the volume you want to install the image on.

Note: If the **Target Volume** list is empty, the machine you are upgrading does not have a second volume available for you to install the upgrade. You must create one to proceed.

- If you selected a target volume, complete the remaining steps to finish the upgrade.
 - If you do not have a second volume, use the following procedure to install the upgrade for this machine:
 - Use SSH to log in to the machine you want to upgrade. You must log in as `root` to perform this procedure.
 - Navigate to the folder where you install software using the command: `cd /shared/images`
 - Install the upgrade to a new volume by running one of the following commands:
 - If you are upgrading a virtual machine: `tmsh install sys software image <full name of the iso file> volume hd1.2 create-volume reboot`
 - If you are upgrading a BIG-IQ 7000 series platform: `tmsh install sys software image <full name of the iso file> volume md1.2 create-volume reboot`
 - While the system installs the upgrade to the new volume, you can check on the status of the upgrade using the command: `tmsh show sys software status`.
 - When the upgrade finishes installing, the machine reboots. Proceed to the next to the last (login) step in this task.
10. To prompt BIG-IQ to reboot into the new software installation volume, select the **Reboot into Target Volume** check box.
 11. Click the **Apply** button.
A popup screen opens, prompting you to confirm the installation.
 12. Click the **Continue** button.
 13. Wait while BIG-IQ loads the new software and reboots.

Depending on your configuration and the number of devices you are managing, this could take up to an hour. During this time, it is important that you not interrupt the installation process by restarting services or the server.

14. Log in to the BIG-IQ that will be the secondary BIG-IQ system to confirm that the upgrade succeeded and complete the setup wizard.

To complete the setup task, you must supply a master key pass phrase that all devices in the logging node cluster must share. Make note of the phrase you use. Each logging node, as well as the primary and secondary BIG-IQ systems must use this phrase before they can join the cluster.

15. If needed, extend the `/var` partition.

The default size of the `/var` file system in a newly installed or upgraded node is 30 GB. This amount of available storage might not be enough to store your data. If you previously extended your disk space, you'll need to do it again after you upgrade, as explained in *K16103: Extending disk space on BIG-IQ Virtual Edition*.

Important: *Upgrading a node requires at least two volumes, so be sure you can extend the `/var` file system on both volumes to the same size; otherwise, upgrades might fail.*

Upload the latest version of the BIG-IQ software image

Download the software image from the F5 Downloads site.

Upload the latest version of the BIG-IQ software image to your primary BIG-IQ system to make it available for this upgrade.

1. At the top of the screen, click **System Management**.
2. At the top of the screen, click **Inventory**.
3. On the left, click **THIS DEVICE > SOFTWARE MANAGEMENT > Available Images**.
4. Click the **Upload Image** button.
5. Click the **Choose File** button and go to the location to which you downloaded the image, and click the **Open** button to upload it to BIG-IQ.
6. Click the **Upload** button.

The screen refreshes to display the progress of the upload.

When the image is finished uploading, it is added to the Available Images list.

Upgrade the primary to the latest version of BIG-IQ software

Before upgrading the primary BIG-IQ in a logging node cluster you must:

1. Prepare the logging node cluster for upgrade.
2. Update the logging nodes in the cluster.
3. Upgrade the HA peer device to the latest version.
4. Download the latest version of the BIG-IQ `.iso` image from the F5 downloads site.

Note: *If the machine you are upgrading does not have two volumes, you must create one using a `CLI` command. The following steps provide options for either case.*

Upgrade BIG-IQ to take advantage of the newest functionality and features.

1. Log in to the BIG-IQ system with your admin user name and password.
2. At the top of the screen, click **System Management**.

3. At the top of the screen, click **Inventory**.
4. On the left, click **BIG-IQ DEVICES > BIG-IQ HA**.
5. On the left, click **Software Version**.
6. Click the **Update** button.
7. From the **Software Image** list, select the image you want to install.
8. From the **Target Volume** list, select the volume you want to install the image on.

Note: If the Target Volume list is empty, the machine you are upgrading does not have a second volume available for you to install the upgrade. You must create one to proceed.

- If you selected a target volume, complete the remaining steps to finish the upgrade.
 - If you do not have a second volume, use the following procedure to install the upgrade for this machine:
 - Use SSH to log in to the machine you want to upgrade. You must log in as `root` to perform this procedure.
 - Navigate to the folder where you install software using the command: `cd /shared/images`
 - Install the upgrade to a new volume by running one of the following commands:
 - If you are upgrading a virtual machine: `tmsh install sys software image <full name of the iso file> volume hd1.2 create-volume reboot`
 - If you are upgrading a BIG-IQ 7000 series platform: `tmsh install sys software image <full name of the iso file> volume md1.2 create-volume reboot`
 - While the system installs the upgrade to the new volume, you can check on the status of the upgrade using the command: `tmsh show sys software status`.
 - When the upgrade finishes installing, the machine reboots. Proceed to the next to the last (login) step in this task.
9. To prompt BIG-IQ to reboot into the new software installation volume, select the **Reboot into Target Volume** check box.
 10. Click the **Apply** button.

A popup screen opens, prompting you to confirm the installation.
 11. Click the **Continue** button.
 12. Wait while the logging node loads the new software and reboots, and then complete the setup wizard.

Depending on your configuration and the number of devices you are managing, rebooting could take up to 15 minutes. During this time, it is important that you do not interrupt the installation process by restarting services or the server.

Note: To complete the setup task, you must supply a master key pass phrase that all devices in the logging node cluster must share. Make note of the phrase you use. Each logging node, as well as the primary and secondary BIG-IQ systems must use this phrase before they can join the cluster.

13. If needed, extend the `/var` partition.

The default size of the `/var` file system in a newly installed or upgraded node is 30 GB. This amount of available storage might not be enough to store your data. If you previously extended your disk space, you'll need to do it again after you upgrade, as explained in *K16103: Extending disk space on BIG-IQ Virtual Edition*.

Important: *Upgrading a node requires at least two volumes, so be sure you can extend the `/var` file system on both volumes to the same size; otherwise, upgrades might fail.*

Even though you can log in to this BIG-IQ system after the software is installed, the system continues some database re-indexing processes in the background. For larger configurations, that can take up to an hour. If you perform any searches on objects before it's done re-indexing, BIG-IQ might not return the expected results. During this time, you can continue with the rest of the upgrade process.

Enabling statistics collection after upgrading from 5.1

Before you can enable statistics for BIG-IP® devices:

- There must be a BIG-IQ® data collection device configured for the BIG-IQ device.
- The BIG-IP device must be located in your network and running a compatible software version. Refer to <https://support.f5.com/kb/en-us/solutions/public/14000/500/sol14592.html> for more information.
- Port 22 and 443 must be open to the BIG-IQ management address, or any alternative IP address used to add the BIG-IP device to the BIG-IQ inventory. These ports and the management IP address are open by default on BIG-IQ.

If you are running BIG-IP version 11.5.1 up to version 11.6.0, you might need `root` user credentials to discover and add the device to the BIG-IP devices inventory. You don't need `root` user credentials for BIG-IP devices running versions 11.6.1 - 12.x.

Note: A BIG-IP device running versions 10.2.0 - 11.5.0 is considered a legacy device and cannot be discovered from BIG-IQ version 5.1. If you were managing a legacy device in previous version of BIG-IQ and upgraded to version 5.1, the legacy device displays as impaired with a yellow triangle next to it in the BIG-IP Devices inventory. To manage statistics for it, you must upgrade it to version 11.5.1 or later. For instructions, refer to the section titled, *Upgrading a Legacy Device*.

To enable statistics collection for BIG-IP devices after upgrading from version 5.1, you add those devices to the BIG-IQ system inventory. Adding devices to the inventory is referred to as *device discovery*.

Note: The ADC component is automatically included (first) any time you discover or import services for a device.

Note: You do not need to discover and import a device's configuration to collect and view statistics for it. You just need to establish trust between your BIG-IQ and the device. If you do not discover and import the device configuration, the virtual servers, pool, pool members, and iRules will be visible in the statistics dimension panes, but these objects will not appear in the configuration page for those objects. Also, you will not be able to manage these objects in BIG-IQ. If you decide you want to manage these objects, you can discover and import the BIG-IP device's configuration later without interrupting statistics collection.

1. At the top of the screen, click **Devices**.
2. Click the **Add Device** button.
3. In the **IP Address** field, type the IPv4 or IPv6 address of the device.
4. In the **User Name** and **Password** fields, type the user name and password for the device.
5. If this device is part of a DSC pair, for the **Cluster Display Name** setting, specify how to handle it:
 - For an existing DSC pair, select **Use Existing** from the list, and then select the name of your DSC group from the next list.
 - To create a new DSC pair, select **Create New** from the list, and type a name in the field.

For BIG-IQ to properly associate the two devices in the same DSC group, the **Cluster Display Name** must be the same for both members in a group.

There can be only two members in a DSC group.

6. If this device is configured in a DSC pair, for the **Deployment Settings**, specify how to handle it:

- **Initiate BIG-IP DSC sync when deploying configuration changes (Recommended):** Select this option if this device is part of a DSC pair and you want this device to automatically synchronize configuration changes with the other member in the DSC group.
 - **Ignore BIG-IP DSC sync when deploying configuration changes:** Select this option if you want to manually synchronize configurations changes between the two members in the DSC group.
7. Click the **Add** button at the bottom of the screen.
The BIG-IQ system opens communication to the BIG-IP device, and checks the BIG-IP device framework.

Note: The BIG-IQ system can properly manage a BIG-IP device only if the BIG-IP device is running a compatible version of the REST framework.

8. If a framework upgrade is required, in the popup window, in the **Root User Name** and **Root Password** fields, type the root user name and password for the BIG-IP device, and click **Continue**.
9. If in addition to basic management tasks (like software upgrades, license management, and UCS backups) you also want to centrally manage this device's configurations for licensed services, select the check box next to each service you want to discover.
You can also select these service configuration after you add the BIG-IP device to the inventory.
10. To enable statistics collection for this BIG-IP device, under Statistics monitoring, select the check box next to each service you want to collect statistics for, and then click **Continue**.

Note: If you want to enable statistics collection without managing any services, just clear the check boxes for all services.

11. Click the **Add** button at the bottom of the screen.
12. On the BIG-IQ primary device, at the top of the screen, click **System**.
13. On the left, expand **BIG-IQ DATA COLLECTION** and then select **BIG-IQ Data Collection Devices**.
The BIG-IQ generates an automatic key pair that you need before the DCD can start collecting and managing statistics.

In about 5 minutes the DCD cluster should start collecting statistics for your managed devices. You can confirm this on the primary BIG-IQ by clicking **Devices**. When statistics are being collected, a column displays to show the date and time of the last statistics collection.

Define external storage snapshots location

Before you configure the external snapshot storage location, collect the following information for the machine that will store your data collection device (DCD) snapshots:

- IP address for the storage machine
- Storage file path
- User name, password, and (optionally) domain for the user account configured on the external storage device
- Read/Write permissions for the storage file path

You need snapshots to perform software upgrades and to restore your old data.

Note: Creating external storage so you can create snapshots is an optional task. However, F5 strongly recommends that you create snapshots to safeguard your data.

If you set up external storage for this logging node cluster in 5.1 and plan to retain that setup after you upgrade, continue setting up the external storage location. When you create DCD snapshots, they need to be stored on a machine other than the DCD. You define the location for the snapshot using the BIG-IQ[®] Centralized Management device.

1. At the top of the screen, click **System**, and then, on the left, click **BIG-IQ DATA COLLECTION** and select **BIG-IQ Data Collection Cluster**.
 - Under **Summary**, you can view information detailing how much data is stored, as well as how the data is stored.
 - Under **Configuration**, you can access the screens that control DCD cluster performance.
2. On the left, click **Configuration > External Storage & Snapshots >**.
The External Storage & Snapshots screen opens.
3. For **External Storage**, click **Configure**.
The External Storage popup screen opens.
4. In the **User name** and **Password** fields, type the user name and password for the user account configured on the external storage device.
5. For the **Domain**, you can type the domain name for the user account configured on the external storage device.
6. For the **Storage Path**, type the path to the external storage location.
You can specify the device using the IP address or the host name. Additionally, you need to specify the path to the folder on the external storage device. For example:

```
//<storage machine ip-address>/<storage-file-path>
```

Note: Remember, the folder you specify must have full read, write, and execute permissions.

7. To test the settings just specified, click **Test**.
A message displays to tell you whether the test completes successfully. If it does not, correct the settings and permissions.
8. When the external storage is specified successfully, click **Save**.

The storage location is accessible to the all of the devices in the DCD cluster.

Confirm that the upgraded primary BIG-IQ system is back in service

After you upgrade the primary BIG-IQ[®] system as part of the minimal downtime workflow, confirm that it is back in service before you proceed.

1. Use SSH to log in to the primary BIG-IQ system.
You must log in as `root` to perform this task.
2. Determine whether the DCD cluster service restarted by running the following command:

```
bigstart status elasticsearch
```

 In the following example, the DCD cluster has been up and running for less than an hour.

```
elasticsearch run (pid 5110) .5 hours
```

3. Determine whether the primary BIG-IQ system rejoined the DCD cluster using the following command:

```
curl localhost:9200/_cat/nodes?v
```

In the following example, the recently upgraded BIG-IQ system (10.144.73.126) has rejoined the cluster (four DCDs, the primary BIG-IQ, and the secondary BIG-IQ).

```
curl localhost:9200/_cat/nodes?v
host      ip          heap.percent ram.percent load node.role master
name
10.11.0.96 10.11.0.96      2           63 0.01 d         m       d6211
10.11.0.97 10.11.0.97      2           63 0.01 d         m       d6212
```

10.11.0.98	10.11.0.98	2	63	0.01	d	m	d6213
10.11.0.99	10.11.0.99	2	63	0.01	d	m	d6214
10.144.73.126	10.144.73.126	22	45	0.04	-	*	09020
b0c-7021-458f-89f4-5e89faf64670							
10.144.73.127	10.144.73.127	22	45	0.05	-	m	09020
c0c-2235-234a-54b2-2f45fab3233b							
"?>							

- If the primary BIG-IQ system did not rejoin the cluster, restart the cluster service using the following command:

```
bigstart restart elasticsearch
```

The cluster service restarts and the primary BIG-IQ system rejoins the cluster. Repeat step 3 to confirm.

- Log in to the BIG-IQ system primary again with your admin user name and password.
- At the top of the screen, click **System**, and then, on the left, click **BIG-IQ DATA COLLECTION > BIG-IQ Data Collection Devices**.
The BIG-IQ Data Collection Devices screen opens to list the data collection devices in the cluster.
- Click **Settings**.
The Properties screen for the DCD cluster opens.
- Note the Data Cluster Status icon color. Do not proceed until it turns green.
When the icon turns green, it indicates that data is again distributed to all members of the DCD cluster.

Note: If the DCD cluster status icon does not turn green, refer to [Troubleshooting Minimal Downtime Upgrade Issues](#). There are several common issues that you can resolve by following the recommended actions.

The DCD cluster is now fully restored to service.

Now you need to upgrade the statistics agent so that the upgraded DCD can start collecting data again.

Completing Post-Upgrade Processes

Recheck data collection device health

You can use the Summary Status screen to review the overall health and status of the data collection devices you've configured. You can use the data displayed on this screen both before and after an upgrade to verify that your data collection device cluster configuration is as you expect.

1. At the top of the screen, click **System**.
2. At the top of the screen, click **System**, and then, on the left, click **BIG-IQ DATA COLLECTION** and select **BIG-IQ Data Collection Cluster**.
 - Under Summary, you can view information detailing how much data is stored, as well as how the data is stored.
 - Under Configuration, you can access the screens that control DCD cluster performance.
3. Note the status icon color for the cluster. If it is not green yet, wait until it turns to green before proceeding. When the icon turns green it indicates that the primary BIG-IQ DCD cluster is functioning again.
4. Analyze the data collection device cluster details listed in the Summary area, and make sure that the values after upgrade match the values from the health check you did before the upgrade. At a minimum, you should confirm that the following values are correct:
 - Data Node Count

Reestablish the HA configuration after upgrading to BIG-IQ version 5.4

After you upgrade both F5® BIG-IQ® Centralized Management systems in a HA configuration, you can re-associate the secondary system with the primary BIG-IQ system.

1. Log in to primary BIG-IQ system with your administrator user name and password.
2. At the top of the screen, click **System**.
3. On the left, click **BIG-IQ HA**.
4. Click the **Add Secondary** button.
5. In the **IP Address** field, type the discovery address you specified on the BIG-IQ system during setup. This is the same IP address the peers in a high availability confirmation use to communicate.
6. In the **User name** and **Password** fields, type the administrative user name and password for the system.
7. In the **Root Password** field, type the root password for the system.
8. Click the **Add** button to add this device to this high availability configuration.

Even though you can log in to the secondary BIG-IQ after the you reestablish the HA configuration, the system continues some database re-indexing processes in the background. For larger configurations, that can take up to an hour. If you perform any searches on objects before it's done re-indexing, BIG-IQ might not return the expected results. During this time, you can use the primary BIG-IQ.

Next, you should verify that both BIG-IQ systems have the same configuration.

Restart snapshot creation

Because of the mixed software version environment that occurs during the upgrade process, if you had configured snapshot schedules in 5.1, you stopped creating snapshots before the upgrade. Now that the upgrade is complete, you need to restart the snapshots to protect your data.

1. Use SSH to log in to the primary BIG-IQ system for this cluster.
You must log in as `root` to perform this procedure.
2. Retrieve the list of scheduled snapshots using the following command: `restcurl cm/shared/esmgmt/es-snapshot-task | grep task-scheduler`

```
config # restcurl cm/shared/esmgmt/es-snapshot-task | grep task-scheduler
"link": "https://localhost/mgmt/shared/task-scheduler/scheduler/0fdf50ec-8a17-3da9-b717-c63637ccc68a"
"link": "https://localhost/mgmt/shared/task-scheduler/scheduler/0af33352-2f33-32b3-85cb-1281bb88c249"
"link": "https://localhost/mgmt/shared/task-scheduler/scheduler/2ad770a8-bdb0-3383-99a9-300846eb0972"
```

In the example here, there are 3 snapshots scheduled.

3. Stop each of the schedules using the following command: `restcurl -X PATCH -d '{"status":"ENABLED"}' shared/task-scheduler/scheduler/<SNAPSHOT ID>`

```
#restcurl -X PATCH -d '{"status":"ENABLED"}'
shared/task-scheduler/scheduler/0af33352-2f33-32b3-85cb-1281bb88c249
```

After you run the command for each scheduled snapshot, snapshots will again be created following the snapshot schedule.

Upgrade the BIG-IP framework

To properly communicate, BIG-IQ[®] Centralized Management and managed BIG-IP[®] devices must be running a compatible version of its framework. If the frameworks are incompatible, BIG-IQ displays a yellow triangle next to the device in the BIG-IP Device inventory.

When you upgrade a BIG-IP device running version 11.5.x to another 11.5.x version, or to an 11.6.x version (for example, from version 11.5.3 to 11.5.4, or from version 11.5.3 to version 11.6.1), you must upgrade the REST framework so BIG-IQ can manage the device.

When you upgrade BIG-IQ from version 5.x to the latest version, you must also upgrade the REST framework for all BIG-IP devices (currently in the BIG-IP Device inventory) running a version prior to 12.0.0.

1. At the top of the screen, click **Devices**.
2. Select the check box next to a device, click the **More** button, and select **Upgrade Framework**.
A popup screen opens.
3. Into the fields, type the required credentials, and click the **Continue** button.
A REST Framework upgrade in progress message displays.

After the framework is updated, you can successfully manage this device.

Repeat these steps for each device.

Re-discover devices and re-import services

After you upgrade F5[®] BIG-IQ Centralized Management, you must rediscover your managed devices and reimport their services for AFM, ASM, DNS, and LTM so you can start managing those devices with the new features introduced in this release.

1. At the top of the screen, click **Devices**.
2. Select the check box next to the devices you want to rediscover and reimport services for.
3. Click the **More** button and select **Re-discover and Re-import**.
4. In the **Name** and **Description** fields, type a name and an optional description to identify this task.
5. For the Conflict Resolution Policy setting, select an option for how you want to handle any differences found between the configuration on BIG-IQ and the BIG-IP device during the re-discover and re-import task.
 - **Use BIG-IQ** to use the configuration setting stored on BIG-IQ if any differences are found.
 - **Use BIG-IP** to override the configuration settings stored on BIG-IQ with the settings from the BIG-IP device.

Important:

Some new features are introduced with each BIG-IQ release so it's a good idea to use the BIG-IP device's configuration after you upgrade BIG-IQ. This ensures you don't inadvertently overwrite a configuration that wasn't previously supported. BIG-IP devices are re-imported in the order listed, from top to bottom. You can use the arrow keys to change the processing order.

When you select **Use BIG-IP** to resolve conflicts, the BIG-IP device used to resolve those conflicts should appear last in the re-import list. If two or more BIG-IP devices contain the same object with different values, only the value in the last imported BIG-IP is used to resolve the conflict for all the BIG-IP devices.

-
6. If you want to save a snapshot of the BIG-IP device's configuration before importing their services, select the **Create a snapshot of the current configuration before importing** check box.
 7. Click the **Create** button at the bottom of the screen.

Legal Notices

Legal notices

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FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This unit generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

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Canadian Regulatory Compliance

This Class A digital apparatus complies with Canadian ICES-003.

Standards Compliance

This product conforms to the IEC, European Union, ANSI/UL and Canadian CSA standards applicable to Information Technology products at the time of manufacture.

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