OnApp Cloud 6.5 Edge 4 Storage Home
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OnApp Storage is a distributed SAN for cloud providers that allows you to turn your existing cloud infrastructure into an extremely scalable, resilient and efficient storage system that is optimized for cloud workloads. While the low-cost SANs are adequate for low-performance workloads and managing data that is not critical, OnApp Storage is an alternative to high-cost Enterprise SAN hardware where the performance throughput or the scalability is important.

The OnApp Storage Guide describes the technical aspects and the overall architecture of the OnApp Storage system. For details on managing the other OnApp Cloud components, refer to the Administration Guide.

Integrated Storage supports PCI devices that have drivers compatible with the Linux kernel versions we use.
1 Features

OnApp Storage is designed for cloud workloads. It provides multiple performance, resilience and cost benefits in comparison to traditional centralized SANs.

1.1 Use of Commodity Hardware

OnApp Storage is an extremely cost-effective cloud storage platform. There is no vendor lock-in with supported disk types or custom network backplanes: you can use off-the-shelf compute resource servers, disks, and Ethernet components. You can build your distributed SAN with SATA, SAS or SSD devices and get exceptional performance in a 10Gbit network environment.

1.2 Fast Deployment

Building your SAN is easy. You deploy additional disk drives in the compute resource servers used by OnApp Cloud and assign them to virtual data stores. Data stores are categorized by performance and have their own policies for striping, redundancy, and over-commit.

1.3 Intuitive SAN Management

Once you have set up your distributed SAN, you can allocate storage to virtual servers in the same way you would assign traditional SAN storage. Data stores are linked with buckets and limits, just like they are with storage based on legacy SAN arrays - except, you can give your customers more options for redundancy and performance.

1.4 Scalability

OnApp Storage has a modular design - you can add additional storage capacity when you need it, without having to rebuild the whole SAN.

You can add multiple disks to any servers connected to the platform.

1.5 Speed & Efficiency

OnApp Storage optimizes I/O throughput for your SAN. Each disk’s I/O queue is independent, so there is no single point where bandwidth bottlenecks can occur. Each storage node manages and compresses its own content in the most efficient way possible, without loss of performance. This ensures that data is stored optimally across the whole environment, while maintaining data replication and drive resiliency properties.
2 Integrated Storage Architecture

This section describes the aspects of the OnApp Storage system architecture.

2.1 Architecture Requirements

OnApp Storage has a number of technical and commercial requirements that must be met to ensure correct performance.

- **Use commodity and pre-existing hardware**
  Use existing storage (HDD/SSD/SCSI) on existing compute resources.

- **Compute resources**
  - Use KVM cloudbooted compute resources.
  - Use KVM static compute resources.

- **Performance to price ratio in comparison to dedicated SAN**
  Performance must be comparable to that of dedicated SAN systems, using similar hardware.

- **Scalability**
  Use distributed techniques where possible and a system that avoids single points of failure.

- **Resilience**
  Allow for multiple replicas of data and also multiple points of access to the system.

- **Efficiency**
  System overheads should be within an acceptable limit in terms of additional resources.

2.2 Architecture

OnApp Storage is a distributed block storage system that uses existing commodity cloud hardware to present a reliable, scalable storage system as an alternative to traditional SANs. This section provides a general overview of the OnApp storage architecture.

At the lowest level, the disk drives are visible to back-end instances that perform network communication with the front end, either locally or within the OnApp Control Panel.

A virtual disk or VDisk is part of a data store. Each VDisk replica has an individual handler that connects it with the front end; the back end also handles the access to the storage drives. Once a VDisk has been successfully created, it becomes available through the device mapper as a block based drive. The Figure 1 shows the integrated storage architecture map, with more implementation details shown in Figure 2.

**Figure 1. Integrated Storage architecture**
Drives that are connected to the compute resource are displayed in the OnApp Management user interface, a web-console which manages the OnApp Cloud Platform and Storage system. After the back end reports about the storage drives, they will be displayed in the OnApp user interface as shown in Figure 3 and Figure 4.

**Figure 3. OnApp Control Panel management interface**
OnApp Storage uses multiple front ends (2+ compute resources) that communicate via back-ends to avoid a single point of failure. As long as there is an active back end with an access to a replica, the data can be accessed. If a compute resource that contains a replica fails, the failed data replica will become out of date as soon as data writes are performed. This leads to the VDisk degrading. To fix the degraded disk, you need to manually perform the disk repair operation, as described in the Repair VS Disks Assigned to Integrated Storage Data Store section. During the disk repair, disk volume is repaired using good available replicas. However, if the disk drive has completely failed and cannot be repaired, it can be forgotten via UI. Then, it can be replaced with the new drive after the rebalancing operation.

OnApp Storage system detects data location. Having detected where the application virtual server is, the Storage system will attempt to keep and use a replica on the back end system which is local to that server. This feature allows to optimize data placement, reduce the amount of network traffic and improve the performance. If the virtual server is migrated to another location, the Storage system will detect changes and migrate data to the new VS location.
Virtual server live migration is available on Xen and KVM compute resources. Follow the links below to view the list of templates that support live migration:

- [http://templates.repo.onapp.com/Linux_templates.html](http://templates.repo.onapp.com/Linux_templates.html)
- [http://templates.repo.onapp.com/FreeBSD_templates.html](http://templates.repo.onapp.com/FreeBSD_templates.html)

Storage migration is fully supported across the data store to any compute resource drives within the same zone.

The OnApp Storage architecture has been designed to use existing cloud hardware. There are many different types of storage drives connected to the compute resource servers. The Storage system divides the drive performance into low, medium and high. For example, most of the Solid State Drives (SSDs) will be classified as high performance. Standard Hard Disk Drives (HDDs) can be either of low or medium performance. The performance metrics are calculated when the storage is activated to check the read and write drives' behavior. You can also manually set disk performance in OnApp User Interface.

Different drives are then detected and enabled through a multicast channel local to a single Control Panel and divided by compute resource zones, as shown in Figure 5. The division by compute resource zones helps to separate the storage channels for different types of underlying compute resource types (Xen/KVM etc).

**Figure 5. Integrated Storage system available across multiple compute resources**

The OnApp Storage system utilizes CloudBoot compute resource bootstrap method and the centralized management system - the OnApp Control Panel, as shown in Figure 6. That means, different compute resources can be provisioned rapidly through a templates system. The compute resources will be provisioned when the storage is activated. After that, the OnApp Storage will be available to all virtual servers across the CP.

**Figure 6. CloudBoot and the Control Panel view**
2.3 Examples of Architecture in Use

This section shows how the OnApp Storage architecture works using the example of VDisk creation. The example comprises all stages of disk creation, from OnApp Storage activation to adding the newly created VDisk to the virtual server.

2.3.1 Step 1. Enabling OnApp Storage

At this stage, back ends for compute resources with storage drives are activated.

![Diagram of OnApp Storage architecture](image)

Figure 1. Enabling Storage
2.3.2 Step 2. Creating a data store

As shown in Figure 2, the data store is created through back ends via API.

For more information, see the Create Integrated Storage Data Store section.

Figure 2. Creating a data store

2.3.3 Step 3. Creating a VDisk

VDisk is created within a data store. After creating a VDisk, wait until it appears online.

Figure 3. Creating a VDisk

2.3.4 Step 4. Attaching the VDisk

When the VDisk is attached, it is associated with the virtual server and can then be used.
2.4 Hardware Requirements

OnApp Storage runs on the hardware that is available to the OnApp Cloud platform. To utilize the OnApp storage, you need at least one active compute resource with a hard disk drive. That means, minimum two servers are required: the Control Panel server and a compute resource server to run the storage system.

The following table shows the ratio of drives and compute resources required to support different configurations. It is possible to have less compute resources, but this will reduce a distributed storage system efficiency.

<table>
<thead>
<tr>
<th>Desc</th>
<th>Replicas</th>
<th>Stripes</th>
<th>HV1</th>
<th>HV2</th>
<th>HV3</th>
<th>HV4</th>
<th>Members</th>
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<tbody>
<tr>
<td>1R-0S</td>
<td>1</td>
<td>0</td>
<td>M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>1R-2S</td>
<td>1</td>
<td>2</td>
<td>M</td>
<td>M</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1R-4S</td>
<td>1</td>
<td>4</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>-</td>
</tr>
<tr>
<td>2R-0S</td>
<td>2</td>
<td>0</td>
<td>M</td>
<td>M</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>2R-2S</td>
<td>2</td>
<td>2</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>-</td>
</tr>
<tr>
<td>2R-4S</td>
<td>2</td>
<td>4</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>4R-0S</td>
<td>4</td>
<td>0</td>
<td>M</td>
<td>M</td>
<td>M</td>
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<tr>
<td>4R-2S</td>
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<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
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Where:
M - storage drive member
R - the number of replicas
S - the number of logical stripes

The maximum size for a VDisk is currently limited to 8TB.

There is no minimum required size for a data store member, however, the smallest template for a single virtual server has a 7GB size. Multiple virtual servers will have higher storage requirements. Also, different data store configurations can be run at the same time.

The maximum size for a single stripe is limited to 2TB.
3 Integrated Storage Data Stores

Integrated storage data store functionality allows combining physical disks from compute resources into a virtual data store to create a distributed block based storage system as an alternative to SAN systems. You can remove disks from a server, add them to any other server and run anywhere in the system without impacting operation of your SAN. The disks in the SAN are grouped by performance.

Integrated storage data store is separated into storage channels (API Endpoints) that correspond to compute zones. This allows managing storage within a zone. The cross zone storage transfers are currently not supported.

It is possible to keep all stripes and replicas on a single compute resource, but this will reduce the efficiency of a distributed storage system.

The number of compute resources used for creating integrated storage data stores must match the number of chosen replicas. Each compute resource should have the stripe number of disk drives (1, if there are no stripes).

To be able to rebalance or migrate the data, two HVs must be used with a configuration of at least two replicas.

For example if we have a system where two compute resources are used with four hard disk drives spread between the two, sized 100GB, 200GB, 300GB, 400GB. The 100GB and 200GB drives are in HV1 and the 300GB and 400GB drives in HV2 as shown in Figure 1.

If we have a data store with 2 replicas and 2 stripes with no overcommit, we could create at the most a 200GB VS if all the drives are empty. This is because the 200GB is split into two stripes for each replica each sized 100GB. We would then have the case where the first drive is fully occupied and all the rest have 100GB of occupied storage as shown in Figure 2. We would not be able to create any other VSs for this data store. This demonstrates that it is desirable to have HDDs that are roughly equivalent in size. As long as there are replica*stripe drives with free space, we can create a VS. The size of the VS we can create will be stripe*(the smallest free size available on all of the stripes).

3.1 How many virtual servers can reside on the integrated storage data store?

Use the following formula to calculate the number of virtual servers that can reside on the data store:

\[(\text{Storage node memory size} - 128) \div 4\]

Where:

- Storage node memory size - integrated storage node’s memory size in MB
- 128 - amount of system memory reserved for the storage controller
- 4 - the amount of memory required for NBD connection in MB

After that, divide the deduced numeral by the number of paths required per disk:

if the data store has 2 replicas and 2 stripes, it requires 4 paths per disk. Linux virtual servers have 2 disks, so 8 paths are required (if using the same data store configuration for main disk and swap).

For example:

The storage node memory = 1024 MB (default value), then:
(1024 - 128) = 896 MB for NBD device paths

\(896 \div 4 = 224\).

Depending on the data store disk configuration, this number determines the maximum number of VDisks that can be created.

Then, if the data store has 2 replicas and 2 stripes, it requires 4 paths per disk. Linux virtual servers have 2 disks, so 8 paths are required (if using the same data store configuration for main disk and swap).

Then, the following number of virtual servers can be hosted on that data store:

- \(224 \div 8 = 28\) Linux virtual servers
- \(224 \div 4 = 56\) Windows virtual servers (with 1 primary drive)

To be able to get more virtual servers in the cloud, we recommend using a lower config for swap drives.

### 3.2 View Integrated Storage Data Stores

To view the list of all integrated storage data stores in the cloud:

1. Go to your Control Panel > Storage menu.
2. Click the label of the compute resource and select Data Stores.
3. On the screen that appears, you’ll see the list of all integrated storage data stores associated with the compute resource and their details:
   - Label - the name of the data store
   - Identifier - the identifier of the data store
   - Disk count - the number of disks hosted on this data store.
   - Total space - the aggregate of all physical drive capacities
   - Performance - the data store performance level
   - Actions - click the Actions icon to Edit or Delete a data store.
4. Mouse over a data store to view the list of storage nodes attached to the data store grouped by compute resource:

![Storage Nodes](image)

5. To edit or delete a data store, click the Actions button next to the required data store, then select the appropriate action.

If required you can view the list of all data stores in the cloud, including Integrated Storage data stores.

To view the list of data stores:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the **Data Stores** icon. The screen that appears lists all data stores currently available and their details:
   - **Label** - the name of the data store
   - **IP address** - the IP address of the data store
   - **Shared?** - whether the data store is shared or not
   - **Identifier** - the identifier of the data store
   - **Enabled** - whether the data store is enabled or not
   - **Data Store Zone** - the data store zone to which this data store is assigned
   - **Location Group** - the location group to which this data store is assigned
   - **Disk Usage** - used disk size within the data store
   - **Disk Capacity** - the disk capacity is equal to usable space of the data store. To see the amount of usable space on an integrated storage data store, refer to [View Integrated Storage Data Store Details](#).
   - **Actions** - click the **Actions** icon to **Edit** or **Delete** a data store.

Prior to the OnApp version 5.3, the **Disk Capacity** parameter indicated the used disk size within the data store plus the maximum disk size. For OnApp versions 5.3 and up, this parameter indicates usable space of the data store.

### 3.3 View Integrated Storage Data Store Details

To view the list of all integrated storage data stores in the cloud:

1. Go to your Control Panel > **Storage** menu.
2. Click the label of the compute resource and select **Data Stores**.
3. On the screen that appears, you’ll see the list of all integrated storage data stores in the cloud.
4. Click the label of the data store to view its details.
5. On the screen that appears, you will see the following data store details:
   - **Total space** - the aggregate of all physical drive capacities
   - **Usable space** - total usable space accounting for replication. For example, if you have 10 TB of physical disks but have chosen to have two replicas, you will have 5 TB usable space.
   - **Maximum disk size** - maximum size of a vdisk that can be created. The maximum vdisk size depends on how many stripes your data store has. Each stripe of a vdisk can be 2 TB so if you have four stripes configured, your maximum disk size is 8TB.
   - **Performance** - the storage node performance level
   - **Copies** - the number of copies used for data in this data store
   - **Stripes** - the number of stripes the data store is be divided into
   - **Overcommit** - overcommit percentage
   - The following data store management options:
     - **Performance benchmarks**
• The list of data store disks

3.4 Create Integrated Storage Data Store

Before creating an integrated storage data store:
1. Create one or more KVM CloudBoot compute resources to group their drives together into a virtual data store.
2. Create a compute zone.
3. Add your compute resources to the compute zone.

After that, you can proceed to the integrated storage data store creation.

To create a new integrated storage data store:
1. Go to your Control Panel > Storage > Compute zone label > Data Stores menu.
2. On the screen that appears, you'll see the list of all integrated storage data stores in the selected compute zone.

   To move to the next step, make sure you have some nodes available for assigning to the newly created data store. Otherwise, the Create new Integrated Storage Data Store button won't be displayed on the screen.

3. To create a new data store, click the Create new Integrated Storage Data Store button, and complete the wizard that follows:

   Name - give your data store a name

   Show advanced options - select this check box to reveal the list of advanced settings:
   o Replicas - specify the number of data copies to increase the resilience to individual drive failure. You can specify 1, 2, or 4 replicas.
   o Stripes - specify the number of data splittings to increase the number of physical disks included in the virtual disk. You can specify 0, 2, or 4 stripes.
   o Overcommit - specify the over-provisioning percentage. You can set the following overcommit values: none (0%), 20%, 50% or unlimited (100%).

Storage Nodes

   In order for your hard drives(nodes) to be detected and active, multicast traffic should be enabled on your switch, for the OnApp Integrated Storage Network/VLAN.

   o Filter by compute resource - use this to filter the nodes (disks) available for inclusion in this data store, by specific compute resources.
4. Click the **Save** button to create the data store.

To provision storage to VSs you need to:

1. Assign the new data store to a data store zone at **Control Panel > Settings > Data Store Zones > Label**.
2. Assign the new data store to a compute zone at **Control Panel > Settings > Compute Zones > Label > Tools > Manage Data Stores**. Note that you should assign the data store to the compute zone within which that data store has been created, otherwise VSs created using the data store will not startup.

---

### 3.5 Edit Integrated Storage Data Store

You can add and remove storage nodes from a data store at any time after the data store has been created. This makes it easy to expand your distributed storage as you add drives to compute resources, or add new compute resources.

To edit a distributed storage data store:

1. Go to your **Control Panel > Storage > Data Stores** menu. On the screen that appears, you will see all data stores currently available.
2. Click the **Actions** icon next to the data store you want to edit, then choose **Edit**.
3. Use filter to sort storage nodes by compute resources.
4. To add or remove storage nodes from this data store, move sliders next to the required nodes.
5. Click the **Save** button to save your changes.

---

### 3.6 Delete Integrated Storage Data Store

To delete integrated storage data store:

1. Go to your **Control Panel > Storage** menu.
2. On the screen that appears, you’ll see the list of all distributed storage data stores in the cloud.
3. Click the **Actions** icon next to the data store you want to remove, then choose **Delete**. You will be asked to confirm the deletion.

---

### 3.7 Configuration Examples

You have to configure compute resource with at least two replicas to be able to rebalance or migrate data.

For example if we have a system where two Compute resources are used with four hard disk drives spread between the two, sized 100GB, 200GB, 300GB, 400GB. The 100GB and 200GB drives are in compute resource1 and the 300GB and 400GB drives in compute resource2 as shown in Figure 1.
If we have a 2 Replica, 2 Stripe with no overcommit data store we could create at the most a 200GB VS if all the drives are empty. This is because the 200GB is split into two stripes for each replica each sized 100GB. We would then have the case where the first drive is fully occupied and all the rest have 100GB of occupied storage as shown in Figure 2. We would not be able to create any other VSs for this data store. This demonstrates that it is desirable to have HDDs that are roughly equivalent in size. As long as there are replica-stripe drives with free space we can create a VS. The size of the VS we can create will be stripe*(the smallest free size available on all of the stripes).

Now take the scenario where we have two compute resources configured as per Figure 3.
The compute resources can be configured with an integrated data store with 2 replicas and 4 stripes as shown in Figure 4.

We can create an 80GB VDisk as that is the largest that the system would support. This is based on 20GB free space of the smallest stripe that can be chosen multiplied by the number of stripes (4) that we have configured for the data store. If we instead had a data store with 2 replicas and 2 stripes using the same disks, the maximum VDisk size we could create would be, 240GB based on 2 stripes each with a maximum size of 120GB. This can be seen in Figure 5.
If the read_local path configuration is set either for the Compute zone or the compute resource itself then the system will attempt to create VDisks using an entire stripe-set on the compute resource where the VS is running.
4 Integrated Storage Data Store Disks

Disks are partitions of an integrated storage data store that can be allocated to specific virtual servers. OnApp Storage disks are managed through the Control Panel > Storage menu. Disks for individual virtual servers are managed through the Control Panel > Cloud > Virtual Servers menu.

- When you exceed the NBD device path limit, you will see the following message in the UI failure log when starting a virtual server: *No free devices available for the operation.*

- Note that advanced disk sector format is not supported for Integrated Storage disks. Ensure that your disk drives support the 512-byte sector alignment before installing and using them with Integrated Storage.

- You cannot decrease size of Integrated Storage data store disks.

Starting from the 3.1.2, VDisks do not require 100% of parent virtual disk space reserved. The default snapshot value is now 10% of the virtual disk size or 1GB, whichever is larger. If disk size is less than 1GB, then snapshot reserve is equal to the disk size. You can change snapshot reservation on parent VDisk via the CLI tool from any compute resource:

```
onappstore snapreserve uuid=<VDISK UUID> reserve=<PERCENTAGE VALUE, e.g '20'>
```

The percentage value must be multiple of 5 between 5 and 100.

4.1 View Integrated Storage Data Store Disks

Disks are partitions of an integrated storage data store that can be allocated to specific virtual servers. OnApp Storage disks are managed through the Control Panel > Storage menu.

You can view the list of Integrated Storage data store disks and its details.

On this page:

- View List of Integrated Storage Data Store Disks
- View Integrated Storage Data Store Disks Details

See also:

- Add Disks to Integrated Storage Data Store
- Repair VS Disks Assigned to Integrated Storage Data Store
4.1.1 View List of Integrated Storage Data Store Disks

To view the list of Integrated Storage data store disks:
1. Go to your Control Panel > Storage > Data Stores menu.
2. Click the label of the required data store.
3. Scroll down to the list of disks to view the list of all data store disks with the following details:
   - Identifier - disk's identifier
   - Label - disk's label
   - Size - disk's size
   - Utilization - disk utilization rate
   - Virtual machine - the virtual server that utilizes this disk
   - Data store - the data store to which this disk belongs
   - In sync? - whether the disk is synced or not
   - Snapshot? - disk's backup status

4.1.2 View Integrated Storage Data Store Disks Details

To view Integrated Storage data store disks details:
1. Go to your Control Panel > Storage > Data Stores menu.
2. Click the label of the required data store.
3. Scroll down to the list of disks and click the label of the disk you are interested in.
4. You will get the following disk details:
   - Virtual Server - label of VS, which utilizes this disk. You can click the VS label to be redirected to the VS
   - Size - disk's size
   - Utilization - disk utilization rate
   - Copies - the number of disk's replicas
   - Stripes - the number of disk's stripes
   - Performance - performance benchmark status
   - Consistency - disk consistency status

Also there are the following buttons:
- **Discard Cache** - click this button to discard all caches for the disk
- **Refresh Resync Status** - click this button to refresh disk resync status
- **Show IO Statistics** - clicking this button will redirect you to IO statistics chart
- **Delete Disk** - click this button to delete disk

Below you can see storage nodes and **Rebalance Disk** button, which allows to move the data from one node to another.
4.2 Add Disks to Integrated Storage Data Store

We recommend creating VDisks according to data store configuration and spread stripe sets (replicas) over different compute resources so that if a compute resource goes down another should be able to run the content after the VS is migrated (if it was hosted on the compute resource). Create several data stores and group the disk drives based on performance levels (e.g. keep SSD separate from SATA to avoid wasting IO throughput for synchronous writes).

To add a new disk to the integrated storage data store in case your compute resource does not support hotplug:

1. Make sure that all VDisks are fully synced. Perform repair if it is required.
2. Migrate all virtual servers from the compute resource to which the drive(s) will be added.
3. Shut down the compute resource and connect the disk drive(s). Some VDisks will degrade - this is the expected behavior.
4. Start up the compute resource.
5. Once the compute resource boots, ensure that the drive is ready for use in the Storage platform.
6. Assign new drive to the free storage controller via OnApp User Interface. If you are assigning a new drive, the drive should be formatted. The drive's SCSI identifier parameter indicates if the drive has been previously identified.
7. Enable the new drive(s) via OnApp User Interface, for more information refer to Manage CloudBoot Compute Resource Devices.
8. Repair all degraded disks:

```
HV#: repairvdisks
```
9. Migrate virtual servers back to compute resource.

In case your compute resource supports hotplug, simply install the new storage drive to the server and assign the new drive(s) via OnApp User Interface. For more information refer to Manage CloudBoot Compute Resource Devices.

4.3 Remove Disks from Integrated Storage Data Store

To remove the disk from the integrated storage data store:

1. Re-balance all vDisks that use this drive to other drives that have free space, one path at a time.
2. Once empty, forget the node. Go to the Integrated Storage Nodes screen, select the Actions drop-down menu next to the required node, then choose Forget.
3. Ensure that all vDisks are fully synced (perform a repair if needed).

If the disk hot plug is enabled, the shut down of compute resource is not needed and steps 4, 6, and 7 can be skipped.

4. Migrate all virtual servers from the compute resource that hosts the drive to another and shut it down.
5. Remove the failed drive and insert a new one if needed.
6. Once the drive has been replaced, start up the compute resource again. Some paths may be displayed as degraded on the integrated storage health check page - this is the expected behavior, as the compute resource may contain other drives that are used for the running VSs in the cloud.

7. Repair all degraded disks by running vDisks’ repair in console on one of the compute resources in the data store zone. Alternatively, repair every vDisk from the UI.

### 4.4 Repair VS Disks Assigned to Integrated Storage Data Store

In the event that a storage node reboots, or a drive fails, it may be necessary to repair the content of one or more virtual disks.

If there are sufficient copies remaining (as configured in the Advanced Settings while creating or editing a distributed data store) then drive content can always be repaired, without any downtime required.

1. Click the Storage menu, and then the label of a data store to show the virtual disks in that store.
2. If any of the VDisks has a red background, it can be repaired via UI.
3. Click the disk label to view its details.
4. On the screen that appears, select the Repair option next to the Consistency field. Note that only one VDisk can be repaired at a time.
5. When the disk is successfully repaired, the consistency value will be changed from the "Degraded" to "Fully synced".
6. Once the content has been re-balanced, the disk will display a green icon again to indicate that all content is fully up-to-date.

The disk will be synchronized a short time after the disk repair is finished (approximately in two minutes).

### 4.5 Rebalance VDisks Assigned to Integrated Storage Data Store

Rebalancing a VDisk assigned to Integrated Storage data store is moving the data from one node to another. You can rebalance a VDisk using User Interface or via Command Line Interface. Currently, rebalancing using UI is preferable.

To rebalance a VDisk via UI:

1. Go to your Control Panel > Storage > Data Stores menu.
2. Click the required Data Store label.
3. On the page that loads, scroll down to the Disks section.
4. Click the label of the VDisk you're interested in.
5. On the page that appears scroll down to the Storage Nodes section and select the target node to host the content (deselect one of current nodes).
6. Click Rebalance Disk button to start the process. The disk will be shown as degraded while the rebalancing is taking place.

To rebalance a VDisk using CLI:
1. View the current members of the disk:

   onappstore diskinfo uuid=<identifier>

2. Forget a member (members) from a particular VDisk. It is recommended to rebalance one path at a time.

   onappstore forget forgetlist=<member> vdisk_uuid=<VD_UUID>

   where VD_UUID is a particular VDisk

3. Choose a new member on which to host the VDisk.

   onappstore repairmembership uuid=<uuid> memberlist=<member>

   Memberlist restricts the members that can be chosen to one or more members. A single member forces the VDisk to use that as the member to host content.

4. Perform the repair that copies content from the master to the slave. The master will be one of the remaining replicas that hosts VDisk content for a stripe. The slave will be the destination drive where the content is copied to.

   onappstore repair uuid=<identifier>
5 Integrated Storage Drive Devices

Drive devices are physical hard drives that can be assigned to compute resources tied to the integrated storage data stores and used as storage nodes. When the integrated storage is enabled and configured, the drive devices are available under the Nodes menu.

5.1 View Integrated Storage Data Store Drives

To view the list of integrated storage data store drives:

1. Go to your Control Panel > Storage menu.
2. Click the Nodes tab.
3. On the screen that appears, you’ll see the list of all available drives in the Drives table along with their details:
   - Device - device identifier
   - Vendor - node vendor
   - Serial - serial number
   - Revision - SCSI inquiry product revision number
6 Diagnostics

The diagnostics feature allows you to check the status of each integrated storage API endpoint and resolve these issues via the OnApp user interface. The main diagnostics screen displays the disk health and node health statuses, with critical issues shown at the top and issues with minimal priority shown lower in the page.

Diagnostics screen displays the following states that may occur in the Integrated Storage system:

- Degraded VDisks
- Lost stripe members
- Inconsistent VDisk membership and current members
- Low disk space warning for physical nodes (90% or < 2GB free)
- Snapshot and VDisk zombies / orphans

You can easily perform the following tasks via the Diagnostics screen:

- Check and clear old transaction files.
- Repair VDisks.
- Repair degraded VDisks in a data store zone.
- Check that all HVs can communicate with each other and the back end nodes.
- Detect when a disk drive does not respond, but has not been removed from the configuration.
- Ensure that the HVs are all on the same version of OnApp.
- Check that failover settings are set to the minimum recommended value of 2mins + if IS and failover is enabled.

To view results of a particular diagnostics, click the label of the required test under the Diagnostics column.

6.1 Storage Health Check

This menu displays the result of diagnostics tests. Below you will find the details on all possible results shown for the following resources:

- Disk Health
- Drive Health
- Compute Resources

6.1.1 Disk Health

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degraded disks</td>
<td>Shows the list of VDisks in a degraded state, which means that one or more (but not all) replicas of a stripe are not fully synchronised. Degraded VDisks are listed with</td>
<td>Use the repair all option to queue the repairs. Repair will resynchronise the content from an elected master to a slave. The repair button starts a repair task that will take some time depending on the data store, network and disk drive configuration</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Details</td>
<td>Action</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Disks with partial member list</td>
<td>Shows the list of VDisks having an incomplete membership list, due to disk failure, network failure or otherwise. Each VDisk should have (S)tribe * (R)eplica members.</td>
<td>Use the repair operation to repair the membership. This will elect a new valid member from the suitable nodes in the data store. Once the membership is repaired, the VDisk will be in a degraded state until it is re-synced.</td>
</tr>
<tr>
<td>Stripes with no replica</td>
<td>Shows the list of VDisks which have lost all replicas for a stripe. There is no redundancy at this point for this stripe and the data is lost. If a VDisk is in this category then the associated VS is likely broken unless the VDisk is a swap drive.</td>
<td>No repair action available.</td>
</tr>
<tr>
<td>Disks with no redundancy found</td>
<td>One or more VDisks have not got a replica stripe member on another compute resource. VDisk is healthy but all replicas of a stripe are on the same compute resource.</td>
<td>Use a Rebalance link in the Actions column that leads to re-balance page for a VDisk. This will allow the content of a VDisk to be rebalanced to another suitable disk drive.</td>
</tr>
<tr>
<td>Partially online Disks found</td>
<td>The list of VDisks that have at least one stripe online and at least one stripe offline. There must be an authoritative member for each stripe.</td>
<td>Use a Repair link in the Action column that will issue a special Storage API call (online refresh action) to fix this problem. Status of the VDisk before will show offline but one or more members will show an online front end.</td>
</tr>
<tr>
<td>Degraded snapshots</td>
<td>The list of VDisk snapshots in degraded states (except ones currently being used for ongoing backups). Backups cannot be made from a degraded snapshot.</td>
<td>To resolve this, use a bulk Delete All link in Action column that will create a background task. This task unmounts, performs unkpartx, makes zombie snapshots offline on each compute resource from the zone, and then removes the snapshot. The task may leave some snapshot VDisks left, so check for unremoved VDisks upon task completion.</td>
</tr>
<tr>
<td>Zombie snapshots found</td>
<td>The list of VDisk snapshots created during the backup procedure but still left after the backup is deleted.</td>
<td>To resolve this, use a bulk Delete All link in Action column that will create a background task. This task makes zombie snapshots offline on each compute resource from the zone, and then removes the snapshot.</td>
</tr>
<tr>
<td>Zombie disks found</td>
<td>The list of VDisks that are not associated with a VS have been found. These may include VDisks created by the command line and VDisks created for benchmarks.</td>
<td>To resolve, use a bulk Delete All link in Action column that will create a background task. This task unmounts, performs unkpartx, makes zombie disks offline on each compute resource from the zone, and then removes the disk. The task may leave some zombie disks left, so check for unremoved disks upon task completion.</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Details</td>
<td>Action</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Disks in other degraded states</td>
<td>The list of VDisks that are degraded but not in any of the other states above. These can be the disks that have missing partial members, missing inactive members, missing active members, or missing unknown members.</td>
<td>No repair action available</td>
</tr>
<tr>
<td>Stale cache volumes</td>
<td>Shows the list of stale cache volumes.</td>
<td>To resolve, use a Forget All button in Actions column to forget all items in the list. If you want to remove only some items, you can click the Forget button next to the specific item.</td>
</tr>
<tr>
<td>Disks with inactive cache</td>
<td>Shows the list of disks within active cache.</td>
<td>No repair action available</td>
</tr>
</tbody>
</table>

### 6.1.2 Drive Health

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial node found</td>
<td>The compute resource hosting the node is reachable, and reports over the API that the node is running. Possibly storage API is not responding on the storage controller server.</td>
<td>To fix, perform a controller restart. Make sure that there is sufficient redundancy such that restarting controllers on one compute resource will not cause VS downtime.</td>
</tr>
<tr>
<td>Inactive nodes found</td>
<td>Either the compute resource hosting the node is not reachable, or it is and is reporting that the storage controller for the node is not running.</td>
<td>Either power-cycle the compute resource, or bring up the storage controller VS. This can be a bit tricky if there are more than one storage controllers running on the same compute resource, and only one has shutdown.</td>
</tr>
<tr>
<td>Nodes with delayed ping found</td>
<td>Node reachable over the storage API, but is not sending out pings. OnApp SAN Controller services is not responding on the node.</td>
<td>To fix this problem, restart the SAN Controller services from inside the storage controller server, that can be triggered from the UI.</td>
</tr>
<tr>
<td>Nodes with high utilization found</td>
<td>The list of nodes with disk utilization over 90%.</td>
<td>To improve, click the Rebalance link in Action column leading to list of disks located on the node, so that user can rebalance them away from it.</td>
</tr>
<tr>
<td>Out of space nodes found</td>
<td>Node utilisation is reported at 100% for one or more nodes.</td>
<td>To Repair action will forget the content of one of the VDisks that is compute resource redundant and in sync.</td>
</tr>
</tbody>
</table>
### Diagnostics

<table>
<thead>
<tr>
<th>Missing drives found</th>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The compute resource configuration has a drive selected that is not being reported to Integrated Storage.</td>
<td>No repair action available. Compute resource configuration edit page can be selected from the error reported to deselect the drive if appropriate.</td>
<td></td>
</tr>
</tbody>
</table>

| Extra Drives | The drives that are disk-hotplugged into the system. | No repair action available from UI. |

| Inactive controllers | The list of controllers that cannot be reached but the host compute resource is responding. | Restart the controller. |

| Unreferenced NBDs found | The list of NBD data paths that are active but not referenced by a device mapper. | To fix, schedule a CP transaction which will try to clean up the unreferenced NBDs by disconnecting from the frontend. Delete all. |

| Reused NBDs found | The list of multiple uses of the same NBD connection. | No repair action available from UI. |

| Dangling device mappers found | The list of device mappers that are not in use. | Click the **Clean all** button to remove the device mappers that are not in use. You can also check the corresponding VS and if the VS is booted do nothing but, otherwise, try to unmount and offline the vDisk. |

### S.M.A.R.T.

Our S.M.A.R.T. drive health diagnostics is based on smartmontools - smartd and smartctl utilities, which read the the hardware-supported attributes from each drive.

Note that starting with ATA/ATAPI-4, revision 4, the meaning of these Attribute fields has been made entirely vendor-specific. However most newer ATA/SATA disks seem to respect their meaning, so the option of printing the Attribute values is retained.

Solid-state drives use different meanings for some of the attributes. In this case the attribute name printed by smartctl is incorrect unless the drive is already in the smartmon tools drive database.

- Please note that in case your servers are using RAID controllers, our S.M.A.R.T. check will not always properly handle the attributes without adding customization to it.

- For MegaRAID controllers, please add the following line to `/onappstore/onappstore.conf` file on each Cloudboot Compute Resource:
  
  ```
  devhealhtopt=[GENTYPE:sat+megaraid,0|SCANOPT:-d
  sat+megaraid,0|SCANTYPE:sat+megaraid,1|FORCETYPE:sa
  t+megaraid,0]
  ```

- For other controllers, please check the smartmontools page or contact OnApp support.
Since this is vendor specific, not all drives support SMART. Nonetheless most do, providing the SMART reporting is enabled in the BIOS and that the hardware supports SMART.

If the drives are behind a RAID or another controller, the controller must also support the SMART’s passthrough for SMART to work. Specific BIOS and firmware upgrades may enable SMART support, however it remains very much hardware and configuration dependent.

| SMART errors found | For one or more Disk drives in the compute resource, SMART inbuilt tests have reported one or more warnings. SMART errors occur when the drive has surpassed the threshold for reporting a failure. | Replace the drives in the maintenance window that appears. |
| SMART warnings found | SMART warnings occur when the failure attributes exist but are not at the threshold level - either Pre-failure or Old age. Pre-failure Attributes are ones which, if less than or equal to their threshold values, indicate pending disk failure. Old age, or usage Attributes, are ones which indicate end-of-product life from old-age or normal aging and wear-out, if the Attribute value is less than or equal to the threshold. | Please note: the fact that an Attribute is of type ‘Pre-fail’ does not mean that your disk is about to fail! It only has this meaning if the Attribute’s current Normalized value is less than or equal to the threshold value. |

### 6.1.3 Compute Resources

The diagnostics procedure to check the version of storage packages on CloudBoot compute resources and report about the results of the procedure in a daily or hourly storage health notification.

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute Resources have different storage versions</td>
<td>The list of CloudBoot compute resources and their storage versions.</td>
<td>Update CloudBoot compute resources via the reboot or live upgrade procedure for them to have identical storage versions.</td>
</tr>
<tr>
<td>All Compute Resources have identical storage versions</td>
<td>Indicates that all CloudBoot compute resources have identical storage versions.</td>
<td>No repair action is required.</td>
</tr>
</tbody>
</table>

### 6.2 Network Health Check

Network Health is a diagnostics which allows you to check the status of each integrated storage API endpoint and resolve these issues via the OnApp user interface. The main diagnostics
screen displays the disk health and node health statuses, with critical issues shown at the top and issues with minimal priority shown lower in the page.

### 6.2.1 Run diagnostic

To run a new diagnostic test:

1. Go to your Control Panel > **Storage > Diagnostics** menu.
2. Scroll to the bottom of the screen and click the **New Diagnostic** button.
3. A new diagnostic test will be successfully created.

This will create a new task that performs some long running actions. For details, click the date of the required diagnostics.

### 6.2.2 View the results of a particular diagnostics

1. On the screen that appears, you will see the following diagnostics test details:
   - Date and time when the test was taken.
   - **Status** - test status.
   - **Compute resource count** - the number of compute resources inspected.

2. Below you will find the further details:
   - **Connectivity matrix** - connectivity matrix displays test results of each compute resource in the API endpoint zone. Click the check box next to the compute resource to view its connectivity matrix, then select the required tab:
     - **Ping** - view the compute resource's ping results. Pings are made from each compute resource to each other compute resource using following command `ping -c 10 -s 1500 -M do 112.111.1.1` (pings are made on storage network), if any of the 10 pings did not succeed, the row that corresponds to this compute resource combination is considered to have failed.
     - The green squares on the chart mean that compute resource can ping another compute resource.
     - **Big ping** - view the results of compute resource ping with maximum packets size (MTU size is defined in the CloudBoot compute resource settings). To make a big ping, the following command is used: `ping -c 10 -s MTU -M do 123.111.1.1` where MTU is substituted by the MTU value set for given compute resource during creation. The green squares on the chart mean that compute resource can ping another compute resource with MTU size packets.
   - **Bandwidth** - view the compute resource's bandwidth test results. Bandwidth is measured from each compute resource to each other compute resource using the following command on source compute resource `iperf -s -D` and on target compute resource `iperf -t60 -N -y C -c 112.111.1.1`
     - The compute resource bandwidth values are displayed on the chart.
   - **Activity log** - activity log contains log messages of all actions that take place during the diagnostic test. Click the log item's **Ref** to view its details.

### 6.2.3 Delete diagnostics

To delete a diagnostics test:

1. Go to your Control Panel > **Storage > Diagnostics** menu.
2. Scroll to the **Diagnostics** table.
3. Click the **Actions** icon next to the diagnostic test you want to remove, then choose **Delete**.

4. Confirm the deletion.

**On this page:**

- **Run diagnostic**
- **View the results of a particular diagnostics**
- **Delete diagnostics**

### 6.3 Content Balance Check

This diagnostic is launched automatically every time you open its page and it allows you to rebalance the content in your cloud enhancing its performance and reliability.

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>DataStores have Nodes with non-uniform capacity</td>
<td>Shows if the actual size of connected nodes is the same and/or how much it differs from the average size of the nodes.</td>
<td></td>
</tr>
<tr>
<td>DataStores have non-uniform Node structure</td>
<td>Indicates the average number of nodes per compute resource and shows the deviations in percents for each cluster.</td>
<td></td>
</tr>
<tr>
<td>Some disks are not distributed between compute resources</td>
<td>The disabled local read performance ensures that all stripes are located on different compute resources. This diagnostic ensures that you have the maximum reliability and in case a compute resource reboots or crashes, only one vDisk stripe gets degraded or inactive. This tab list the disks which stripes are located on the same compute resources. You can click the disk's label to view its details.</td>
<td>Use <strong>rebalance</strong> to redistribute the content between compute resources so that each compute resource has one stripe of the vdisk.</td>
</tr>
<tr>
<td>Some disks are not optimized for local read performance</td>
<td>Local read performance ensures the complete stripe set is located on the same compute resource. This tab list the disks which stripes are located on different compute resources. You can click the disk's label to view its details.</td>
<td>Use <strong>rebalance</strong> option to rebalance the disk so that the complete stripe set is within one compute resource.</td>
</tr>
</tbody>
</table>
### Diagnostics

<table>
<thead>
<tr>
<th>Diagnostics</th>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content is not uniformly distributed across compute resources</td>
<td>Show the list of compute resources with indication of free space available for each compute resource and the percentage ratio to the average free space for all compute resources within one data store.</td>
<td>Use <strong>rebalance</strong> to redistribute the content between compute resources so that each compute resource has the same amount of free space which is equal to the average value.</td>
</tr>
<tr>
<td>Content is not uniformly distributed within compute resources</td>
<td>Shows the list of nodes with indication of free space available for each node and the percentage ratio to the average free space for all nodes in the data store.</td>
<td>Use <strong>rebalance</strong> to redistribute the content between nodes so that each node has the same amount of free space which is equal to the average value.</td>
</tr>
<tr>
<td>The diagnostic is not run for data stores where the amount of nodes equals to the number of stripes multiplied by replicas, that is Stripes×Replicas=Nodes. In this case, the Rebalance action is not available either.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some Virtual Servers are not placed in an optimal way</td>
<td>Lists the virtual servers which are running on different compute resources than their disks. This item will only be displayed for the current compute zone on the content balancer window if you are using &quot;Local Read Path&quot; there.</td>
<td>Use <strong>migrate</strong> option to migrate the virtual server to the compute resource where its disks are located.</td>
</tr>
</tbody>
</table>

#### 6.4 Diagnostics API

Below you can find API requests and additional information for different health checks:

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>Response Statuses</th>
<th>POST types</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL</td>
<td>Decription</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Health:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. curl -i -X POST -u admin:password</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URL</td>
<td>ID</td>
<td>Response Status Code</td>
<td>POST types</td>
</tr>
<tr>
<td>-----</td>
<td>----</td>
<td>----------------------</td>
<td>------------</td>
</tr>
<tr>
<td><a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/degraded_disks/repair_all.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/degraded_disks/repair_all.json</a></td>
<td>partial_memberlist_disks</td>
<td>200/204/201</td>
<td>repair ID / repair ALL</td>
</tr>
<tr>
<td>2. curl -i -X POST -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/data_stores/:data_store_id/repair.json">http://onapp.test.com/storage/:hypervisor_group_id/data_stores/:data_store_id/repair.json</a></td>
<td>disks_with_no_redundancy</td>
<td>200</td>
<td>rebalance ID: GET &quot;/storage/:hypervisor_group_id/data_stores/l538vcsdq0eq4x/disks/b8fzygu7642p0n&quot; just leads to the rebalance vdisk page</td>
</tr>
<tr>
<td>3. curl -i -X POST -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partial_memberlist_disks/repair_all.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partial_memberlist_disks/repair_all.json</a></td>
<td>partially_online_disks</td>
<td>200/204</td>
<td>repair ID</td>
</tr>
<tr>
<td>1. curl -i -X GET -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partially_online_disks.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partially_online_disks.json</a></td>
<td>degraded_snapshots</td>
<td>200/201</td>
<td>repair ALL</td>
</tr>
<tr>
<td>URL</td>
<td>ID</td>
<td>Respon se STATUS</td>
<td>POST types</td>
</tr>
<tr>
<td>--------------------------------------------------------------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>curl -i -X POST -d '{&quot;disk_id&quot;:&quot;qy3dlb1a06xp79&quot;, &quot;node_id&quot;:10407142}' -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repairs.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repairs.json</a> -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>curl -i -X POST -d '{&quot;disk_id&quot;:&quot;qy3dlb1a06xp79&quot;, &quot;node_id&quot;:10407142}' -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repairs.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repairs.json</a> -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/disks_with_other_degradations.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/disks_with_other_degradations.json</a> -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>disks_with_other_degradations</td>
<td>200</td>
<td>No repair action available</td>
</tr>
<tr>
<td>curl -i -X POST -d '{&quot;disk_id&quot;:&quot;qy3dlb1a06xp79&quot;, &quot;node_id&quot;:10407142}' -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repairs.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repairs.json</a> -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URL</td>
<td>ID</td>
<td>Response Status</td>
<td>POST types</td>
</tr>
<tr>
<td>-------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>group_id/health_checks/stale_cache_volumes/repair_all.json -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>partial_nodes</td>
<td>200/204</td>
<td>Repair ID</td>
</tr>
<tr>
<td>2. curl -i -X POST -d '{&quot;node_id&quot;:911788171}' -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/delayed_ping_nodes/repairs.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/delayed_ping_nodes/repairs.json</a> -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>high_utilization_nodes</td>
<td>200</td>
<td>rebalance button just leads to disks page</td>
</tr>
<tr>
<td>URL</td>
<td>ID</td>
<td>POST types</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>curl -i -X GET -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/smart_warnings.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/smart_warnings.json</a></td>
<td>smart_warnings</td>
<td>200 No repair action available from UI.</td>
<td></td>
</tr>
</tbody>
</table>
### Content Balance:

1. **curl** -i -X GET -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/uniform_node_capacity.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>RESPONSE STATUS</th>
<th>POST TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>-H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>uniform_node_capacity</td>
<td>200</td>
<td>No repair action available from UI.</td>
</tr>
</tbody>
</table>

2. **curl** -i -X GET -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/uniform_node_structure.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

<table>
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<tr>
<th>URL</th>
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</tr>
</thead>
<tbody>
<tr>
<td>-H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>uniform_node_structure</td>
<td>200</td>
<td>No repair action available from UI.</td>
</tr>
</tbody>
</table>

1. **curl** -i -X GET -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/disk_content_distribution.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>RESPONSE STATUS</th>
<th>POST TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>-H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>disk_content_distribution</td>
<td>200/204</td>
<td>repair ALL 204</td>
</tr>
</tbody>
</table>

2. **curl** -i -X POST -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/disk_content_distribution/repair_all.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

1. **curl** -i -X GET -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/inter_hypervisor_balance.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>RESPONSE STATUS</th>
<th>POST TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>-H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>inter_hypervisor_balance</td>
<td>200/204</td>
<td>repair ALL 204</td>
</tr>
</tbody>
</table>

2. **curl** -i -X POST -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/inter_hypervisor_balance/repair_all.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

1. **curl** -i -X GET -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/intra_hypervisor_balance.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>RESPONSE STATUS</th>
<th>POST TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>-H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>intra_hypervisor_balance</td>
<td>200/204</td>
<td>repair ALL 204</td>
</tr>
</tbody>
</table>

2. **curl** -i -X POST -u admin:password
   `http://onapp.test.com/storage/:hypervisor_group_id/health_checks/intra_hypervisor_balance/repair_all.json`
   `-H 'Accept: application/json' -H 'Content-type: application/json'`
<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>Response Status</th>
<th>POST types</th>
</tr>
</thead>
</table>
| 1. curl -i -X GET -u admin:password
  http://onapp.test.com/storage/:hypervisor_group_id/health_checks/virtual_machine_placement_optimization.json
  -H 'Accept: application/json' -H 'Content-type: application/json'
| virtual_machine_placement_optimization                              | 200/204                              | repair ALL ->
  local_read_policy(migrate) |
7 Storage Nodes

OnApp storage nodes are self-managing, self-discovering, and self-contained hot-pluggable units. Each storage node manages its own content in the most efficient way possible, without loss of performance, using a thin-provisioning layer for storage space efficiency and overcommit. This ensures that data is stored optimally across the whole environment while maintaining data replication and drive resiliency properties. There is no centralized management system to fail, and each node can make decisions about data synchronization and load balancing without depending on a central controller.

The list of storage nodes can be found in the Storage > Nodes menu.

7.1 NBD paths

The number of NBD paths available for your virtual disks depends on the amount of RAM available to the storage node. You can use the following formula to calculate the maximum number of NBD paths, N:

\[ N = \frac{\text{Controller memory size} - 128}{4}, \]

where:
- Controller memory size = the memory assigned to the storage controller (by default it is 1024MB, you may calculate the needed memory as the DB size (the memory assigned to the storage controller, 128MB by default) + 10 MB x vDisk parts at the controller)
- 128 = amount of system memory reserved for the storage controller
- 4 = the amount of memory needed per NBD server

So by default:

\[ (1024 - 128) = 896 \text{ MB for NBD servers} \]
\[ 896 \div 4 = 224 \text{ NBD paths available} \]

Each stripe in a datastore needs 1 NBD path, so the total number of vDisks, D, you can have is given by:

\[ D = \frac{N}{S \times R} \]

where: S = the number of stripes in the datastore
R = the number of replicas

Example

If the datastore has two replicas and two stripes, it requires four paths (2 strips x 2 replicas) per disk. Using the defaults for the storage controller, each controller can host:

\[ 224 \div 8 = 56 \text{ vDisks} \]

Linux virtual servers have at least two disks (main disk and swap disk), so eight paths would be required (if you are using the same datastore configuration for main disk and swap). So, this configuration supports 28 Linux virtual servers or 56 Windows virtual servers.

To fit more virtual servers in the cloud, we recommend using unreplicated storage for swap drives.

If you want to get more vDisks to run, either the number of disks per controller has to be decreased or the memory for the storage controllers has to be increased.

7.2 Free space per storage node

In order to calculate free space per storage node we use the next two formulas:

a) Formula for overcommit scheme: physical_disk_size + overcommit_value_in_percentage - allocated_space

b) Formula without overcommit: physical_disk_size - allocated_space
For example:
Our physical disk which is mounted to the controller has a size of 558.6GB:
Allocated space for it - 659 GB
Overcommit - 20%
So: 558.6+20%-659=11.32 or 11 GB

The same calculation is done for the second formula but without using the overcommit value.

- Enabling overcommit and running out of physical space is a dangerous condition and should always be avoided. It is strongly recommended that you create data stores with overcommit = none for production purposes.
- These calculations will not make sense for overcommit unlimited. We can use them only when we have a specific value of overcommit (for instance 20%, 50%, etc).

7.3 View the List of Storage Nodes

To view the list of storage nodes:
1. Go to your Control Panel > Storage > Nodes menu.
2. On the screen that appears, you will see the list of all storage drives available on the cloud.
3. To filter storage nodes by specific compute resource, choose the required compute resource from the Host drop down box and click the Filter button.
4. To view inactive nodes only, move the inactive slider to the right, then click the Filter button.
5. To view node’s properties, edit or forget it, press the Actions button next to the node, then choose the required action.

7.4 View Storage Node Details

To view the list of storage nodes:
1. Go to your Control Panel > Storage > Nodes menu.
2. On the screen that appears, you will see the list of all storage nodes in the cloud.
3. Click the Actions button next to the required storage node, then choose Properties.
4. On the screen that follows, you will see the following node details:
   - Performance - node performance mode: low, normal or high
   - Model - node model
   - Size - node size in GB
   - Allocated space - allocated node’s space in GB
   - Serial - serial number
   - Status - storage node status: 1 if the node is enabled and 0 if it is disabled
   - Disk count - the number of VDisks hosted on this node.
7.5 Forget Storage Node

Forget option makes the data store forget about the drive. Use the forget option when you need to remove drives for maintenance or replacement in the following cases:

- When a node disappears permanently, for example, due to disk removal or failure it is necessary to 'forget' it.
- When you need to remove and repair the membership in order to resync a drive.

Forget command removes the failed storage node from all formerly owned vDisks. Use the forget disk option only if you are going to remove the vDisk completely!

On this page:

- Forget storage node via UI
- Forget storage node via CLI
- Failed disk removal

See also:

- View the List of Storage Nodes
- Edit Storage Node

7.5.1 Forget storage node via UI

To forget storage node:

1. Go to your Control Panel > Storage > Nodes menu.
2. On the screen that appears, you will see the list of all storage nodes in the cloud.
3. Click the **Actions** button next to the required storage node, then choose **Forget**.

To forget several storage nodes:

1. Go to your Control Panel > Storage > Nodes menu.
2. On the screen that appears, you will see the list of all storage nodes in the cloud.
3. Tick the check-boxes next to the required storage nodes, then click the **Forget Nodes** button.

7.5.2 Forget storage node via CLI

To forget storage node via CLI:

1. Check if that there are sufficient replicas and good paths for all vDisks that reside on that disk before removing a physical drive. Then:
   - To forget a node from a specified VDisk:
2. Remove the disk.
3. After that, you can add a new vDisk at this point. 
   Before adding a new disk:
   - Make sure that all vDisks that are hosted on the compute resource have sufficient replicas.
   - Migrate all VSs that are hosted on the compute resource to another compute resource.
4. After that, add the disk to the data store by editing the Integrated Storage data store settings in the OnApp Control Panel.
5. Repair the degraded vDisks of the removed member.
6. Run the following commands in the CLI:

   - onappstore repairmembership uuid=<UUID>
   - onappstore repair uuid=<UUID>

7. Check the disk status as before with the repair operation:

   - onappstore resynchstatus uuid=mq98y0trhi5bxo
   status={u'3335881780':{u'4142566975':59,u'138773005':{u'433710490':66}}}
   result=SUCCESS

### 7.5.3 Failed disk removal

If you have a failed disk, you can remove it. To remove a failed disk:
1. Check for a copy of the content.
2. Forget disk using forgetlist command.
3. Repair membership for all vdisks that had content on that disk
4. Repair VDisk for all vdisks that had content on that disk

Steps 3-4 are performed for a vdisk with the repair option from UI.
7.6 Edit Storage Node

You can change the node's performance by editing a storage node. To do so:
1. Go to your Control Panel > Storage > Nodes menu.
2. On the screen that appears, you will see the list of all storage nodes in the cloud.
3. Click the Actions button next to the required storage node, then choose Edit.
4. On the screen that appears, select the required storage node performance type from the drop-down box.
5. Click the Submit button to apply your settings.

After you submit the settings, changing the node performance can take up to ten minutes, depending on the workload.

7.7 View Storage Node Statistics

To view the storage node IO statistics:
1. Go to your Control Panel > Storage menu.
2. Click the Nodes tab.
3. On the screen that appears, you will see the list of all storage nodes in the cloud.
4. Click the Actions button next to the required storage node, then choose Properties.
5. On the screen that follows, press the Show IO Statistics button.
6. On the Statistics screen, specify the viewing parameters:
   a. Choose the required IO statistics type from the drop-down box. You can view the following IO statistics types:
      ▪ read I/Os
      ▪ read merges
      ▪ read sectors
      ▪ read ticks
      ▪ write I/Os
      ▪ write merges
      ▪ write sectors
   b. Set From and To time. By default, the statistics are generated for the last three months or the actual VS existence period.
   c. Move the Show in my Timezone slider to the right to show bandwidth statistics according to your profile's time zone settings.
   d. Press Filter.

7.8 View Storage Node Disks

To view the list of disks located on a particular storage node:
To view the storage node IO statistics:

1. Go to your Control Panel > Storage menu.
2. Click the Nodes tab.
3. On the screen that appears, you will see the list of all storage nodes in the cloud.
4. Click the label of a storage node you are interested in to view its properties, then click the Show Disks button.
5. On the screen that appears, you will see the list of storage node disks along with their details:
   - **Identifier** - disk's identifier
   - **Label** - disk's label
   - **Size** - disk's size
   - **Utilisation** - disk utilization rate
   - **Virtual machine** - the virtual server that utilizes this disk
   - **Data store** - the data store to which this disk belongs
   - **In sync?** - whether the disk is synced or not
   - **Snapshot?** - disk’s backup status

To delete a disk, click the Actions button next to the required disk, then select Delete.
8 Static Compute Resources

In OnApp you can install compute resources in two ways, using the static compute resources installation methodology or CloudBoot.

Static resources are compute resources that run on the KVM virtualization environment and make use of the local, shared, or OnApp Integrated storage.

Static compute resources have a number of advantages for the users, such as:

- Provide system resources such as CPU, memory, and network
- Control the virtual differentiation of entities such as virtual servers and application data being delivered to cloud-hosted applications
- Take care of secure virtualization and channeling of storage, data communications, and server processing
- Can be located at different geographical zones
- Can have different CPU and RAM
- Can be associated with the data stores, networks, and backup servers of the same type

To start using Integrated Storage on KVM static compute resources:

1. Go to **Settings > Configuration > System**.
2. In the OnApp Storage section, move **Enable OnApp Storage** slider to the right to enable the OnApp storage on the cloud.

You can enable Integrated Storage only for new CentOS 7 KVM static compute resources. For details on how to enable Integrated Storage during the creation of a static compute resource, refer to the **Create Static Compute Resource** section.

8.1 View Static Compute Resource Details

Each virtual server in the cloud is run on a specific compute resource that allocates CPU and RAM, while storage capacity is allocated from a data store attached to the compute resource.

You can view compute resource settings and hardware information.

Ensure that *See all compute resources* permission is on before viewing compute resource details.

On this page:

- [View Compute Resource Settings](#)
- [View Compute Resource Hardware Information](#)

8.1.1 View Compute Resource Settings

To view compute resource settings:

1. Go to your Control Panel > **Admin > Settings** menu.
2. Click the **Compute Resources** icon.
3. On the screen that appears, you will see the list of all compute resources in the cloud along with their details:
• **Status** - whether the compute resource is online, offline or in maintenance mode
• **Label** - the name of the compute resource
• **IP Address** - the IP address of the compute resource
• **Enabled** - whether the compute resource is enabled or disabled. If disabled, you cannot create the virtual servers on it, or migrate the VSs to this compute resource.
• **Compute Zone** - the compute zone to which the compute resource is assigned
• **Operating System Type** - the operating system type of the virtual servers that can live on this compute resource
• **CPU Cores** - a number of CPU cores
• **RAM** - total/free RAM
• **VS** - the number of VSs associated to the compute resource

**Features** - , where the first icon shows compute resource’s failover status, the second one - statistics collection, the third one - CloudBoot status and the fourth one - backup status (for CloudBoot compute resources only; it shows whether CloudBoot compute resource is used as a backup server).

To sort information by column in ascending or descending order, mouse over the particular column header and click a triangle icon.

To view a particular compute resource details, click the label of a required compute resource. On the screen that appears you'll see compute resource details (RAM usage/RAM available, IP Address, CPU MHZ/CPU cores etc.) and **Activity log** of this compute resource. To view details of a transaction from activity log, click its Ref number.

To edit or delete a compute resource, click the **Actions** button next to the compute resource, then select the required action.

### 8.1.2 View Compute Resource Hardware Information

**To view compute resource hardware info:**

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon.
3. On the screen that appears, you will see the list of all compute resources in the cloud.
4. Click the **Actions** button next to the compute resource and press **Hardware Info**. Also, you can click the label of a specific compute resource and press **Tools** > **Hardware Info**.
5. You will get the following details:
   - **Summary info**
     - This section contains the basic information about the compute resource:
       - **Current Uptime** - the time the compute resource/backup server has been working and available, the number of its users, and the average load.
       - **Total CPU** - the total amount of CPU (number of cores/frequency in MHz) allocated to the compute resource/backup server.
       - **Memory** - the total amount of memory (GB) allocated to the compute resource/backup server.
       - **Type** - the type of the compute resource, for example, KVM, etc. For backup servers, the type is Backup server.
- **OS** - the operating system of the compute resource/backup server.
- **Manufacturer/Model** - the manufacturer and model of the motherboard.
- **BIOS/Serial Number** - the system BIOS, its serial number and release date.

  - **CPU**
    This section shows CPU manufacturer logo and information about CPU slots. Click the **CPU details info** button to get detailed information about CPU from the Intel ARK database if available.

  - **RAM**
    This section includes information about memory slots (double data rate, memory clock in MHz, size)

  - **HD**
    This section shows information about hard drive slots, its size etc..

  - **Network**
    This section contains information about network cards. Click the **Info** button next to the specific network to get its detailed information from the Intel ARK Database if available.

6. If hardware information is empty or incomplete, click the **Update Hardware Info** button in the right upper corner.

### 8.2 View Static Compute Resource Details 6.1

Each virtual server in the cloud is run on a specific compute resource that allocates CPU and RAM, while storage capacity is allocated from a data store attached to the compute resource.

You can view compute resource settings and hardware information.

- Ensure that **See all compute resources** permission is on before viewing compute resource details.
- To start using Integrated Storage on static compute resources:
  1. Go to **Settings > Configuration > System**.
  2. In the OnApp Storage section, move **Enable OnApp Storage** slider to the right to enable the OnApp storage on the cloud.

On this page:

- View Compute Resource Settings
- View Compute Resource Hardware Information
- View Integrated Storage Settings

### 8.2.1 View Compute Resource Settings

To view compute resource settings:

1. Go to your Control Panel > **Admin > Settings** menu.
2. Click the **Compute Resources** icon.

3. On the screen that appears, you will see the list of all compute resources in the cloud along with their details:

- **Status** - whether the compute resource is online, offline or in maintenance mode
- **Label** - the name of the compute resource
- **IP Address** - the IP address of the compute resource
- **Enabled** - whether the compute resource is enabled or disabled. If disabled, you cannot create the virtual servers on it, or migrate the VSs to this compute resource.
- **Compute Zone** - the compute zone to which the compute resource is assigned
- **Operating System Type** - the operating system type of the virtual servers that can live on this compute resource
- **CPU Cores** - a number of CPU cores
- **RAM** - total/free RAM
- **VS** - the number of VSs associated to the compute resource
- **Features** - ( ), where the first icon shows compute resource's failover status, the second one - statistics collection, the third one - CloudBoot status and the fourth one - backup status (for CloudBoot compute resources only; it shows whether CloudBoot compute resource is used as a backup server)

To sort information by column in ascending or descending order, mouse over the particular column header and click a triangle icon.

To view a particular compute resource details, click the label of a required compute resource. On the screen that appears you'll see compute resource details (RAM usage/RAM available, IP Address, CPU MHZ/CPU cores etc.) and **Activity log** of this compute resource. To view details of a transaction from activity log, click its Ref number.

To edit or delete a compute resource, click the **Actions** button next to the compute resource, then select the required action.

### 8.2.2 View Compute Resource Hardware Information

To view compute resource hardware info:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon.
3. On the screen that appears, you will see the list of all compute resources in the cloud.
4. Click the **Actions** button next to the compute resource and press **Hardware Info**. Also, you can click the label of a specific compute resource and press **Tools > Hardware Info**.

![Image](image.png)

5. You will get the following details:

   - **Summary info**
     - This section contains the basic information about the compute resource:
       - **Current Uptime** - the time the compute resource/backup server has been working and available, the number of its users, and the average load.
       - **Total CPU** - the total amount of CPU (number of cores/frequency in MHz) allocated to the compute resource/backup server.
         - **Memory** - the total amount of memory (GB) allocated to the compute resource/backup server.
       - **Type** - the type of the compute resource, for example, Xen, KVM, etc. For backup servers, the type is Backup server.
         - **OS** - the operating system of the compute resource/backup server.
       - **Manufacturer/Model** - the manufacturer and model of the motherboard.
       - **BIOS/Serial Number** - the system BIOS, its serial number and release date.

   - **CPU**
     - This section shows CPU manufacturer logo and information about CPU slots. Click the **CPU details info** button to get detailed information about CPU from the Intel ARK database if available.

   - **RAM**
     - This section includes information about memory slots (double data rate, memory clock in MHz, size)

   - **HD**
     - This section shows information about hard drive slots, its size etc.

   - **Network**
     - This section contains information about network cards. Click the **Info** button next to
the specific network to get its detailed information from the Intel ARK Database if available.

6. If hardware information is empty or incomplete, click the Update Hardware Info button in the right upper corner.

## 8.2.3 View Integrated Storage Settings

OnApp provides an overview of integrated storage settings enabled on compute resources available in your cloud. On the Integrated Storage Settings page, you can view information on SAN bonding mode and MTU value, information about disks assigned to cache and controller.

To view integrated storage settings:

1. Go to the Control Panel > Admin > Settings menu and click the Compute Resources icon.
2. On the page that appears, you will see the list of compute resources available in your cloud. Click the Actions button next to the label of a compute resource and select the Integrated Storage Settings option.
3. You will get the following details:

   - **SAN bonding mode** - the type of the bonding mode. The default type of the bonding mode is 802.3ad
   - **MTU** - the maximum transportation unit size. By default, the maximum transportation unit size is set to 1500
     - **VLAN id** - virtual LAN id (Optional)
   - **Cache settings**:
     - **Number of cache mirrors** - the number of cache mirrors for the compute resource. By default, the number of cache mirrors is set to 1
     - **Number of cache stripes** - the number of cache stripes for the compute resource. By default, the number of cache stripes is set to 1
   - **Controller settings**:
     - **Controller RAM** - the controller RAM value. By default, the controller RAM value is set to 1024
     - **Drives per controller** - the number of disks per controller virtual server. By default, the controller virtual server is created per 4 disk drives.
     - **Controller DB size** - the controller DB size value. By default, the controller DB size is 128

## 8.3 Create Static Compute Resource

You can add static compute resources at any time. To add a static compute resource:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute resources icon.
3. Press "+" button or click the Add New Compute Resource button underneath the list of Compute resources on the screen.
4. On the screen that appears:
   o **Label** - enter a Compute resource label.
   o **IP Address** - add an IP address.
   o **Compute Resource Type** - choose a Compute resource type (KVM).
   o **Operating System Type** - choose an operating system type (Any OS, Windows only or Non-Windows).
     - **Any OS** - when this option is selected, any VS with any Operating system will live on compute resource. By default, each compute resource will be created with the Any OS option. The existing compute resources also will have the Any OS set.
     - **Windows only** - when this option is selected, only VSs with the operating system Windows will be living on this compute resource. This compute resource will not be available for selection when creating a Linux or FreeBSD VS, nor when migrating a VS.
     - **Non-Windows** - when this option is selected, only VSs with the operating system Linux or FreeBSD will be possible to create on this compute resource. This compute resource will be skipped for Windows-based VSs in VS creation wizard, or when migrating a VS. Also when failover happens, Windows-based VSs won’t migrate to this compute resource.
   o **Backups IP address** - add a provisioning network IP address.
   o **CPU Units** - adjust the slider to set the desired amount of CPU units for this Compute resource. For more info on CPU units, refer to Billing Calculation. Do not apply CPU Units for KVM Compute resources running on baremetal servers. Mind that setting a different amount of CPU units will affect your cloud configuration. It will not be possible to create Instance Package VSs on the compute zone to which you assign this compute resource.
   o **Enabled** - move the slider to the right to enable a Compute resource. Compute resources that are not enabled cannot be used to host VSs.
   o **Collect Stats** - move the slider to the right to collect statistics for this Compute resource.
   o **Disable Failover** - move the slider to the right to disable failover on this Compute resource (failover is automatic VS migration to another Compute resource if this one goes down).
   o **Failover recipe** - select a recipe to run before the failover process.
   o **Integrated Storage** - move the slider to the right to enable Integrated Storage on static compute resources.
   o **Power Cycle Command** - arbitrary command string to be executed by IPMI from the CP server. If the command is entered, a new option "Power Cycle Compute resource" - which will execute the entered command will appear in Tools menu at Admin > Settings > Compute resources > Compute resource page.

Currently, a command or commands should be written in one line separated by a semicolon. If the command(s) is written in two lines you will receive a "fail" response, although the transaction will be performed. The power cycle command is
executed on Control Panel under user onapp, this may be any script created in bash.

5. Click the Save button. The Compute resource will be added to the system. You can view it under the Compute resources menu. Click the Back button to return to the Compute resource Settings page.

For details on how to create a CloudBoot Compute resource, refer to the Create CloudBoot Compute Resource section.

After you create a compute resource you need to add it to a compute zone of the required type. For more information on compute zone types, refer to Zone Types.

8.4 Edit Static Compute Resource

To edit a static compute resource:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute resources icon.
3. Click the Actions button next to the Compute resource you want to edit, then click Edit.
4. On the screen that follows, change details as required:
   - Label - the Compute resource's name
   - Operating System Type - choose an operating system type (Any OS, Windows only or Non-Windows)

Note that the compute resource won't be edited if the VSs with the inappropriate operating system are present on it. Thus, it won't be possible to set Windows only type for a compute resource if there are any Linux or FreeBSD VSs living on it. Likewise, it won't be possible to set the Non-Windows type for a compute resource, if there are Windows-based VSs living on it.

- IP Address - IP address of the Compute resource
- Backup IP address - provisioning network IP address
- CPU units - change the amount of CPU units assigned to this Compute resource.

Mind that setting a different amount of CPU units will affect your cloud configuration. It will not be possible to create Instance Package VSs on the compute zone to which you assign this compute resource.

- Enabled - enable or disable the ability to install/boot virtual servers on this Compute resource
- Collect Stats - enable or disable the ability to collect statistics for this Compute resource
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- **Disable failover** - enable or disable the VS migration to another Compute resource if this Compute resource is marked as offline by the Control panel server.

  - If you want to enable/disable failover for all compute resources within the compute zone, refer to Manage Failover section of this guide.
  - If you use automatic failover with write-back caching you may lose some data in the event of a failover.

- **Failover recipe** - select a recipe to run before the failover process
- **Integrated Storage** - move the slider to the right to enable Integrated Storage on static compute resources.
- **Power Cycle Command** - arbitrary command string to be executed by IPMI from the CP server. If the command is entered, a new option “Power Cycle Compute resource” - which will execute the entered command will appear in Tools menu at Settings > Compute resources > Compute resource page.

Currently, a command or commands should be written in one line separated by a semicolon. If the command(s) is written in two lines you will receive a “fail” response, although the transaction will be performed. The power cycle command is executed on Control Panel under user onapp, this may be any script created in bash.

5. Click the **Save** button to save your changes.

### 8.4.1 Edit Integrated Storage Settings

You may enable Integrated Storage on static compute resources created after upgrade to OnApp 6.1. To start using Integrated Storage on static compute resources:
1. Go to Settings > Configuration > System.
2. In the OnApp Storage section, move Enable OnApp Storage slider to the right to enable the OnApp storage on the cloud.

To edit integrated storage settings:
1. Go to the Control Panel > Admin > Settings menu and click the Compute Resources icon.
2. On the page that appears, you will see the list of compute resources available in your cloud. Click the Actions button next to the label of a compute resource and select the Integrated Storage Settings option.
3. Click the Edit button.
4. On the screen that loads, edit the following parameters:
   - SAN bonding mode - choose bonding mode type from the drop-down menu
   - MTU - specify the maximum transportation unit size. You can set the frame size from 1500 to 9000 bytes
   - VLAN id - specify the ID of a VLAN number
   - Cache settings:
     - Number of cache mirrors - specify the number of cache mirrors for the compute resource
     - Number of cache stripes - specify the number of cache stripes for the compute resource
   - Controller settings:
     - Controller RAM - specify the controller RAM value. You may calculate the amount of memory needed for a storage controller as DB size (128MB by default) + 10 MB x vDisk parts at the controller.
     - Drives per controller - specify the number of disks per controller virtual server. You can specify from 1 to 4 disks. By default, the controller virtual server is created per 4 disk drives.
     - Controller DB size - select the controller DB size value (minimum 128 MB, maximum 256 MB)
5. Click the Save button to save changes.
8.5 Manage Static Compute Resource Hardware Devices

You can manage static compute resource hardware devices (disks and network interfaces), which are configured during Static compute resource creation.

8.5.1 Edit static compute resource hardware devices configuration

To edit static compute resource hardware devices configuration:

1. Go to Control Panel > Admin > Settings menu > Compute Resources > label of compute resource > Tools > Hardware Devices.
2. The page that loads displays the Storage versions details and the list of devices together with their details. The Storage version displays the onappstore rpm version and may have the UNKNOWN VERSION value if the compute resource was booted from an older ramdisk image.
   - For disks - name, status and SCSI identifier
   - For network interfaces - name, status and MAC
3. Click the Edit Hardware Device Configuration button.
4. Assign each disk to Storage or to Cache, or leave it unassigned:
   - Unassigned - leave the disk unused
   - Assigned to Storage - select to use this disk into storage datastore
   - Assigned to Cache - select to use this disk for DM-Cache
5. Configure network interfaces. For each Compute resource NIC, you can use one of the following options:
   - Unassigned - leave the NIC unused.
   - Assigned to SAN - select this option to use this interface for storage network. In this case, NIC interface will be bonded with virtual network interface of the Storage Controller Server.
6. Click Next.
7. After devices are successfully reconfigured, click Finish.

To disable SAN network, unassign all network interfaces from the compute resource at Control Panel > Admin > Settings > Compute Resources > label of the compute resource > Tools > Edit hardware devices > set the Unassigned option for all network interfaces. If you need to configure networks manually, refer to Manual Integrated Storage Network Configuration.

On this page:

- Edit static compute resource hardware devices configuration
- Advanced network interfaces
8.5.2 Advanced network interfaces

You can also manage the advanced configuration of network interface devices at Control Panel > Settings > Compute Resources > label of the necessary compute resource > Tools > Hardware Devices page. The Advanced Network Interfaces slider becomes visible in the top right corner of the page once the compute resource starts speaking VIF Storage API. For this, the compute resource should be properly connected to the Control Panel and have network interfaces available. Move the slider to the right to show the advanced network interfaces for a compute resource.

8.5.2.1 Add Advanced Network Interface Device
If required, you can manually create an advanced network interface with custom parameters. To do so:

1. Go to your Control Panel > Admin > Settings > Compute Resources > label of the necessary compute resource.
2. Click the Tools button and select the Hardware Devices option.
3. On the page that appears, click the Create new custom network interface device button.
4. Specify the following details:
   - Name
   - PCI
   - MAC address
5. Click Save.

To edit the network interface label, PCI or MAC address, click the Edit icon next to the appropriate network interface.

To delete a network interface, click the Delete icon next to the interface you want to delete.

8.6 Delete Compute Resource

Compute resources can be removed from your cloud if required. A Compute resource cannot be removed until all of the virtual servers assigned to it are migrated to another Compute resource.

To remove a Compute resource:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute resources icon.
3. Click the Actions button next to the Compute resource you want to delete, then click Delete.
9 CloudBoot Compute Resources

CloudBoot functionality is a method of compute resource installation without the presence of a local disk or other local storage, utilizing the PXE and DHCP servers.

This allows users to both lower their hardware requirements on the compute resources (no local storage is required to boot a compute resource), as well as make the process of adding new compute resources to the cloud more efficient:

- No manual admin work required to boot compute resources
- No local storage needed to boot compute resources
- Self-discovery of new compute resources added to the cloud
- Ability to move compute resources quickly between zones

To start using CloudBoot, you must enable CloudBoot and Storage in the system configuration first (Settings > Configuration > CloudBoot). Visit Configuration Settings chapter for more details.

It’s recommended to use a separate network for compute resources when using the CloudBoot system to prevent errors of other servers (not compute resources) on the cloud to boot into the CloudBoot network.

All compute resources must reside on the same VLAN (this concerns compute resources only, not the VS’s themselves).

For details on how to create a CloudBoot compute resource, refer to the Create CloudBoot compute resource section.

For details on how to create and collect kernel crash dumps on the CloudBoot compute resources, refer to the Kernel Crash Dumping Mechanism on KVM Compute Resources section.

9.1 View Compute Resource Details

Each virtual server in the cloud is hosted by a specific physical compute resource server, from which it receives CPU time, RAM and storage capacity from the data stores attached to that compute resource.

You can view compute resource settings and hardware information.

- Ensure that See all compute resources permission is on before viewing compute resource details.
- To view Integrated Storage settings on CloudBoot compute resources:
  a. Go to Settings > Configuration > System.
  b. In the CloudBoot section, move Enable CloudBoot slider to the right to enable the device management for static compute resources with Integrated Storage.
c. In the OnApp Storage section, move *Enable OnApp Storage* slider to the right to enable the OnApp storage on the cloud.

**On this page:**

- *View compute resource settings*
- *View compute resource hardware information*
- *View Integrated Storage Settings*

### 9.1.1 View compute resource settings

To view compute resource settings:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon.
3. On the screen that appears, you will see the list of all compute resources in the cloud along with their details:
   - **Status** - whether the compute resource is online, offline or in maintenance mode
   - **Label** - the name of the compute resource
   - **IP Address** - the IP address of the compute resource
   - **Enabled** - whether the compute resource is enabled or disabled. If disabled, you cannot create the virtual servers on it, or migrate the VSs to this compute resource.
   - **Compute Zone** - the compute zone to which the compute resource is assigned
   - **Operating System Type** - the operating system type of the virtual servers that can live on this compute resource
   - **CPU Cores** - number of CPU cores
   - **RAM** - total/free RAM
   - **VS** - the number of VSs associated to the compute resource

   - **Features** - where the first icon shows compute resource's failover status, the second one - statistics collection, the third one - CloudBoot status and the fourth one - backup status (for CloudBoot compute resources only; it shows whether CloudBoot compute resource is used as a backup server)

To sort information by column in ascending or descending order, mouse over the particular column header and click a triangle icon.

To view a particular compute resource details, click the label of a required compute resource. On the screen that appears you'll see compute resource details (RAM usage/RAM available, IP Address, CPU MHZ/CPU cores etc.) and **Activity log** of this compute resource. To view details of a transaction from activity log, click its Ref number.

To edit or delete a compute resource, click the **Actions** button next to the compute resource, then select the required action.
9.1.2 View compute resource hardware information

To view compute resource hardware info:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon.
3. On the screen that appears, you will see the list of all compute resources in the cloud.
4. Click the Actions button next to the compute resource and press Hardware Info. Also you can click the label of a specific compute resource and press Tools > Hardware Info.
5. You will get the following details:
   - **Summary info**
     This section contains the basic information about the compute resource:
     - current uptime, users, load average
     - compute resource CPU
     - compute resource memory
     - type of virtualization
     - operating system
     - manufacturer and model
     - BIOS and serial number
   - **CPU**
     This section shows CPU manufacturer logo and information about CPU slots. Click the CPU details info button to get detailed information about CPU from the Intel ARK database if available.
   - **RAM**
     This section includes information about memory slots (double data rate, memory clock in MHz, size)
   - **HD**
     This section shows information about hard drive slots, its size etc..
   - **Network**
     This section contains information about network cards. Click the Info button next to the specific network to get its detailed information from the Intel ARK Database if available.
6. If hardware information is empty or incomplete, click the Update Hardware Info button in the right upper corner.

9.1.3 View Integrated Storage Settings

OnApp provides an overview of integrated storage settings enabled on compute resources available in your cloud. On the Integrated Storage Settings page, you can view information on SAN bonding mode and MTU value, information about disks assigned to cache and controller.

To view integrated storage settings:
1. Go to the Control Panel > Admin > Settings menu and click the Compute Resources icon.
2. On the page that appears, you will see the list of compute resources available in your cloud. Click the Actions button next to the label of a compute resource and select the Integrated Storage Settings option.

3. You will get the following details:
   - **SAN bonding mode** - the type of the bonding mode
   - **MTU** - the maximum transportation unit size
   - Cache settings:
     - **Number of cache mirrors** - the number of cache mirrors for the compute resource
     - **Number of cache stripes** - the number of cache stripes for the compute resource
   - Controller settings:
     - **Controller RAM** - the controller RAM value
     - **Drives per controller** - the number of disks per controller virtual server. By default, the controller virtual server is created per 4 disk drives.
     - **Controller DB size** - the controller DB size value

![Image](image.png)

### 9.2 Create CloudBoot Compute Resource

CloudBoot compute resources are created in Control Panel > **Admin** > **Settings** menu. To add a compute resource:

1. Configure the IP range which the Control Panel will assign to compute resources.

2. Add specific compute resources to the Control Panel itself.

   **On this page:**

   - **Add CloudBoot IPs**
     - **Add CloudBoot IP Net**
     - **Add CloudBoot IP Range**
     - **Add CloudBoot IPs**
   - **Create CloudBoot Compute Resource**
     - **Step 1 of 5. Type**
     - **Step 2 of 5. MAC Address**
     - **Step 3 of 5. Properties**
     - **Step 4 of 5. Devices**
     - **Step 5 of 5. Finalize**

### 9.2.1 Add CloudBoot IPs

To add CloudBoot IPs you need to create an IP net, then add an IP range to the IP net and finally add IPs to the new range.
9.2.1.1 Add CloudBoot IP Net

To add a CloudBoot IP net:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon, then click CloudBoot IPs tab. On the screen that appears, you'll see the list of CloudBoot IP nets which include IP ranges.
3. Click the New IP Net button.
4. On the page that loads fill in the following details:
   - label
   - network address
   - network mask
   - add default IP range - tick this checkbox for the default IP range to be added to the IP net automatically. Otherwise, you'll need to add the required IP ranges and IPs after the IP net is created.
5. Click Submit to save the new IP net.

9.2.1.2 Add CloudBoot IP Range

To add an IP range to an IP net:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute resources icon, then click CloudBoot IPs tab. On the screen that appears, you'll see the list of CloudBoot IP nets which include IP ranges.
3. Click the Actions icon next to the required IP net and select Add New IP Range.
4. Fill in the the start and end address and the default gateway of the new IP range.
5. Click Add to save the new IP range.

The dynamic range should be quite a bit larger than the actual IPs that will get assigned. This allows space for reassigning new nodes that come online, without creating address collisions.

Compute resource management interfaces must be on the same subnet as the Control Panel server, and addresses must be valid for that addressable subnet. The Compute resource management interface must also have PXE boot enabled.

9.2.1.3 Add CloudBoot IPs

To add new CloudBoot IP address:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute resources icon, then click CloudBoot IPs tab. On the screen that appears, you'll see the list of CloudBoot IP nets which include IP ranges.
3. Click the **Create IP Address** button.

4. Specify the following IP address properties:
   - **IP net** - the IP net to which you want to add the IP address
   - **IP range** - the IP range to which you want to add the IP address
   - **IP addresses** - start typing the IP address you want to add. You can add the IP addresses that appear in a drop-down list. You can add one or several new IP addresses.

5. Click **Submit**.

### 9.2.2 Create CloudBoot Compute Resource

To create a CloudBoot compute resource:

1. Go to your Control Panel > **Admin** > **Settings** > **Compute Resources** menu.
2. Click the **Add New CloudBoot Compute Resource** button at the bottom of the screen.
3. Fill in the wizard step by step. Each of these steps is described in the corresponding sections below.
4. Click the **Create CloudBoot Compute Resource** button to start the creation process.

#### 9.2.2.1 Step 1 of 5. Type

At this step, select the type of CloudBoot compute resource you want to create:

- KVM - KVM CloudBoot Compute Resource, based on CentOS 6
- KVM - KVM CloudBoot Compute Resource, based on CentOS 7
- Backup - CloudBoot Provisioning and Backup Resource, for backups maintenance, based on CentOS 6
- Backup - CloudBoot Provisioning and Backup Resource, for backups maintenance, based on CentOS 7
- Smart - KVM Cloudboot Compute Resource, where you can deploy a smart server, based on CentOS 6
- Smart - KVM Cloudboot Compute Resource, where you can deploy a smart server, based on CentOS 7
- Baremetal - KVM CloudBoot Compute Resource, where you can deploy a baremetal server, based on CentOS 7 (new provisioning)

Click **Next** to proceed to the following step of the wizard to specify the MAC Address.

#### 9.2.2.2 Step 2 of 5. MAC Address

At this step, select MAC IP Address of the new compute resource. It will be picked up automatically when you first PXE boot a new server on your cluster using the Control Panel.
Should you receive the "No available Compute Resources discovered" message, you can wait (this step is auto-refreshed every 30 seconds) or click the **Refresh** button until MAC IP Address appears. 

Click **Next** to proceed to the following step of the wizard to specify the properties.

9.2.2.3 Step 3 of 5. Properties

- **At this step, specify the CloudBoot compute resource properties:**
  - **Label** - give the compute resource a name
  - **Pxe IP address** - select an IP address for this compute resource from the address pool available
  - **Enabled** - move the slider to the right to allow VSs to be installed/booted on this compute resource
  - **Compute Zone** - select the compute zone, to which this compute resource will be assigned, from the drop-down list
  - **Apply Compute Zone Custom Config** - move this slider to the right to apply a Compute Zone custom config

  If this check box is selected, a Compute Zone custom config is applied before a resource custom config.

  - **Custom Config** - specify any custom commands you want to run when compute resource is booted

  Centos now defaults to NFSv4. This is known to cause compatibility issues so we strongly recommend that you use NFSv3 for all mounts. This can be done by passing `-t nfs -o vers=3` in any mount commands.

  We strongly recommend that you recheck if custom config doesn't brake any functionality. So before putting in production, the server with changed custom config should be rebooted, and the server behaviour rechecked. We recommend to perform the [Storage Health Check](#) and [Network Health Check](#).

- **Show Advanced settings** - move this slider to the right to specify advanced compute resource settings:
  - **Backup IP address** - add a provisioning network IP address
  - **CPU units** - set the number of CPU units which will be assigned to the compute resource
  - **Collect Stats** - move the slider to the right to collect statistics for this compute resource
- **Disable Failover** - move the slider to the right to disable VS migration to another compute resource if this compute resource is marked as offline by the Control Panel server

  - Failover option is not available for baremetal servers.
  - If you use automatic failover with write-back caching you may lose some data in the event of a failover.

- **Failover recipe** - select a recipe to run before the failover process

- **MTU** - specify the maximum transportation unit size. You can set the frame size from 1500 to 9000 bytes

  The maximum transportation unit (MTU) is the maximum size of a unit that can be transmitted transferred via ethernet traffic. Any data that exceed the specified MTU value will be divided into smaller units before being transferred. Utilization of jumbo frames allows you to reduce/increase throughput (depending on a set frame size) and increase CPU utilization during large size file transfers.

- **SAN bonding mode** - choose bonding mode type from the dropdown menu

  After editing the SAN bonding mode option, it is required to reboot your Compute Resource to apply the settings.

  Please note, that using more than one NIC for SAN subnet requires switch support. Please ensure that your network infrastructure supports the utilized NIC bonding and is configured correctly. By default, the utilized NICs bonding mode is IEEE 802.3ad Dynamic link aggregation which requires grouping appropriate ports together according to the section [5 Switch Configuration](#) of Linux Ethernet Bonding Driver guide.

- **Storage Controller RAM** - specify the storage controller RAM value. You may calculate the amount of memory needed for a storage controller as DB size (128 MB by default) + 10 MB x vDisk parts at the controller.

- **Storage Controller DB size** - select the storage controller DB size value (minimum 128 MB, maximum 256 MB)

- **Drives per Controller** - specify the number of disks per controller virtual server. You can specify from 1 to 4 disks. By default, the controller virtual server is created per 4 disk drives

- **Power Cycle command** - arbitrary command string to be executed by IPMI from the CP server. If the command is entered, a new option "Power Cycle Compute resource" - which will execute the entered command will appear in the Tools menu at **Admin > Settings > Compute resources > Compute resource** page.
Currently, a command or commands should be written in one line separated with semicolon. If the command(s) is written in two lines you will receive a "fail" response, although the transaction will be performed.

Click Next to proceed to the following step of the wizard.

9.2.2.4  Step 4 of 5. Devices

At this step the compute resource is rebooted and the new configuration, set in step 3, is applied. It can take some time (the wizard makes 10 attempts with 1 minute interval). Once the compute resource comes back online you will be shown a list of devices that it contains - currently these are disks, cache settings and network interfaces. After the compute resource is created these devices can be further managed from the Control Panel (Admin > Settings > Compute Resources > label of compute resource > Tools > Manage devices).

Devices are unassigned by default. You can assign disks and network interfaces to a particular task.

9.2.2.4.1 Disks

Disks can be assigned to Storage (typical option when disk is connected to Integrated Storage) or to Cache (as cache device). To assign disks to one of these tasks, click on the required task near the device. Move the Format all assigned disks slider to the right to enable formatting for all disks, which are assigned to a particular task. You will get a confirmation pop-up window before formatting disks.

When you assign disk to Cache, then SSD caching is enabled. This feature increases disk I/O performance. There are two basic cache modes of operation:

- Write-through: improves read I/O performance, no impact on reliability
- Write-back: improves both read and write I/O performance, small chance of data loss.

Please do not unassign and assign the same cache device while migrating, rebalancing, or deleting a destination virtual disk. If you have already unassigned the cache device, please wipe the disk before assigning the device back.

Caching can be configured on two levels: per data store and per disk. For more information, refer to the SSD Caching section of OnApp Storage guide.

9.2.2.4.2 Cache Settings

Cache settings include the following options:

- Number of cache mirrors
• **Number of cache stripes**

**9.2.2.4.3 Network Interfaces**

• **Advanced network interfaces configuration** - move the slider to the right to enable the advanced configuration of network interface devices. You will be able to create new custom network interface devices and specify their PCI and MAC address after the compute resource is created.

Network interfaces can be assigned to SAN. Using more than one NIC for SAN subnet requires switch support. Ensure that your network infrastructure supports the utilized NIC bonding and is configured correctly.

Ensure that the *Compute Resource Devices* permissions are on before managing devices. For more information refer to the [List of all OnApp Permissions](#) section of this guide.

Click **Next**.

**9.2.2.5 Step 5 of 5. Finalize**

At this step, wait until compute resource devices configuration is applied. Then you will be indicated that compute resource is successfully configured and ready for operation. Click the **Complete** button. The compute resource will be added to the system. You can view it under the *Compute Resources* menu. You do not need to power cycle the Compute resource manually – the Control Panel handles this remotely, and takes care of the configuration automatically.

**9.3 Edit CloudBoot Compute Resource**

To edit a CloudBoot compute resource:

1. Go to your Control Panel > **Admin > Settings** menu.
2. Click the **Compute Resources** icon.
3. Click the **Actions** button next to the CloudBoot compute resource you want to edit and then click **Edit**.

On this page:

- **Edit CloudBoot Compute Resource**
- **Edit Integrated Storage Settings**

**9.3.1 Edit CloudBoot Compute Resource**

On the screen that follows, change details as required:

• **Properties**
- **Label** - the compute resource's name
- **MAC** - the MAC address of the compute resource
- **Operating System Type** - the operating system type of the virtual servers that can live on this compute resource
- **Backup IP address** - provisioning network IP address
- **CPU Units** - set the amount of CPU units assigned to this compute resource
- **Enabled** - enable or disable the ability to install/boot virtual servers on this compute resource
- **Collect Stats** - enable or disable the ability to collect statistics for this compute resource
- **Disable Failover** - enable or disable the VS migration to another compute resource, if this compute resource is marked as offline by the Control Panel server

  - Failover option is not available for baremetal servers.
  - If you use automatic failover with write-back caching you may lose some data in the event of a failover.

- **Failover recipe** - select a recipe to run before the failover process

- **Pxe IP address** - select a new IP address for this compute resource from the address pool

  - When you change the Pxe IP address, you should reboot the CloudBoot compute resource immediately after saving the new settings. If you do not reboot the resource immediately, the Control Panel will fail to connect to the new IP address, causing failover transactions. You can reboot the compute resource manually from the console or use the Power Cycle command (if configured). You cannot use the **Reboot** option on the CP UI to reboot the resource after changing the IP address.
  You can also change the IP address of a CloudBoot compute resource that is offline and once the resource is booted, it will be available on the new IP Address.
  - If InfiniBand is enabled for CloudBoot, you should change a value of the `cloud_boot pxe config` after changing the Pxe IP address.

**Advanced**

Move the Advanced slider to the right to edit advanced Compute resource settings:

1. **MTU** - specify the maximum transportation unit size. You can set the frame size from 1500 to 9000 bytes

   The maximum transportation unit (MTU) is the maximum size of a unit that can be transmitted transferred via ethernet traffic. Any data that exceed the specified MTU value will be divided into smaller units before being transferred. Utilization of jumbo frames allows you to reduce increase throughput and increase CPU utilization during large size file transfers.
- **SAN bonding mode** - choose bonding mode type from the drop-down menu

  After editing the SAN bonding mode option, it is required to reboot your compute resource to apply the settings.

  Please note that using more than one NIC for SAN subnet requires switch support. Please ensure that your network infrastructure supports the utilized NIC bonding and is configured correctly. By default, the utilized NICs bonding mode is IEEE 802.3ad Dynamic link aggregation which requires grouping appropriate ports together according to the section 5 **Switch Configuration** of Linux Ethernet Bonding Driver guide.

- **Storage Controller RAM** - specify the storage controller RAM value. You may calculate the amount of memory needed for a storage controller as DB size (128 MB by default) + 10 MB x vDisk parts at the controller.

- **Storage Controller DB size** - select the storage controller DB size value (minimum 128 MB, maximum 256 MB)

- **Drives per Controller** - specify the number of disks per controller virtual server. You can specify from 1 to 4 disks. By default, the controller virtual server is created per 4 disk drives.

- **Storage VLAN** - select VLAN for Integrated Storage Network

  After editing the Storage VLAN, it is required to reboot your compute resource to apply settings. By default, Storage VLAN is set to 0 that is equal to no VLAN. If you already use a VLAN parameter in onappstore.conf that was added manually, please change the Storage VLAN parameter for each compute resource and save the CP configuration after editing to regenerate boot configuration. These requirements do not apply to VLAN used by means of a custom config script.

- **Apply Compute Zone Custom Config** - move this slider to the right to apply a Compute Zone custom config

  If this check box is selected, a Compute Zone custom config is applied before a CloudBootCompute resource custom config.

- **Custom Config** - specify any custom commands you want to run when a compute resource is booted

- **Power Cycle Command** - arbitrary command string to be executed by IPMI from the CP server. If the command is entered, a new option "Power Cycle Compute resource" which will execute the entered command will appear in the Tools menu at Admin > Settings > Compute resources > Compute resource page.

  Currently, a command or commands should be written in one line separated by a semicolon. If the command(s) is written in two lines you will receive a "fail" response, although the transaction will be performed. The power cycle command is
executed on Control Panel under user onapp, this may be any script created in bash.

5. Click the **Save** button to save your changes.

You can manage CloudBoot compute resource devices (disks, network interfaces, and PCI devices) on the Devices page. For more information refer to **Manage CloudBoot Compute Resource Devices**.

### 9.3.2 Edit Integrated Storage Settings

To view Integrated Storage settings on CloudBoot compute resources:

1. Go to **Settings > Configuration > System**.
2. In the CloudBoot section, move *Enable CloudBoot* slider to the right to enable the device management for static compute resources with Integrated Storage.
3. In the OnApp Storage section, move *Enable OnApp Storage* slider to the right to enable the OnApp storage on the cloud.

To edit integrated storage settings:

1. Go to the **Control Panel > Admin > Settings** menu and click the **Compute Resources** icon.
2. On the page that appears, you will see the list of compute resources available in your cloud. Click the **Actions** button next to the label of a compute resource and select the **Integrated Storage Settings** option.
3. Click the **Edit** button.
4. On the screen that loads, edit the following parameters:
   - **Cache settings**:
     - *Number of cache mirrors* - specify the number of cache mirrors for the compute resource
     - *Number of cache stripes* - specify the number of cache stripes for the compute resource
   - **Controller settings**:
     - *Controller RAM* - specify the controller RAM value. You may calculate the amount of memory needed for a storage controller as DB size (128MB by default) + 10 MB x vDisk parts at the controller.
- **Drives per controller** - specify the number of disks per controller virtual server. You can specify from 1 to 4 disks. By default, the controller virtual server is created per 4 disk drives.
- **Integrated Storage DB size** - select the controller DB size value (minimum 128 MB, maximum 256 MB)
- **SAN bridge name** - specify the SAN bridge name for the compute resource
- **SAN bond name** - specify the SAN bond name for the compute resource
- **SAN bonding mode** - choose bonding mode type from the drop-down menu
- **MTU** - specify the maximum transportation unit size. You can set the frame size from 1500 to 9000 bytes
- **VLAN id** - specify the ID of a VLAN number
- Click the **Save** button to save changes.

### 9.4 Manage CloudBoot Compute Resource Devices

You can manage CloudBoot compute resource devices (disks, network interfaces and PCI devices), which are configured during CloudBoot compute resource creation.

#### 9.4.1 Edit CloudBoot Compute Resource Devices Configuration

To edit CloudBoot compute resource devices configuration:

1. Go to Control Panel > **Admin** > **Settings** menu > **Compute Resources** > label of compute resource > **Tools** > **Manage Devices**.
2. The page that loads displays the Storage and CloudBoot versions details and the list of devices together with their details. The Storage version displays the onappstore rpm version and may have the UNKNOWN VERSION value if the compute resource was booted from an older ramdisk image.
   - For disks - name, status and SCSI identifier
   - For network interfaces - name, status and MAC
3. Click the **Edit Device Configuration** button.
4. Configure disks:
   - Move the **Passthrough all disks** slider to the right to pass through all disks to Storage Controller Server without the bond and the Storage Controller Server will have the complete control over disks.
   - Assign each disk to Storage or to Cache, or leave it unassigned
   - For disks assigned to Cache, specify number of mirrors and stripes
5. Configure network interfaces. For each Compute resource NIC, you can use one of the following options:
   - **Unassigned** - leave the NIC unused.
   - **SAN subnet** - select this option to use this interface for storage network. In this case, NIC interface will be bonded with virtual network interface of the Storage Controller Server.
   - **Passthrough to storage** - this option is available for Xen CloudBoot compute resources. The network interface will be added to the Storage Controller Server without the bond and the Storage Controller Server will have the complete control over this interface.
6. Configure PCI devices:
   - move the **Passthrough custom PCI devices** slider to the right to display all PCI devices available on the Compute resource. You can then choose specific devices to pass through to the storage controller.

7. Click **Next**.

8. After devices are successfully reconfigured, click **Finish**.

To disable SAN network, unassign all network interfaces from the compute resource at Control Panel > **Admin** > **Settings** > **Compute Resources** > label of the compute resource > **Tools** > **Edit hardware devices** > set the **Unassigned** option for all network interfaces. If you need to configure networks manually, refer to **Manual Integrated Storage Network Configuration**.

On this page:

- **Edit CloudBoot Compute Resource Devices Configuration**
- **Advanced Network Interfaces**
  - **Add Advanced Network Interface Device**

### 9.4.2 Advanced Network Interfaces

You can also manage the advanced configuration of network interface devices at Control Panel > **Settings** > **Compute Resources** > label of the necessary compute resource > **Tools** > **Hardware Devices** page. The **Advanced Network Interfaces** slider becomes visible in the top right corner of the page once the compute resource starts speaking VIF Storage API. For this, the compute resource should be properly connected to the Control Panel and have network interfaces available. Move the slider to the right to show the advanced network interfaces for a compute resource.

#### 9.4.2.1 Add Advanced Network Interface Device

If required, you can manually create an advanced network interface with custom parameters. To do so:

1. Go to your Control Panel > **Settings** > **Compute Resources** > label of the necessary compute resource.
2. Click the **Tools** button and select the **Hardware Devices** option.
3. On the page that appears, click the **Create new custom network interface device** button.
4. Specify the following details:
   - Name
   - PCI
   - MAC address
5. Click **Save**.

To edit the network interface label, PCI or MAC address, click the Edit icon next to the appropriate network interface.
To delete a network interface, click the Delete icon next to the interface you want to delete.

### 9.5 Delete CloudBoot Compute Resource

Compute resources can be removed from your cloud if required. A compute resource cannot be removed until all of the virtual servers assigned to it are migrated to another compute resource.

To remove a compute resource:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon.
3. Click the Actions button next to the compute resource you want to delete, then click Delete.

### 9.6 InfiniBand Configuration

Your hardware must meet the following requirements for Ethernet mode utilization:
- VPI enabled switches (including a proper license key).
- VPI adapter cards (HCAs).

Current limitations:
- To avoid compatibility issues, do not enable InfiniBand for the cloud with compute resources other than CentOS 6 KVM.
- InfiniBand in the Ethernet mode is supported only on CentOS 6 KVM nodes. Nodes running on CentOS 7 are not currently supported by InfiniBand in the Ethernet mode.
- InfiniBand is supported only for the SAN network, not PXE boot.

To set up an compute resource to operate in IB/Ethernet mode on the SAN network:
1. Add new compute resource based on boot MAC from UI, but do not configure storage yet.
2. Log in to the compute resource via SSH and run the following commands:

   ```
   HV# /sbin/connectx_port_config -n
   ```

   Choose Ethernet mode, and run:
3. After the compute resource reboots, perform the CloudBoot compute resource setup, as described in Create CloudBoot compute resource.

4. Run the following script on the Control Panel server:

```
CP# cd /tftpboot/images/centos5/diskless/snapshot
CP# cp -Rp default/overlay <MAC_OF_HV_MGT_NIC>/
```

5. Reboot the compute resource via UI.

6. After that, you will be able to select the InfiniBand interface as a storage NIC.

7. Then you can safely remove the /tftpboot/images/centos5/diskless/snapshot/default/overlay directory.

9.7 Configuring CloudBoot Settings in BIOS

- **PLEASE NOTE:** Your BIOS settings may vary from the example provided in this section.
- Please enable virtualization. While mostly all servers support this feature, not all vendors enable this feature as shipped from the factory. For more details on how to enable this feature, refer to Red Hat Virtualization guide.

To use PXE boot, you have to make sure it is enabled in BIOS. To do so:

1. Select the required Ethernet card supporting PXE as a boot device:
2. After that, go to the Advanced settings > PCI/PnP configuration.
3. In the **Advanced** settings, select the first/primary Onboard LAN/NIC Option ROM and press **Enter**.

Use up and down arrow keys to set Option ROM settings to enabled and press **Enter**.
4. Set local disk as a second boot device.

9.8 Enable/Disable Storage Related Services for CloudBoot Compute Resources

You can disable the storage-related services for CloudBoot compute resources. This option allows to perform maintenance tasks on CloudBoot compute resources such as swapping or adding server components (disk drives, NICs, RAM, PCI cards, etc). The primary function is to disable and stop all storage related services on a CloudBoot compute resource. This feature is useful when there are suspicions that a specific server component is failing or is not working properly after the update due to the bad firmware or driver. It can be used together with the Maintenance Mode for KVM Compute Resources.

- If you want to disable the storage services not only for CloudBoot compute resources but for the entire cloud, edit the Enable OnApp Storage option at the System Configuration page. When OnApp Storage is not enabled for your cloud, the Disable Storage Related Services option will not be available for CloudBoot compute resources.
- Ensure that the Enable/Disable Storage-Related Services permission is on before managing Integrated Storage for a compute resource. For more information, refer to the List of all OnApp Permissions section.
To disable the storage-related services for CloudBoot compute resources with Integrated Storage:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon.
3. Click a label of the compute resource you are interested in.
4. Click the Tools > Disable Storage-Related Services.
5. On the screen that follows, the Integrated Storage Health check will be run automatically. If the health check is successful, you will get the green tick near it and you can click Disable to finish. If the check is unsuccessful, the Disable button becomes inactive. In this case you can use the Force slider to make the Disable button active. But be aware, that Force option may lead to data loss.

To enable the storage-related services for CloudBoot compute resources:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon.
3. Click a label of the compute resource you are interested in.
4. Click the Tools > Enable Storage-Related Services.

If you have rebooted your compute resources with the Disable Storage-Related Services option, you should reboot them again after you have enabled Integrated Storage so that the StorageAPI service is started properly.

Also starting with OnApp 5.4, the maintenance mode is available for CloudBoot compute resources.

9.9 Migrate Xen CloudBoot Compute Resources (to CentOS 6)

CentOS 6 reached End of Life on November 30th, 2020. CentOS does no longer support it and provide security updates or fix bugs. That is why we recommend you to upgrade to CentOS 7.

You can run a cold migration of virtual servers from CloudBoot compute resources based on CentOS 5 & Xen 3 to an environment running CentOS 6 & Xen 4.

Since the CloudBoot OS is loaded from the Control Panel server to the Compute Resources RAM and afterwards is booted, this document describes how to change the target Cloudboot OS. The cold migration procedure requires several changes in to the Control Panel DataBase and a reboot to load the new CloudBoot OS. OnApp recommends to stop all VMs before the upgrade to ensure that all Compute Resources will be
upgraded after reboot avoiding mixed CloudBoot OS in the same CloudBoot Compute Resource Zone.

On this page:

- Prerequisites
- Migrate CloudBoot OS
- Update Control Panel Settings
- Reboot Compute Resources
- Power On Virtual Servers

9.9.1 Prerequisites

9.9.1.1 Ensure that CloudBoot Compute Resources are Compatible with CentOS 6

To start with, ensure that your existing CloudBoot compute resources are compatible with CentOS 6. For this purpose, you can create a staging CentOS 6 & Xen 4 compute zone with Integrated Storage and set up several test virtual servers in this zone. The compute resource hardware should be identical to the one used in the production environment.

After you set up the compute resource and attach it to the staging compute zone, run the following steps:

1. Create an Integrated Storage Data Store, using similar Stripe, Replica, and Overcommit settings.
2. Attach all the required resources, including network, data stores, IP list, etc.
3. Create several virtual servers with configuration similar to the one on your production Xen 3 environment.
4. Perform various operations on virtual servers to ensure that your compute resource works as expected.

In case you encounter any issues, contact OnApp Support for assistance.

9.9.1.2 Schedule Shutdown of all Virtual Servers in Production Environment

After ensuring that your existing CloudBoot compute resources are compatible with CentOS 6, you need to schedule a date when you can shut down all virtual servers that run in the production Xen 3 compute zone.

To prepare the production Xen 3 compute zone for shutdown, create a backup of your Control Panel database.

When you are ready, you can shut down virtual servers as follows:

1. Go to the Control Panel > Cloud > Virtual Servers menu.
2. Click a label of the target virtual server. Expand the **Tools** menu and click the **Shutdown** button.
3. Repeat this action for each virtual server in the compute zone.

### 9.9.2 Migrate CloudBoot OS

After all virtual servers are shut down, log in to your Control Panel database and update CloudBoot OS for CentOS 5 & Xen 3 compute resource in the compute zone.

Below, you can find the instructions on how you can update CloudBoot OS:

1. Find the database password by running the following command:
   ```
   cat /onapp/interface/config/database.yml | grep password
   ```

2. Open the onapp database in MySQL by running the next command:
   ```
   mysql -p
   mysql> use onapp;
   ```

3. Select the CentOS 5 & Xen 3 compute resources with the following command:
   ```
   mysql> select id,label,ip_address,hypervisor_group_id,hypervisor_type,cloud_boot_os from hypervisors where hypervisor_type = "xen";
   ```

   ```
   +----+----------------+-----------------------+-----------------+-------------------+---------------------+
   | id | label           | ip_address            | hypervisor_group_id | hypervisor_type    | cloud_boot_os       |
   +----+----------------+-----------------------+-----------------+-------------------+---------------------+
   | 2  | LVIS-XEN-HV1-f0-30 | 192.168.1.30          | 48               | xen                | centos5             |
   | 4  | LVIS-XEN-HV2-84-31 | 192.168.1.31          | 48               | xen                | centos5             |
   +----+----------------+-----------------------+-----------------+-------------------+---------------------+
   2 rows in set (0.00 sec)
   ```

4. Update the CloudBoot OS on selected compute resources in the compute zone with the next command:
   ```
   mysql> update hypervisors set cloud_boot_os="centos6" where hypervisor_type = "xen" and hypervisor_group_id = 48; (where 48 is you Compute Resource Zone ID)
   ```
5. Check the result by running the following command:

```
mysql> select id,label,ip_address,hypervisor_group_id,hypervisor_type,cloud_boot_os from hypervisors where hypervisor_type = "xen";
```

```
+----+--------+-------------------+-----------------+----------+----------+
<table>
<thead>
<tr>
<th>id</th>
<th>label</th>
<th>ip_address</th>
<th>hypervisor_group_id</th>
<th>hypervisor_type</th>
<th>cloud_boot_os</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>LVIS</td>
<td>192.168.1.30</td>
<td>48</td>
<td>xen</td>
<td>centos6</td>
</tr>
<tr>
<td>4</td>
<td>LVIS</td>
<td>192.168.1.31</td>
<td>48</td>
<td>xen</td>
<td>centos6</td>
</tr>
</tbody>
</table>
+----+--------+-------------------+-------------------+----------+----------+
2 rows in set (0.00 sec)
```

9.9.3 Update Control Panel Settings

When the CloudBoot OS is migrated, you need to update the Control Panel configuration as follows:

1. Go to the Control Panel > Admin > Settings > Configuration menu.
2. Click the Save Configuration button.
3. Wait for the UpdateStorageConfig transactions to be completed.

9.9.4 Reboot Compute Resources

Next, you need to check the state of your compute resources and reboot them:

1. Log in to each compute resource and check it for the degraded vdisks.
   Alternatively, you can check the disks health at the Integrated Storage Diagnostics page. It is recommended to fix all issues that you encounter in Diagnostics before rebooting compute resources.

2. Reboot the target compute resources. Wait for the compute resource to come back online and check whether all previous nodes are online and healthy.

3. Check the Diagnostics page for possible degraded vdisks and nodes. Fix all issues that you encounter in Diagnostics.

In case nodes won’t come up online for a compute resource:
1. Go to the Admin > Settings > Compute Resources > Hypervisor > Manage Devices > Edit Configuration page.
2. Assign a new SCSI identifier (drive) to the Integrated Storage.
3. Reboot the compute resource.
4. Wait for the compute resource to come back online and check whether all previous nodes are online and healthy.
5. Check the Diagnostics page for possible degraded vdisks and nodes. Fix all issues that you encounter in Diagnostics.

9.9.5 Power On Virtual Servers

At this point, virtual servers data should be migrated to CentOS 6 Xen 4 CloudBoot compute resource. To make sure that you have no connectivity issues, run Network Health Check. If everything works as expected, start up your virtual servers in the migrated Xen 4 compute resource zone.

9.10 Migrate KVM CloudBoot Compute Resources

You can run a cold migration of virtual servers from CloudBoot compute resources based on CentOS 6 KVM to an environment running CentOS 7 KVM.

Since the CloudBoot OS is loaded from the Control Panel server to the Compute Resources RAM and afterwards is booted, this document describes how to change the target Cloudboot OS. The cold migration procedure requires several changes in to the Control Panel DataBase and a reboot to load the new CloudBoot OS. OnApp recommends to stop all VMs before the upgrade to ensure that all Compute Resources will be upgraded after reboot avoiding mixed CloudBoot OS in the same CloudBoot Compute Resource Zone.

On this page:

- Prerequisites
- Migrate CloudBoot OS
- Update Control Panel Settings
- Reboot Compute Resources
- Power On Virtual Servers
9.10.1 Prerequisites

9.10.1.1 Ensure that CloudBoot Compute Resources are Compatible with CentOS 7

To start with, ensure that your existing CloudBoot compute resources are compatible with CentOS 7. For this purpose, you can create a staging CentOS 7 KVM compute zone with Integrated Storage and set up several test virtual servers in this zone. The compute resource hardware should be identical to the one used in the production environment.

After you setup the compute resource and attach it to the staging compute zone, run the following steps:

1. Create an Integrated Storage Data Store, using similar Stripe, Replica, and Overcommit settings.
2. Attach all the required resources, including network, data stores, IP list, etc.
3. Create several virtual servers with configuration similar to the one on your production environment.
4. Perform various operations on virtual servers to ensure that your compute resource works as expected.

In case you encounter any issues, contact OnApp Support for assistance.

9.10.1.2 Schedule Shutdown of all Virtual Servers in Production Environment

After ensuring that your existing CloudBoot compute resources are compatible with CentOS 7, you need to schedule a date when you can shut down all virtual servers that run in the production CentOS 6 KVM compute zone.

To prepare the production CentOS 6 KVM compute zone for shutdown, create a backup of your Control Panel database.

When you are ready, you can shut down virtual servers as follows:

1. Go to the Control Panel > Cloud > Virtual Servers menu.
2. Click a label of the target virtual server. Expand the Tools menu and click the Shutdown button.
3. Repeat this action for each virtual server in the compute zone.

9.10.2 Migrate CloudBoot OS

After all virtual servers are shut down, log in to your Control Panel database and update CloudBoot OS for CentOS 6 KVM compute resource in the compute zone.

Below, you can find the instructions on how you can update CloudBoot OS:

1. Find the database password by running the following command:
   
   ```
   cat /onapp/interface/config/database.yml |grep password
   ```

2. Open the OnApp database in MySQL by running the next command:
3. Select the CentOS 6 KVM compute resources with the following command:

```sql
mysql> select id,label,ip_address,hypervisor_group_id,hypervisor_type,cloud_boot_os from hypervisors where hypervisor_type = "kvm";
```

<table>
<thead>
<tr>
<th>id</th>
<th>label</th>
<th>ip_address</th>
<th>hypervisor_group_id</th>
<th>hypervisor_type</th>
<th>cloud_boot_os</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>LVIS-KVM-HV1-f0-30</td>
<td>192.168.1.30</td>
<td>48</td>
<td>kvm</td>
<td>centos6</td>
</tr>
<tr>
<td>4</td>
<td>LVIS-KVM-HV2-84-31</td>
<td>192.168.1.31</td>
<td>48</td>
<td>kvm</td>
<td>centos6</td>
</tr>
</tbody>
</table>

2 rows in set (0.00 sec)

4. Update the CloudBoot OS on selected compute resources in the compute zone with the next command:

```sql
mysql> update hypervisors set cloud_boot_os="centos7" where hypervisor_type = "kvm" and hypervisor_group_id = 48; (where 48 is you Compute Resource Zone ID)
```

Query OK, 2 rows affected (0.03 sec)
Rows matched: 2  Changed: 2  Warnings: 0

5. Check the result by running the following command:

```sql
mysql> select id,label,ip_address,hypervisor_group_id,hypervisor_type,cloud_boot_os from hypervisors where hypervisor_type = "kvm";
```

<table>
<thead>
<tr>
<th>id</th>
<th>label</th>
<th>ip_address</th>
<th>hypervisor_group_id</th>
<th>hypervisor_type</th>
<th>cloud_boot_os</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>LVIS-KVM-HV1-f0-30</td>
<td>192.168.1.30</td>
<td>48</td>
<td>kvm</td>
<td>centos7</td>
</tr>
<tr>
<td>4</td>
<td>LVIS-KVM-HV2-84-31</td>
<td>192.168.1.31</td>
<td>48</td>
<td>kvm</td>
<td>centos7</td>
</tr>
</tbody>
</table>

2 rows in set (0.00 sec)
9.10.3 Update Control Panel Settings

When the CloudBoot OS is migrated, you need to update the Control Panel configuration as follows:

1. Go to the Control Panel > Admin > Settings > Configuration menu.
2. Click the Save Configuration button.
3. Wait for the UpdateStorageConfig transactions to be completed.

9.10.4 Reboot Compute Resources

Next, you need to check the state of your compute resources and reboot them:

1. Log in to each compute resource and check it for the degraded vdisks.

   Alternatively, you can check the disks health at the Integrated Storage Diagnostics page. It is recommended to fix all issues that you encounter in Diagnostics before rebooting compute resources.

2. Reboot the target compute resources. Wait for the compute resource to come back online and check whether all previous nodes are online and healthy.
3. Check the Diagnostics page for possible degraded vdisks and nodes. Fix all issues that you encounter in Diagnostics.

   In case nodes won’t come up online for a compute resource:
   
   1. Go to the Admin > Settings > Compute Resources > Hypervisor > Manage Devices > Edit Configuration page.
   2. Assign a new SCSI identifier (drive) to the Integrated Storage.
   3. Reboot the compute resource.
   4. Wait for the compute resource to come back online and check whether all previous nodes are online and healthy.
   5. Check the Diagnostics page for possible degraded vdisks and nodes. Fix all issues that you encounter in Diagnostics.

9.10.5 Power On Virtual Servers

At this point, virtual servers data should be migrated to CentOS 7 KVM compute resource. To make sure that you have no connectivity issues, run Network Health Check.

If everything works as expected, start up your virtual servers in the migrated CentOS 7 KVM compute resource zone.

9.11 Migrate Xen CloudBoot Compute Resources (to CentOS 7)

You can run a cold migration of virtual servers from CloudBoot compute resources based on CentOS 6 Xen to an environment running CentOS 7 Xen.

Since the CloudBoot OS is loaded from the Control Panel server to the Compute Resources RAM and afterwards is booted, this document
OnApp Cloud 6.5 Edge 4 Storage Home

describes how to change the target CloudBoot OS. The cold migration procedure requires several changes in to the Control Panel DataBase and a reboot to load the new CloudBoot OS. OnApp recommends to stop all VMs before the upgrade to ensure that all Compute Resources will be upgraded after reboot avoiding mixed CloudBoot OS in the same CloudBoot Compute Resource Zone.

On this page:

- Prerequisites
- Migrate CloudBoot OS
- Update Control Panel Settings
- Reboot Compute Resources
- Power On Virtual Servers

9.11.1 Prerequisites

9.11.1.1 Ensure that CloudBoot Compute Resources are Compatible with CentOS 7

To start with, ensure that your existing CloudBoot compute resources are compatible with CentOS 7. For this purpose, you can create a staging CentOS 7 Xen compute zone with Integrated Storage and set up several test virtual servers in this zone. The compute resource hardware should be identical to the one used in the production environment.

After you setup the compute resource and attach it to the staging compute zone, run the following steps:

1. Create an Integrated Storage Data Store, using similar Stripe, Replica, and Overcommit settings.
2. Attach all the required resources, including network, data stores, IP list, etc.
3. Create several virtual servers with configuration similar to the one on your production environment.
4. Perform various operations on virtual servers to ensure that your compute resource works as expected.

In case you encounter any issues, contact OnApp Support for assistance.

9.11.1.2 Schedule Shutdown of all Virtual Servers in Production Environment

After ensuring that your existing CloudBoot compute resources are compatible with CentOS 7, you need to schedule a date when you can shut down all virtual servers that run in the production CentOS 6 Xen compute zone.
To prepare the production CentOS 6 Xen compute zone for shutdown, create a backup of your Control Panel database.

When you are ready, you can shut down virtual servers as follows:
1. Go to the Control Panel > **Cloud** > **Virtual Servers** menu.
2. Click a label of the target virtual server. Expand the **Tools** menu and click the **Shutdown** button.
3. Repeat this action for each virtual server in the compute zone.

### 9.11.2 Migrate CloudBoot OS
After all virtual servers are shut down, log in to your Control Panel database and update CloudBoot OS for CentOS 6 Xen compute resource in the compute zone.

Below, you can find the instructions on how you can update CloudBoot OS:

1. Find the database password by running the following command:
   ```bash
cat /onapp/interface/config/database.yml | grep password
   ```
2. Open the OnApp database in MySQL by running the next command:
   ```bash
   mysql -p
   mysql> use onapp;
   ```
3. Select the CentOS 6 Xen compute resources with the following command:
   ```bash
   mysql> select id,label,ip_address,hypervisor_group_id,hypervisor_type,cloud_boot_os from hypervisors where hypervisor_type = "xen";
   ```
   ```text
   +----+-------------+-------------------+---------------------+-------------------+-----------------
   | id | label              | ip_address   | hypervisor_group_id | hypervisor_type | cloud_boot_os |
   +----+-------------------+-------------+---------------------+-------------------+-----------------+
   | 2  | LVIS-XEN-HV1-f0-30 | 192.168.1.30 | 48 | xen | centos6 |
   | 4  | LVIS-XEN-HV2-84-31 | 192.168.1.31 | 48 | xen | centos6 |
   +----+-------------------+-------------+---------------------+-------------------+-----------------+
   2 rows in set (0.00 sec)
   ```
4. Update the CloudBoot OS on selected compute resources in the compute zone with the next command:
mysql> update hypervisors set cloud_boot_os="centos7" where hypervisor_type = "xen" and hypervisor_group_id = 48; (where 48 is your Compute Resource Zone ID)

Query OK, 2 rows affected (0.03 sec)
Rows matched: 2  Changed: 2  Warnings: 0

5. Check the result by running the following command:

mysql> select id,label,ip_address,hypervisor_group_id,hypervisor_type,cloud_boot_os from hypervisors where hypervisor_type = "xen";

<table>
<thead>
<tr>
<th>id</th>
<th>label</th>
<th>ip_address</th>
<th>hypervisor_group_id</th>
<th>hypervisor_type</th>
<th>cloud_boot_os</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>LVIS-XEN-HV1-f0-30</td>
<td>192.168.1.30</td>
<td>48</td>
<td>xen</td>
<td>centos7</td>
</tr>
<tr>
<td>4</td>
<td>LVIS-XEN-HV2-84-31</td>
<td>192.168.1.31</td>
<td>48</td>
<td>xen</td>
<td>centos7</td>
</tr>
</tbody>
</table>

2 rows in set (0.00 sec)

9.11.3 Update Control Panel Settings

When the CloudBoot OS is migrated, you need to update the Control Panel configuration as follows:

1. Go to the Control Panel > Admin > Settings > Configuration menu.
2. Click the Save Configuration button.
3. Wait for the UpdateStorageConfig transactions to be completed.

9.11.4 Reboot Compute Resources

Next, you need to check the state of your compute resources and reboot them:

1. Log in to each compute resource and check it for the degraded vdisks.

Alternatively, you can check the disks health at the Integrated Storage Diagnostics page. It is recommended to fix all issues that you encounter in Diagnostics before rebooting compute resources.

2. Reboot the target compute resources. Wait for the compute resource to come back online and check whether all previous nodes are online and healthy.
3. Check the Diagnostics page for possible degraded vdisks and nodes. Fix all issues that you encounter in Diagnostics.

**In case nodes won’t come up online for a compute resource:**

1. Go to the Admin > Settings > Compute Resources > Hypervisor > Manage Devices > Edit Configuration page.
2. Assign a new SCSI identifier (drive) to the Integrated Storage.
3. Reboot the compute resource.
4. Wait for the compute resource to come back online and check whether all previous nodes are online and healthy.
5. Check the Diagnostics page for possible degraded vdisks and nodes. Fix all issues that you encounter in Diagnostics.

### 9.11.5 Power On Virtual Servers

At this point, virtual servers data should be migrated to CentOS 7 Xen compute resource. To make sure that you have no connectivity issues, run Network Health Check.

If everything works as expected, start up your virtual servers in the migrated CentOS 7 Xen compute resource zone.
10 CloudBoot IPs

CloudBoot IPs are IP addresses which compute resources will acquire via DHCP when they boot. To add IP addresses you first need to create IP nets which in their turn contain IP address ranges to which you can add individual IPs.

10.1 View CloudBoot IP Addresses

To view the list of CloudBoot IP addresses:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon, then click CloudBoot IPs tab.
3. On the screen that appears, you'll see the list of CloudBoot IP nets which include IP ranges. Click the IP net to view the IP addresses in it with their details:
   - IP Address - the CloudBoot IP address
   - CloudBoot Compute Resource - click the compute resource label to view its details
   - Compute Zone - click the compute zone label to view its details

To delete an IP address, click the Delete icon next to the required IP address. You cannot delete those IP addresses that are assigned to compute resources and/or compute zones.

On this page:

- View CloudBoot IP Addresses
- Create CloudBoot IP Net
- Manage CloudBoot IP Nets
- Add IP Range to IP Net
- Manage CloudBoot IP Ranges
- Add CloudBoot IP Address
- Delete CloudBoot IP Addresses

See also:

- Storage Nodes
- CloudBoot Compute Resources
- Diagnostics

10.2 Create CloudBoot IP Net

To add a CloudBoot IP net:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the **Compute Resources** icon, then click **CloudBoot IPs** tab. On the screen that appears, you’ll see the list of CloudBoot IP nets which include IP ranges.

3. Click the **New IP Net** button.

4. On the page that loads fill in the following details:
   - **Label** - the name of the IP net
   - **Network address** - the network address of the IP net
   - **Network mask** - the network mask of the IP net
   - **Add default IP range** - tick this checkbox for the default IP range to be added to the IP net automatically. Otherwise, you’ll need to add the required IP ranges and IPs after the IP net is created.

5. Click **Submit** to save the new IP net.

### 10.3 Manage CloudBoot IP Nets

To edit an existing CloudBoot IP net:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon, then click **CloudBoot IPs** tab.
3. Click the **Actions** icon next to the require IP net and select **Edit**.
4. Edit the details of the IP net:
   - **Label** - the name of the IP net
   
   If the IP net does not contain any IP ranges, you can also edit the following parameters:
   - **Network address** - the network address of the IP net
   - **Network mask** - the network mask of the IP net

5. Click **Submit** to save changes.

To delete an existing CloudBoot IP net:

You can delete only those IP nets that do not contain any IP ranges.

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon, then click **CloudBoot IPs** tab.
3. Click the **Actions** icon next to the required IP net and select **Delete**.
10.4 Add IP Range to IP Net

- If required, you can skip this step and proceed to adding IP addresses. In this case the system will automatically create in the appropriate IP net an IP range containing the IP(s) you add.
- The **Add New IP Range** button is not displayed if there are no IP addresses that can be added to the IP net.

To add an IP range to an IP net:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon, then click **CloudBoot IPs** tab. On the screen that appears, you’ll see the list of CloudBoot IP nets which include IP ranges.
3. Click the **Actions** icon next to the required IP net and select **Add New IP Range**.
4. Fill in the the start and end address and the default gateway of the new IP range.
5. Click **Add** to save the new IP range.

10.5 Manage CloudBoot IP Ranges

To edit an IP range in an IP net:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon, then click **CloudBoot IPs** tab.
3. Click the IP net in which you want to edit an IP range.
4. Click the **Actions** icon next to the required IP net and select **Edit**.
5. Fill in the the start and end address and the default gateway of the IP range.
6. Click **Submit** to save the changes.

To delete an IP range:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon, then click **CloudBoot IPs** tab.
3. Click the IP net in which you want to edit an IP range.
4. Click the **Actions** icon next to the required IP net and select **Delete**.
10.6 Add CloudBoot IP Address

To add new CloudBoot IP address:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon, then click CloudBoot IPs tab. On the screen that appears, you’ll see the list of CloudBoot IP nets which include IP ranges.
3. Click the Create IP Address button.
4. Specify the following IP address properties:
   - IP net - the IP net to which you want to add the IP address
   - IP range - the IP range to which you want to add the IP address
   - IP addresses - start typing the IP address you want to add. You can add the IP addresses that appear in a drop-down list. You can add one or several new IP addresses.
5. Click Submit.

10.7 Delete CloudBoot IP Addresses

To delete CloudBoot IP address:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon, then click CloudBoot IPs tab.
3. On the screen that appears, you’ll the list of all CloudBoot IP addresses.
4. Click the Delete icon next to the CloudBoot IP address you want to remove.
5. Confirm the deletion.
11 CloudBoot Backup Servers

CloudBoot backup servers are CloudBooted KVM compute resources that can be used as backup servers. Follow the step-by-step instructions provided in this chapter to configure CloudBoot backup servers in your cloud.

PLEASE NOTE:
- You should configure some local or remote attached storage for persistent backups on the provisioning/backup server.
- We strongly recommend you to deploy one or more backup servers for backups and VS provisioning when using a CloudBoot functionality.
- Before backup server creation, create new KVM CloudBoot compute resource with an IP address from the dynamic range. Refer to the Create CloudBoot Compute Resource section of the guide for details. Ensure to choose the ‘Backup’ option and don’t format disks.

11.1 Create CloudBoot Backup Server

To create a CloudBoot backup server:

1. Go to your Control Panel>Admin>Settings menu, then press Backup Servers icon.
2. Click the Create Backup Server button.
3. Fill in the form that appears:
   - Label - give your backup server a label
   - IP address - enter the backup server IP address (IPv4)
   - Backup IP address - add a provisioning network IP address
   - Capacity - set the backup server capacity (in GB)
   - Backup server zone - select the backup server zone to which this backup server will be assigned
4. Move the Enabled slider to the right to enable the backup server.
5. Move the Enable Integrated Storage on Static Backup Server slider to the right to enable Integrated Storage on static compute resources.
6. Click the Add Backup server button.

If you intend to attach LVM-based storage and create backups, you should also add the IP address of the KVM compute resource added in step 1 in the 'Backup IP address' field of each of your compute resources.

11.2 Edit CloudBoot Backup Server

To edit a CloudBoot backup server:
1. Go to your Control Panel > Admin > Settings menu and click the Backup Servers icon.

2. On the screen that appears, you'll see the list of all backup servers currently set up in the cloud. Click the Actions button next to the backup server you want to edit, then click Edit to change the backup server's properties:

   - **Label** - the name of the backup server
   - **IP address** - the backup server IP address (IPv4)
   - **Backup IP address** - provisioning network IP address
   - **Capacity (in GB)** - the backup server capacity
   - **Backup server zone** - the backup server zone to which this backup server is assigned

   It is possible to move backup servers only between backup server zones of the same type. For more information refer to [Zone Types](#).

   - **Enabled** – move this slider to the right to enable the backup server or to the left to disable the backup server

   Note that disabling a backup server affects backups and [virtual server provisioning](#) as follows:

   **Backups**
   - You cannot create new backups on this backup server anymore.
   - Backups that were created before disabling the backup server remain on this BS.
   - You can restore virtual servers from backups available on this backup server.
   - You can convert virtual server backups to templates.

   **Provisioning**
   - The virtual server provisioning is not available on this backup server except for the following case.
   - If a template is located only on this backup server, provisioning of virtual servers based on this template is still performed on this backup server.

   - **Enable Integrated Storage on Static Backup Server** - move the slider to the right to enable Integrated Storage on static backup server.
   - Click the Save Backup server button to save changes.

### 11.3 Delete CloudBoot Server

To delete a CloudBoot backup server:

1. Go to your Control Panel > Admin > Settings menu and click the Backup Servers icon.
2. Click the backup server's label.
3. On the screen that appears, you'll see the list of all backup servers currently set up in the cloud.
4. Click the **Actions** button next to the backup server you want to remove from the cloud, then click **Delete**. You'll be asked to confirm deletion.

All the backups stored on that backup server will be deleted!
12 Performance Benchmarks

Performance benchmarks are used for measuring the integrated data store performance by running tests against it. Performance benchmarks are only available for disks created manually. It is not possible to use benchmarking for disk that are being used for virtual servers.

12.1 View Performance Benchmarks

To view the list of previously run performance benchmarks:

1. Go to your Control Panel > Storage > Data Stores menu.
2. On the screen that appears, you’ll see the list of all integrated storage data stores in the cloud.
3. Click the label of the required data store.
4. On the data store’s details screen, click the Performance Benchmarks button.
5. On the screen that appears, you will see the list of benchmarks along with the following details:
   - **Creation time** - time when the benchmark was run
   - **Type** - benchmark type: xddwrapper or ddwrapper
   - **Status**.

To view test result and activity log, click the benchmark status.

12.2 Create Performance Benchmark

To run a performance benchmark:

1. Go to your Control Panel > Storage > Data Stores menu.
2. On the screen that appears, you’ll see the list of all integrated storage data stores in the cloud.
3. Click the label of the required data store.
4. On the data store’s details screen, click the Performance Benchmarks button.
5. On the screen that appears, click the Create Benchmark button.
6. Specify new benchmark details:
   a. **Type** - specify the benchmark type:
      - ddwrapper - select the ddwrapper task to utilize the control domain
      - xddwrapper - select the xddwrapper to create a virtual server and run the benchmark within that server.
   b. **Compute resource** - chose the compute resource on which the test will be performed
   c. **Disk uuid** - select the VDisk that will be used for the performance benchmark
   d. **Block size** - specify the block size which the dd will use for benchmarks in KB. The block size is equal to the bs=<value> option
   e. If you have chosen the xddwrapper type at step a, specify the following details:
      - **Xddwrapper type** - choose the the type of operation to run: read, write or a ratio test that compares the read to write speed
- **Read/Write ratio** - This parameter only applies to the read/write ratio performance test

The "Read/Write ratio" is only used when the ratio xddwrapper type is selected to specify the percent of read operations.

- **Random seek** - select this check box to determine if data should be read from random locations
- **Random seek range** - specify the range from 0 to the block number to define where random seeks will be performed
- **Mbytes** - specify the number of megabytes to transfer
- **Passes** - number of types to perform the test
- **Queuedepth** - Number of queues to use.
- **Timelimit** - Timeout limit for running the benchmark. This parameter returns the performance levels up until the timeout value
- **Reqsize** - specifies the number of blocks to transfer. The size of the block is specified in the **Block size** parameter

f. Click the **Start Benchmark** button to run this benchmark test.

### 12.3 Delete Performance Benchmark

To delete a benchmark:

1. Go to your Control Panel > **Storage** > **Data Stores** menu.
2. On the screen that appears, you’ll see the list of all integrated storage data stores in the cloud.
3. Click the label of the required data store.
4. On the data store’s details screen, click the **Performance Benchmarks** button.
5. On the screen that appears, you will see the list of all data store benchmarks.
6. Click the **Actions** icon next to the required benchmark, then choose **Delete**.
13 Disk Hot Plug

This page contains outdated information and we recommend using hot disk plug only from UI. For relevant instructions, refer to Manage CloudBoot Compute Resource Devices.

Starting from the 3.1.2 version, OnApp Cloud supports disk hot plug for CloudBooted compute resources using the Integrated Storage platform. You can now assign and unassign drives from the IO controllers on the compute resources, using a CLI utility that is provided on the root FS of the CloudBoot compute resource. If no free slots are available while assigning disks using hotplug, the system will automatically initialize new controllers to assign the required number of disks.

To use the hotplug, run the following command from the required compute resource:

```
diskhotplug
```

The list of available disk hotplug commands:

- `diskhotplug list`
- `diskhotplug assign <Controller> <Slot> <device>`
- `diskhotplug unassign <Controller> <Slot>`
- `diskhotplug initNewController`
- `diskhotplug restartController <Controller>`

After the upgrade (both live and non-live compute resource reboot) you will now see drives appear in the `diskhotplug 'list'` output.

Example for a system with 6 disk drives set with default 4 drives per controller:

```
> [root@x.x.x.x ~]# /usr/pythoncontroller/diskhotplug list
> Controller 0
>    Slot 0  - /dev/sda (SCSIid:Z2A7VJQD_Z2A7VJQD,NodeID:130322041)
>    Slot 1  - /dev/sdb (SCSIid:9WM6B5WQS_9WM6B5WQ,NodeID:4043912490)
>    Slot 2  - /dev/sdc (SCSIid:9WM6B955S_9WM6B955,NodeID:2281894381)
>    Slot 3  - /dev/sdd
> (SCSIid:CVPR116003YH160DGN_2CW16_CVPR116003YH160DGN,NodeID:476612602)
> Controller 1
>    Slot 0  - /dev/sde (SCSIid:350025388500786eb_S1D9NEAD904298F,NodeID:235613508)
>    Slot 1  - /dev/sdf
> (SCSIid:35000cca0220b54c8_KP675RF,NodeID:2574447922)
>    Slot 2  - EMPTY
>    Slot 3  - EMPTY
```

Use the 'unassign' command to remove a drive, e.g. due to mechanical drive failure, or to manually move it to another server:

```
diskhotplug unassign <Controller> <Slot>
```

In the example below, `/dev/sdf` is being removed:
To insert a new drive into the IO controller, use the 'assign' command:

diskhotplug assign <Controller> <slot> <device>

For example:

```
> [root@x.x.x.x ~]# /usr/pythoncontroller/diskhotplug assign 1 1 /dev/sdf
> [root@x.x.x.x ~]# /usr/pythoncontroller/diskhotplug list
> Controller 0
>     Slot 0 - /dev/sda (SCSIid:Z2A7VJQD_Z2A7VJQD,NodeID:130322041)
>     Slot 1 - /dev/sdb (SCSIid:9WM6B5WQS_9WM6B5WQ,NodeID:4043912490)
>     Slot 2 - /dev/sdc (SCSIid:9WM6B955S_9WM6B955,NodeID:2281894381)
>     Slot 3 - /dev/sdd
> (SCSIid:CVPRI16003YH160DGN_2CW16_CVPRI16003YH160DGN,NodeID:476612602)
> Controller 1
>     Slot 0 - /dev/sde
> (SCSIid:350025388500786eb_S1D9NEAD904298P,NodeID:235613508)
>     Slot 1 - EMPTY
>     Slot 2 - EMPTY
>     Slot 3 - EMPTY
```

NOTE:
- Use the UI diagnostic view to query the current state of the Integrated Storage platform.
- Check that all VDisk content is redundant and all vdisks are in-sync before attempting to unassign a physical drive when it is still active in the system.
- If no free slots are available while assigning disks using hotplug, the system will automatically initialize new controllers to assign the required number of disks.

To avoid warning messages such as DELAYED_PING showing on the diagnostics page, it will also be necessary to forget the disk drive. Whenever removing a disk drive permanently from
OnApp Integrated Storage forget should be used. This can be performed by selecting nodes, finding the corresponding node and then using the Forget option.
14 Monitoring Tool

OnApp Storage monitoring tool is a CLI utility that checks disks’ status and sends an email to a defined recipient. The time between updates is configurable.

To set up the monitoring tool, you can either modify the script directly or edit the `MonitorTool.conf` configuration file. We recommend using the second solution. Either the script can be modified directly to modify the entries or the recommended solution is to modify the `MonitorTool.conf` configuration file. You can edit the following configuration settings:

<table>
<thead>
<tr>
<th>Configuration Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code># Number of minutes between sending emails</code></td>
<td><code>email_delay=60</code></td>
</tr>
<tr>
<td><code># Email subject</code></td>
<td><code>email_subj=OnApp Alert Message - Degraded Disks</code></td>
</tr>
<tr>
<td><code># Email to address</code></td>
<td><code>email_to=&lt;support&gt;@&lt;onapp.com&gt;</code></td>
</tr>
<tr>
<td><code># Email from address</code></td>
<td><code>email_from=&lt;support&gt;@&lt;onapp.com&gt;</code></td>
</tr>
<tr>
<td><code># Use TLS - requires python with SSL support. /usr/pythoncontroller/python does not have TLS support on standard CP installation.</code></td>
<td><code>TLS=False</code></td>
</tr>
<tr>
<td><code># SMTP address of email provider</code></td>
<td><code>smtp_addr=&lt;smtp_provider.com&gt;</code></td>
</tr>
<tr>
<td><code># SMTP Port</code></td>
<td><code>smtp_port=25</code></td>
</tr>
<tr>
<td><code># SMTP User Name</code></td>
<td><code>smtp_user=&lt;onapp@onapp.com&gt;</code></td>
</tr>
<tr>
<td><code># SMTP Password</code></td>
<td><code>smtp_pass=&lt;password&gt;</code></td>
</tr>
<tr>
<td><code># Allow known host warning to pass</code></td>
<td><code>relaxed_ssh=True</code></td>
</tr>
</tbody>
</table>

Once the configuration file has been generated, you can run the MonitorTool. If you are using default configuration settings, an email will be sent to the destination regardless of the degraded VDisks existence.

To ensure that the script runs periodically, check that the entry that runs the `/usr/pythoncontroller/python /tmp/MonitorTool.py` command is created in the crontab. If there are degraded disks, the email with the list of degraded disks will be sent after the email delay time is surpassed. Once the disks have been repaired through the Control Panel user interface, the disks will no longer be reported as degraded.
15 Performance measurement steps

1. **Measuring Dom0 Network performance**
   - Bonded interfaces
   - Recommended network settings for switches
2. **Measuring Raw Disk Performance**
3. **Data store performance**
4. **VS Disk Performance**
5. **General notes on performance**
6. **Enabling caching on the storage controller**
7. **Results**

Some customers may experience MAC address flapping across ports because the switch does not support the balance-rr mode. In this case, we recommend setting up separated VLANS per each bond pair for that switch.

### 15.1 Measuring Dom0 Network performance

Run this test to analyse the performance between Dom0 on two hypervisors. This performance test checks the asymmetric network performance for issues in either direction of the network communication.

1. Log into the two hypervisors through the CP server.

```
ssh root@<ipaddr_cpserver>
[root@<ipaddr_cpserver> ~]# ssh <ipaddr_hv>
```

2. Check if the network configuration is set up correctly for both hypervisors.
3. Run the CloudBoot healthcheck script and check results for inaccuracies.
4. Make sure that all SAN NICs across hypervisors have default MTU settings of 1500 and disabled jumbo frames.
5. Run the `iperf` binary against hypervisors to measure the network throughput and verify that network performance is as expected. Run this binary twice for each pair of hypervisors, reversing the source and destination (`ipaddr_hv_1` and `ipaddr_hv_2`) each time:

   This command runs `iperf` in server mode with a flag to avoid delays:

```
[root@ipaddr_hv_1 ~]# iperf -s -N
```

   This command provides the speed of the connection from the client to the server:
This value should be recorded as Perf_D0_H2_D0_H1.
Reversing the roles of the two iperfs (change from client to server and vice-versa) the performance from HV1 to HV2 will be calculated. This should be recorded as Perf_D0_H1_D0_H2.
If the two values differ or the performance is lower than expected, check your configuration at the network level.

**Bonded interfaces**

1. Run the following command to get the list of NICs that are bonded together as onappstorebond. If there are no bonds, ethx will be returned in the output:

   ```
   [root@<ipaddr_hv_1> ~]# brctl show
   ```

2. If there is a network bond, run:

   ```
   [root@<ipaddr_hv_1> ~]# cat /proc/net/bonding/onappstorebond
   ```

3. Check that the links are up and that they are running at the same speed.
4. Check settings of the each interface mentioned in the bond as well as for the bond itself:

   ```
   [root@<ipaddr_hv_1> ~]# ethtool -k <onappstorebond>
   [root@<ipaddr_hv_1> ~]# ethtool -k <eth0>
   ```

**Output example for <eth0>:**

```none
Cannot get device rx csum settings: Operation not supported
rx-checksumming: off
tx-checksumming: on
scatter-gather: on
tcp segmentation offload: on
udp fragmentation offload: off
generic segmentation offload: off
generic receive-offload: off
```

5. If the TCP segmentation offload (TSO) is disabled, you can enable it with the following command:

   ```
   [root@<ipaddr_hv_1> ~]# ethtool -k <eth0> tso on
   ```

   We also recommend enabling the generic segmentation offload (GSO). To do so:

   ```
   [root@<ipaddr_hv_1> ~]# ethtool -k <eth0> gso on
   ```

You can enable both TSO and GSO at the same time:
Currently TSO and GSO bonding is disabled on Xen/CentOS 5 HVs with NIC bonding.

15.2 Recommended network settings for switches

- Disabling STP and LACP modes for managed switches can improve the performance. As OnApp Storage uses balance-rr for network interface card bonding, LACP and STP protocols affect the efficiency.
- Connect OnApp Storage interfaces to a single VLAN, with no other devices connected to it.
- Use two-fold number of interfaces for scaling bonding. Therefore, bonding should be used for x2 NICs.
- Currently, we recommend using KVM hypervisors for environments with 10Gb Ethernet cards or those that use bonded interfaces.

15.3 Measuring Raw Disk Performance

Follow these steps to check the disks’ raw speed. These tests need to be adapted for custom bond scripts. Also, all hypervisors must be in default PV mode, without hardware passthrough.

1. Log in into the hypervisor without creating a data store.
2. Stop running OnApp groupmon services:
   ```bash
   [root@<ipaddr_hv_1> ~]# service groupmon stop
   ```
3. Run the test that is included in the `perftest.sh blockdevice` script against all the integrated storage drives.
   ```bash
   [root@<ipaddr_hv_1> ~]# service groupmon stop
   ```
   This is a destructive test! Do not run it against drives which have not been added to the storage platform.
4. Copy the `perftest.sh` test from the `/tmp/<perftest>` directory to the CP server.
5. Run the following script against all integrated storage drives:
   ```bash
   formatandconfigure /dev/swap
   ```
   After that, drive devices will be ready for use in onappstorage.
6. Restart the OnApp storage service:
15.4 Data store performance

1. Create a data store with a single drive member via OnApp user interface or via CLI. Sing the OnApp web interface or the CLI create a data store with a single drive member.
   a. To create a data store via CLI:

   ```
   [root@<ipaddr_hv_1> ~]# onappstore createds name=<datastore_name> membership_count=1 owners=<node UUID of one of the local drives>
   ```

   b. Check if the data store is successfully created:

   ```
   [root@<ipaddr_hv_1> ~]# onappstore listds
   ```

2. Create a 4GB VDisk:

   ```
   [root@<ipaddr_hv_1> ~]# onappstore create name=<vdisk_name> size=4096 Datastore=<ds_uuid>
   ```

   The following details will be returned on successful VDisk creation: disk owner's details, vdisk_uuid and result=SUCCESS. For example:

   ```
   uuid=tcm3ly5fi46ebj owners=<992993183> Datastore=<1ag3m5dqoh86yc> stripesize=<256> result=SUCCESS
   ```

3. Locate the frontend UUID of the first hypervisor for testing:

   ```
   [root@<ipaddr_hv_1> ~]# onappstore getid
   ```

   Output example:

   ```
   result=SUCCESS uuid=3654210369
   ```

4. Make online the VDisk you have created at Step 2:

   ```
   [root@<ipaddr_hv_1> ~]# onappstore online frontend_uuid=<value from getid command> uuid=<vdisk uuid created above>
   ```

5. Check if the disk appeared online:

   ```
   [root@<ipaddr_hv_1> ~]# ps auxww | grep -w bdevclient | grep tcm3ly5fi46ebj
   ```

   Output example:
6. Use the `nbd_conn_info` tool to get the network block device connection information:

```
[root@<ipaddr_hv_1> ~]# nbd_conn_info /dev/nbd0
```

This command returns information about that particular NDB device. It checks if all the paths are live and that mirrored devices are not degraded. Repair all detected degraded paths to improve the performance.

7. Check the VDisk's local write performance:

```
[root@<ipaddr_hv_1> ~]# dd if=/dev/zero of=/dev/mapper/tcm3ly5fi46ebj bs=64M oflag=direct
```

**Output example:**
```
dd: writing '/dev/mapper/tcm3ly5fi46ebj': No space left on device
17+0 records in
16+0 records out
1073741824 bytes (1.1GB) copied, <5.61974> s, <191> MB/s
```

Record as Perf_w_VD1_HV1_2R_1S_0Over (2R_1S_0Over should be the data store configuration used for the set up).

8. Check VDisk's local read performance:

```
[root@<ipaddr_hv_1> ~]# dd of=/dev/null if=/dev/mapper/tcm3ly5fi46ebj bs=64M iflag=direct
```

**Output example:**
```
16+0 records in
16+0 records out
1073741824 bytes (1.1GB) copied, <3.80509> s, <282> MB/s
```

Record as Perf_r_VD1_HV1_2R_1S_0Over (2R_1S_0Over should be the data store configuration used for the set up).

9. Switch to the HV 2 and turn off the VDisk:

```
[root@<ipaddr_hv_2> ~]# onappstore offline uuid=tcm3ly5fi46ebj
```

10. Run the following commands online on the remote hypervisor:

```
[root@<ipaddr_hv_2> ~]# onappstore getid
```

**Output example:**
result=SUCCESS uuid=<3156021174>

Then:

[root@<ipaddr_hv_2> ~]# onappstore online uuid=<tcm3ly5fi46ebj>
frontend_uid=<3156021174>

Output example:

result=SUCCESS

11. Run the same commands for the remote performance:

[root@<ipaddr_hv_2> ~]# dd if=/dev/zero of=/dev/mapper/tcm3ly5fi46ebj bs=64M oflag=direct
[root@<ipaddr_hv_2> ~]# dd of=/dev/null if=/dev/mapper/tcm3ly5fi46ebj bs=64M iflag=direct

Record as Perf_r_HV2_VD1_HV1_2R_1S_0Over

Notes:
The results will contain different performance levels depending on the configuration. The local path test initially should produce read and write throughput numbers that are very similar to the raw disk performance for the same disk that you measured previously. The remote performance tests results should be somewhat similar to the raw network throughput measurement you ran previously between the two hypervisors.

[root@<ipaddr_hv_1> ~]# dmsetup status /dev/mapper/tcm3ly5fi46ebj
/dev/mapper/0_tcm3ly5fi46ebj: 0 2097152 mirror_sync 2 CW,wml=0,w[0]=100,w[1]=50 0,43:0,A 1,43:1,A
=> Live_Devs: 2, IO_Count: TRD: 8334 ORD: 0 TWR: 28672 OWR: 0
/dev/mapper/1_tcm3ly5fi46ebj: 0 2097152 mirror_sync 2 CW,wml=1,w[0]=50,w[1]=100 0,43:2,A 1,43:3,A
=> Live_Devs: 2, IO_Count: TRD: 8329 ORD: 0 TWR: 28672 OWR: 0
/dev/mapper/tcm3ly5fi46ebj: 0 4194304 striped 2 253:0 253:1 1 AA

- Entries should show up depending on the vdisk mirroring & striping configuration.
- All devices should show "A" (i.e. alive) mirrors, highlighted above with bold and underlined "A". If a device shows "U" or "D", this means that there is a dead mirror.
- If a VDisk runs in a degraded mode the system will continue to work, but performance will be lower both for reads and writes, according to how many paths are inactive/dead.
- Striped configs should show all devices as "A", or the entire VDisk will be out of sync and reporting I/O errors.
15.5 VS Disk Performance

To test the disk performance on the Linux virtual servers, OnApp uses a ddwrapper tool to create a small virtual server instance with the performance tests. The ddwrapper creates a virtual server that reports a device /dev/mapper/<vdisk> and runs performance tests on the virtual server. The drive is paravirtualized and handled slightly differently for Xen and KVM. Then, this performance checks the block performance of the virtual server drive.

We recommend running the swap off command before running the virtual server performance tests. To do so, run:

```
[root@<ipaddr_vm1> ~]# swapoff -a
```

Otherwise, disable a single swap drive:

```
[root@<ipaddr_vm1> ~]# swapoff </dev/xvda2>
```

1. Create a VDisk on the integrated storage data store and make it online on the HV1:

```
[root@<ipaddr_hv_1> ~]# onappstore create name=<vdisk_name> size=<4096> Datastore=<ds_uuid>
```

```
[root@<ipaddr_hv_1> ~]# onappstore getid
```

```
[root@<ipaddr_hv_1> ~]# onappstore online frontend_uuid=<result of getid> uuid=<vdisk uuid>
```

2. To run it, log into a hypervisor and run the following command:

```
[root@<ipaddr_hv_1> ~]# ddwrapper device=/dev/mapper/ej8f2sc74p6wgv bs=64M count=8
```

Output example:

```
result=SUCCESS
write_results=536870912_bytes_(537_MB)_copied,_2.73083_seconds,_197_MB/s
write_time=2.73083 write_mbps=197
read_results=536870912_bytes_(537_MB)_copied,_2.32336_seconds,_231_MB/s
read_time=2.32336 read_mbps=231
```

3. Make the disk offline and delete it:

```
[root@<ipaddr_hv_1> ~]# onappstore offline uuid=ej8f2sc74p6wgv
```
4. Create a new VDisk and make it online on HV2.
5. Run it from another hypervisor:

```
[root@<ipaddr_hv_2> ~]# ddwrapper device=/dev/mapper/wfuxsok2bhladi bs=64M count=8
```

Output example:

```
result=SUCCESS
write_results=536870912_bytes_(537_MB)_copied,_2.74059_seconds,_196_MB/s
write_time=2.74059
write_mbps=196
read_results=536870912_bytes_(537_MB)_copied,_1.03714_seconds,_518_MB/s
read_time=1.03714
read_mbps=518
```

NOTE:
- Both the physical underlying disks and the onapp store devices performance depends heavily on the concurrency and/or block sizes of the request queue, so with single-thread 8KB requests the performance will not be ideal.
- If bs is set to 8KB, on a 300MB/s capable SSD drive, the performance could show 50-100MB/s and this would be a good performance level. Using larger block sizes, the network interface will normally become the bottleneck with 1Gbps NIC cards using modern non-SSD disks.
- VirtIO enabled templates normally show better performance than the non VirtIO enabled templates. If there is poor performance for a virtual server, then a similar VirtIO template should be used instead - [http://templates.repo.onapp.com/Linux/](http://templates.repo.onapp.com/Linux/).
- PV drivers if present in the image can also improve the performance of the virtual servers.

15.6 General notes for performance

1. You can also change the blkbk.reqs to improve performance. To do that, modify the following from CP:

```
[root@<ipaddr_cp_1> ~]# vi /tftpboot/pxelinux.cfg/template-xen
```

```
Add blkbk.reqs=128
```

For single-threaded sequential dd tests it only makes sense if you use large block sizes. If the block size is set less than the default chunk size for OnApp Storage (256KB), the performance levels will be severely degraded.
2. Xdd tests can increase the concurrency to push more requests into the queue in order to get decent performance:

```
[root@<ipaddr_hv_1> ~]# xdd -targets 1 /dev/<sdaX> -dio -mbytes 512 -op read -blocksize 4096 -reqsize 2 -queuedepth 64 -verbose
```

3. If dom0 performance is much higher than the virtual server's performance, it may be as a result of the irqbalance daemon. To disable it, use:

```
[root@<ipaddr_hv_1> ~]# /etc/init.d/irqbalance stop
```

4. Performance can also be improved by instead of completely stopping irqbalance, using oneshot mode instead:

```
[root@<ipaddr_hv_1> ~]# irqbalance --oneshot
```

Or by adding to the custom boot script

```
/etc/init.d/irqbalance stop
```

5. To check if irqbalance is running, use the following command:

```
[root@<ipaddr_hv_1> ~]# service irqbalance status
```

### 15.7 Enabling caching on the Storage Controller

Enabling caching on the storage controller can help increase the read performance if there are many virtual servers with sustained reads running on a hypervisor. The hypervisor will need to allocate more memory to the storage node’s virtual server and change the VDisks to use the cache.

1. Make all the VDisks from the virtual servers offline from the OnApp UI, then shut down all the connected virtual servers.

2. Log in into the hypervisor and shut down the storage node:

   **For Xen hypervisor:**

   ```
   [root@<ipaddr_hv_1> ~]# xm shutdown <STORAGENODE0>
   ```

   **For KVM hypervisor:**

   ```
   [root@<ipaddr_hv_1> ~]# virsh shutdown <STORAGENODE0>
   ```

3. Increase the amount of RAM available for the storagenode:

   ```
   [root@<ipaddr_hv_1> ~]# vi /onappstore/VMconfigs/<NODE1-STORAGENODE0>
   ```

   Change memory='640' to a higher value e.g. '2048'

4. Take note of the ip_address.
5. Restart the StorageNode

```
[root@<ipaddr_hv_1> ~]# initSAN
```

6. Telnet to the StorageNode:

```
[root@<ipaddr_hv_1> ~]# telnet <ip_addr_storage_node0>
```

7. List all the VDisk entries in the database:

```
/ # du -a /DB/ | grep xml
```

8. For each VDisk entry, add the following line just before `<replicas>`

```
V/ # vi </DB/NODE-2900573203/vdisks/730nmaqg5z82uj.xml>
```

9. Add the `<dev_flags>none</dev_flags>` field.

10. Save changes for each entry.

Now caching should be enabled for those VDisks.

### 15.8 Results

If you have issues with the performance please return the following table with as many entries completed as possible.

<table>
<thead>
<tr>
<th>Type</th>
<th>From</th>
<th>To</th>
<th>Dom0</th>
<th>SN0</th>
<th>VD</th>
<th>VM</th>
<th>D0</th>
<th>SN0</th>
<th>VD</th>
<th>VM</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/W</td>
<td>HV1</td>
<td>HV2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dom0</td>
<td>HV2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SN0</td>
<td>HV2</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VD</td>
<td>HV2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VM</td>
<td>HV2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk</td>
<td>HV1</td>
<td>HV2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dom0</td>
<td>HV2</td>
<td></td>
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<tr>
<td></td>
<td>SN0</td>
<td>HV2</td>
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</tr>
<tr>
<td></td>
<td>VD</td>
<td>HV2</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VM</td>
<td>HV2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results from running perftest.sh should be copied to the CP server. Also, include the location of the results.
15.9Notes

Tests like bonnie++ ([http://www.googluc.com/bonnie.html](http://www.googluc.com/bonnie.html)) and hdparm perform quite specific tests that may not perform optimally on virtual disk drives. Some OnApp templates do not come with virtIO. The templates that come with VirtIO are specifically named in the template name. Templates with VirtIO tend to perform much better.

We currently do not perform ext3 or other filesystem tests.
# 16 Expected Behaviour During Degraded Service

This table illustrates compute resource behaviours during crash or degraded service.

<table>
<thead>
<tr>
<th>VMOps</th>
<th>Can utilise a Backup Server</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
</tr>
<tr>
<td>Cluster State</td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>A</td>
</tr>
<tr>
<td>compute resource Crash &lt; 2 min</td>
<td>D</td>
</tr>
<tr>
<td>compute resource Crash &gt; 2 mins</td>
<td>A</td>
</tr>
<tr>
<td>Running compute resource (VDisk degraded)</td>
<td>A</td>
</tr>
<tr>
<td>Running compute resource repairing</td>
<td>A</td>
</tr>
<tr>
<td>Running compute resource healthy</td>
<td>A</td>
</tr>
</tbody>
</table>

Where:

A: Allowed mode and supported by the OnApp platform.

D: Disallowed mode, not supported or recommended by the OnApp platform.
# 17 Cloudboot and Static Boot Mixed Mode Behaviours

This table illustrates supported actions between cloudboot and static boot Hypervisors.

We highly recommend using single type systems, avoiding mixed-mode systems.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Type</th>
<th>Static</th>
<th>Cloudboot</th>
<th>Working?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failover/ VM migrate</td>
<td>Static</td>
<td>LVM</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>IS</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Cloudboot</td>
<td>LVM</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>IS</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation</th>
<th>VM running on HV Type</th>
<th>Static</th>
<th>Cloudboot</th>
<th>Working?</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDisk Content Migrate</td>
<td>Static</td>
<td>LVM</td>
<td>A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>IS</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cloudboot</td>
<td>LVM</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>IS</td>
<td>A</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation</th>
<th>Type</th>
<th>HV backup is run on</th>
<th>LVM</th>
<th>IS</th>
<th>Working?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup</td>
<td>No dedicated</td>
<td>Static</td>
<td>A</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cloudboot</td>
<td>A</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Static</td>
<td>-</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cloudboot</td>
<td>-</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation</th>
<th>Static</th>
<th>Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get List of Disks</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>List Disks per VM</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Create Disk</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Delete Disk</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>View Disk IOPs</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Build Disk</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Unlock Disk</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Backup</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Op</td>
<td>Static</td>
<td>Cloud</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Get list of Backups</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Resize (Up)</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Resize (Down)</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Get list of nodes</td>
<td>N/A</td>
<td>A</td>
</tr>
<tr>
<td>Get Node details</td>
<td>N/A</td>
<td>A</td>
</tr>
<tr>
<td>Create Datastore</td>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>Delete Datastore</td>
<td>D</td>
<td>A</td>
</tr>
</tbody>
</table>

Where:
A: Allowed mode and supported by the OnApp platform.
D: Disallowed mode, not supported or recommended by the OnApp platform.
N/A: Not available
18 Integrated Storage Common Scenarios

Deprecated documentation - for the latest update refer to Upgrade Guide for Cloud with CloudBooted Servers

This document covers common scenarios on how to upgrade Integrated Storage compute resources, and how to maintain CloudBoot compute resources.

On this page:

- **Upgrade**
  - Offline Upgrade
  - Upgrade with VS Migration
  - Live Upgrade

18.1 Upgrade

You can upgrade CloudBoot compute resources in the following ways:

1. **Upgrade by rebooting compute resources when VSs are offline**
2. **Upgrade by rebooting compute resources when VSs are migrated to another compute resource**
3. **Live upgrade**

18.1.1 Offline Upgrade

To perform an offline upgrade, i.e. when the virtual servers are shut down and compute resources rebooted, perform the following steps:

1. Make sure all disks are not degraded.
2. Stop all virtual servers on the cloud.
3. Download and install the latest OnApp YUM repository file:

```bash
bash#> rpm -Uh https://rpm.repo.onapp.com/repo/onapp-repo.noarch.rpm
```

4. Install CloudBoot dependencies:

```bash
bash#> yum update onapp-store-install
bash#> /onapp/onapp-store-install/onapp-store-install.sh
```

5. After that, go to your Control Panel **Settings** menu.
6. Reboot compute resources:
   a. Click the **Appliances** icon.
   b. Click the label of the CloudBoot compute resource you wish to upgrade.
   c. On the compute resource details screen, click the **Actions** button, then click **Reboot Compute resource**.
7. Reboot all backup servers.
8. Check diagnostics page to make sure all nodes are active (Integrated Storage > Compute Zones > Diagnostics menu).

**18.1.2 Upgrade with VS Migration**

To perform an upgrade by rebooting compute resources and migrating virtual servers, follow the procedure below:

1. Make sure all disks are not degraded.
2. Migrate all the virtual servers from the CloudBoot compute resource to another compute resource. Follow the instructions described in the Migrate Virtual Server section of the Admin guide to migrate virtual servers.
3. Download and install the latest OnApp YUM repository file:

   ```bash
   bash#> rpm -Uvh http://rpm.repo.onapp.com/repo/onapp-repo.noarch.rpm
   ```

4. Install CloudBoot dependencies:

   ```bash
   bash#> yum update onapp-store-install
   bash#> /onapp/onapp-store-install/onapp-store-install.sh
   ```

5. Reboot compute resources:
   a. After that, go to your Control Panel Settings menu.
   b. Click the Appliances icon.
   c. Click the label of the CloudBoot compute resource you have migrated all VSs from.
   d. On the compute resource details screen, click the Actions button, then click Reboot Compute resource.
6. Check diagnostics page to make sure all nodes are active (Integrated Storage > Compute Zones > Diagnostics menu).
7. Do a Repair All on the degraded VDisks.
8. Repeat steps 5-7 for all other compute resources.
9. Reboot the backup servers.

If there is an issue during this procedure, fall-back to offline upgrade.

**18.1.3 Live Upgrade**

To perform a live upgrade, follow the documentation Live Upgrade CloudBoot Hypervisors (for OnApp Cloud 3.2). For other versions, refer to appropriate Get Started guides.
19 Advanced Technical Details

Starting with OnApp Storage version 3.3.0-19 and OnApp Cloud version 3.3.1 CloudBoot platform moved from Groupmon to ISD daemon which resulted in the number of changes. No longer ship a python based groupmon daemon. ISD is a small, compact C---based daemon that:

- Listens on multicast channel, or unicast port
- Updates local DB based on received ping messages
- Sends out ping messages based on local DB content
- Much smaller memory footprint

Please consider the following information and instructions for advanced configuration and administration of your CloudBoot platform.

19.1 ISD Daemon

19.1.1 ISD config details

Default ISD configuration file:

```
/onappstore/etc/isd.conf
```

On this page:

- ISD config details
- ISD debugging
- ISD logging

Contents generated from (in dom0)

```
/onappstore/onappstore.conf
```

Contents generated from (Backend SN)

```
/proc/cmdline
```

Isd.conf generated by

```
# /etc/init.d/isd hostconf (dom0)
# /etc/init.d/isd guestconf (Backend SN)
```

To manage all start/stop logic for IS control path, use the following script:

```
/etc/init.d/SANController updateconfig
```
19.1.2 ISD debugging

Init script runs `isd --C /onappstore/etc/isd.conf` with no additional options.

- You may run it manually in the foreground with:

  ```
  isd --C /onappstore/etc/isd.conf -d
  ```

- If `--d` is specified twice then ISD will also raise the `syslog_priority` to 'debug'.

19.1.3 ISD logging

- ISD logs via syslog
  Use `tail --f /var/log/messages | grep --w isd` on a CP server or in SN

- For verbose logs raise the `syslog_priority` (isd.conf) to either 'info' or 'debug'

- Every `stats_interval` seconds, ISD logs a line with its current counters of messages received from the network:

  ```
  isd(5731): notice: stats(): ANY=0/PING=0/DS_PING=0/0
  SV_PING=0/0 VDISK_DEL=0/0 HEARTBEAT=0/0 UNKNOWN=0/0
  ```

- For each message type received:
  - Value #1 is the number of messages received during the last `stats_interval` seconds
  - Value #2 is the total number of messages received since isd was started

19.2 Cron Tasks

Starting with OnApp Cloud 3.3.1 and OnApp Storage 3.3.0-19, periodic task execution is handled by standalone python scripts:

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>*/2 * * * * root localupdate</td>
<td>syncs database state with the state on the local disks</td>
</tr>
<tr>
<td>*/1 * * * * root check_active_sync</td>
<td>checks for ongoing repairs, and performs online refresh at the end of resyncs</td>
</tr>
<tr>
<td>*/1 * * * * root timeout_nodes</td>
<td>checks for nodes we have not heard from in 2 mins, and times out accordingly</td>
</tr>
<tr>
<td>*/1 * * * * root nbd_stats</td>
<td>collects NBD stats</td>
</tr>
<tr>
<td>*/2 * * * * root stale_devices</td>
<td>cleans up NBD device counters in /tmp/NBDdevs with the actual NBD devices and device mapper references</td>
</tr>
</tbody>
</table>

ISD only reports data as read from the local DB and only updates the DB with data as received from other nodes.

19.3 Database

In OnApp 3.3.1 there is no more Redis database on the compute resources:

- Local FS-based DB stored under /onappstore/DB
- All content stored in FS structure or text files
  - Much easier to debug state from any endpoint
  - Can use standard ssh + shell commands to gather DB state from any node

On this page:
19.3.1 [FS_DB] Datastore Subdir

```
/onappstore/DB/Datastore:
jdbhnovc7rz86
/onappstore/DB/Datastore/jdbhnovc7rz86:
description members name overcommit replicas sector_size stripes
uuid vdisk
/onappstore/DB/Datastore/jdbhnovc7rz86/members:
1308341613 1638717502 3789723832 3830220270 4284135282 976785243
/onappstore/DB/Datastore/jdbhnovc7rz86/vdisks:
awoeuctr854pmd qksozqwm8yaji 103obar8v249sz n8k74ulq5my1w2 r6vpuag9
10syn4 t2sbe73qmk1ldu
```

19.3.2 [FS_DB] Node Subdir

```
/onappstore/DB/Node:
1152875907 1308341613 1638717502 1855767384 3789723832
3830220270 4284135282 976785243
/onappstore/DB/Node/1308341613:
backupchannel datastoremember freespace hbtl hostid ipaddr lastping model nodestat
us performance revision serial size status utilization uuid vdisk vendor version
/onappstore/DB/Node/1308341613/vdisks:
awoeuctr854pmd n8k74ulq5my1w2 t2sbe73qmk1ldu
```

19.3.3 [FS_DB] VDisk Subdir

```
/onappstore/DB/VDisk:
awoeuctr854pmd qksozqwm8yaji 103obar8v249sz n8k74ulq5my1w2 r6vpuag910syn4 t2sbe73qmk1ldu
/onappstore/DB/VDisk/awoeuctr854pmd:
datastore description highest_gen_count memberinfo membership name replicas sector_size
sectors snapshot snapshots st_mems st_size uuid
/onappstore/DB/VDisk/awoeuctr854pmd/memberinfo:
1308341613 1638717502 4284135282 976785243
/onappstore/DB/VDisk/awoeuctr854pmd/memberinfo/1308341613:
```
Automated content rebalancing is now provided through diagnostics UI for IS

- Phase 1: Co-locate stripes or distribute content evenly
- Phase 2: Balance load across compute resources
- Phase 3: Balance load across drives with an compute resource
- Phase 4: Migrate VMs to optimal content location

Asymmetric drives across compute resources will provide non-optimal balancing, with warning in UI.

StorageNode Rootfs Format

StorageNode image format matches the cloudboot initramfs format providing:

- More efficient root fs memory allocation
- Built as CPIO archive (standard format supported by kernel) and extracted at boot Ame
- Dropbear ssh deamon is enabled by default since 3.2.2
- DB is stored in memory by default as standalone loopback file mount device (non-sparse). Size is adjustable via onappstore.conf

To unpack, run the following:
```
mkdir /tmp/extract; cd /tmp/extract && zcat ../initrd.img | cpio -id || exit 1
```

To repack, run:
```
    cd /tmp/extract && find . | cpio --H newc --quiet --o) | gzip -9 > ./initrd.img || exit 1
```
20 Customizable CloudBoot Images

OnApp CloudBoot compute resources allow you to add custom drivers. This feature is needed when hardware is not supported by the kernel version used by OnApp. If required, you can also change existing modules. The procedures for adding new modules and changing existing ones are similar with the exception of the fourth stage.

The process consists of the following stages:

- **Environment installation**
- **Compile/Build custom driver (the recommended way)**
- **Compile/Build custom driver (using tools we provide)**
- **Proceed with the image customization**

20.1. Environment installation

In order to get the environment the same as OnApp CloudBoot compute resources run, please install corresponding template into your OnApp cloud (templates are available via Template Server):

The templates are for OnApp versions >= 5.0. There are no templates available for other CentOS versions and virtualization variants (like CentOS5 XEN, and CentOS7 KVM). It is strongly recommended that you create a VS and run them as KVM guests.

20.2. Compile/Build custom driver (the recommended way)

It is recommended to get and install source RPM (.src.rpm) of the certain driver version provided by driver maintainer. It will ensure that you rebuild driver against CloudBoot's kernel with correct settings and options.

The steps below might not match for 100% your driver building procedure, but they are a part of general understanding how to rebuild kernel modules from source RPM.

Let's go step by step through megaraid sas driver version 06.904.09.00 for Dell PERC H310/H710/H710P/H810/SPERC8/SPERC8 External/H330/H730/H730P/H830 SAS RAID Controllers building for CentOS6 KVM ramdisk, which runs CentOS 6.7 and kernel version 2.6.32-642.6.2.el6.x86_64.

The file needs to be downloaded into the installed guest with the corresponding build environment.

2. Try to locate `src.rpm` within the downloaded file (if the file is not the RPM package itself):

```
# tar ztf UnifiedDriver_6.904.09_RHEL6.tar.gz | grep src.rpm
Kmod=megaraid_sas_rhel6.5 x86_64/megaraid_sas-06.904.09.00_rhel6.5-2.src.rpm
Kmod=megaraid_sas_rhel6.6 x86_64/megaraid_sas-06.904.09.00_rhel6.6-2.src.rpm
Kmod=megaraid_sas_rhel6.7 x86_64/megaraid_sas-06.904.09.00_rhel6.7-2.src.rpm
Kmod=megaraid_sas_rhel6.8 x86_64/megaraid_sas-06.904.09.00_rhel6.8-2.src.rpm
```

Extract the required `.src.rpm` from the archive:

```
# tar zxf UnifiedDriver_6.904.09_RHEL6.tar.gz Kmod=megaraid_sas_rhel6.8\x86_64/megaraid_sas-06.904.09.00_rhel6.8-2.src.rpm
```

3. Install the `.src.rpm`:

```
# rpm -ivh Kmod=megaraid_sas_rhel6.8\x86_64/megaraid_sas-06.904.09.00_rhel6.8-2.src.rpm
```

4. At this point you are ready to rebuild the source RPM of the driver against the required kernel version (`CentOS6 KVM` example, kernel version `2.6.32-642.6.2.el6.x86_64`):

```
# rpmbuild --define='kernel_version 2.6.32-642.6.2.el6.x86_64' /root/rpmbuild/SPECS/megaraid_sas.spec
```

The build could fail with the following error:

```
+ make -C /usr/src/kernels/2.6.32-573.el6.x86_64
M=/root/rpmbuild/BUILD/megaraid_sas-06.904.09.00_rhel6.7)obj/default
make: *** /usr/src/kernels/2.6.32-573.el6.x86_64: No such file or directory.  Stop.
error: Bad exit status from /var/tmp/rpm-tmp.8EzUVv (%build)
```

This particular error means that the kernel version is hardcoded in the `.spec`. It is required to modify the `megaraid_sas.spec` file to fix the error.

Edit the file and remove the `%global kernel_version 2.6.32-642.el6.x86_64` line from it:
Please be aware that the errors and RPM's macro can differ, so you should personally take care of fixing them and passing correct values to rpmbuild utility. In our case kernel_version was the issue reason.

5. Locate the kernel module file .ko. As soon as the rpmbuild succeeds, run:

```bash
# find /root/rpmbuild/BUILDROOT -name ".*ko
/root/rpmbuild/BUILDROOT/megaraid_sas-06.904.09.00_rhel6.8-2.x86_64/lib/modules/2.6.32-642.6.2.el6.x86_64.debugextra/megaraid_sas/megaraid_sas.ko
/root/rpmbuild/BUILDROOT/megaraid_sas-06.904.09.00_rhel6.8-2.x86_64/lib/modules/2.6.32-642.6.2.el6.x86_64/extra/megaraid_sas/megaraid_sas.ko
```

The lib/modules/2.6.32-642.6.2.el6.x86_64/extra/megaraid_sas/megaraid_sas.ko is the kernel module, with which you can customize your CentOS7 KVM CloudBoot ramdisk/image.

20.3III. Compile/Build custom driver (using tools we provide)

If your are not able to locate .src.rpm provided by the driver's vendor, please use our tools to build RPM package(s) with the driver for your hardware from sources.
Let's go step by step through i40e driver version 1.6.42 for PCIe® Intel® 40 Gigabit Ethernet Network Connections building for CentOS6 KVM ramdisk, which runs CentOS 6.7 and kernel version 2.6.32-642.6.2.el6.x86_64.


2. Check if the file matches our naming requirements, is packed with tar+gzip and allocates "main" Makefile:

   o the driver sources file should be named like DRIVER_NAME-DRIVER_VERSION.tar.gz. Otherwise, you should unpack the sources and move them into newly created DRIVER_NAME-DRIVER_VERSION directory. Then please repack the whole directory into the DRIVER_NAME-DRIVER_VERSION.tar.gz;

   o allocate the "main" Makefile.

```bash
# tar ztf i40e-1.6.42.tar.gz | grep Makefile
i40e-1.6.42/src/Makefile
```

Our file is located in the src directory.
3. Start building the RPM package with our tools:

Please check for new tools versions by running `# yum update onapp-ramdisk-kmod-build`.

```bash
# cd /onapp/onapp-ramdisk-kmod-build
# ./onapp-ramdisk-kmod-build.sh -n i40e -v 1.6.42 -C src
```

-C src is the option to specify the "main" Makefile location.

4. The following package is created if the build succeeded:

```
/root/rpmbuild/RPMS/x86_64/onapp-ramdisk-centos6-kvm-kmod-i40e-1.6.42-1.x86_64.rpm
```

It contains the following files to customize CentOS6 KVM ramdisk/image:

```bash
# rpm -qpl /root/rpmbuild/RPMS/x86_64/onapp-ramdisk-centos6-kvm-kmod-i40e-1.6.42-1.x86_64.rpm
```

5. Run the tool with `-h` for help and more options:
6. Put the onapp-ramdisk-centos6-kvm-kmod-i40e-1.6.42-1.x86_64.rpm into your Control Panel box and install it there:

```bash
# rpm -Uvh onapp-ramdisk-centos6-kvm-kmod-i40e-1.6.42-1.x86_64.rpm
```

**20.4IV. Proceed with the image customization**

To add a custom CloudBoot driver:

1. Check if there is a file called "earlyboot.sh" in the overlay folder on the CP for each compute resource. For example, for a compute resource with the MAC address 00:11:22:33:44:55, look whether the /tftpboot/images/centos5/diskless/snapshot/00-11-22-33-44-55/overlay/earlyboot.sh folder exists. This script will be run before the onapp SAN Controller service is run and as such can be used for adding custom drivers.

   Whilst the path mentions centos5, in practice this same script is used for all compute resource types.

   You need to add an executable bit for the earlyboot.sh script for it to become executable. This is done with the help of the chmod command:
You can then check whether the executable bit has been added to the earlyboot.sh file ('x' indicates the executable file):

```bash
correct earlyboot.sh
ls -la earlyboot.sh
-rwxr-xr-x 1 root root 90 Feb 25 19:06 earlyboot.sh
```

2. Include drivers in the same overlay folder.
3. Reference the files in the earlyboot.sh script as if the overlay folder is the root folder.
4. Insert drivers for each compute resource in the overlay folder as described.

An example overlay file for the megaraid driver:

- When adding a new module:

```bash
[root@cp-onapp overlay]# cat earlyboot.sh
#!/bin/sh
PATH=/sbin:/usr/sbin:/bin:/usr/bin
export PATH
insmod /megaraid/megaraid_sas.ko
```

- When changing an existing module:

```bash
[root@cp-onapp overlay]# cat earlyboot.sh
#!/bin/sh
PATH=/sbin:/usr/sbin:/bin:/usr/bin
export PATH
rmmod megaraid_sas
insmod /megaraid/megaraid_sas.ko
```

The megaraid driver folder is actually in the overlay folder, not the root:

```bash
ls -lR
.
.: total 8
-rwxr-xr-x 1 root root 37 Apr 15 16:47 earlyboot.sh
drwxr-xr-x 2 root root 4096 Jul 9 12:21 megaraid

./megaraid:
total 2000
-rw-r--r-- 1 root root 2048000 Jul 9 12:22 megaraid_sas.ko
```

5. The driver will then be inserted and can be used immediately after you reboot the compute resource. Otherwise, to use the driver you need to load it manually and restart the services.
21 Onappstore Commands

1. View the current members of the disk:

   ```
   onappstore diskinfo <uuid>
   ```

2. Forget a member (members) from a particular VDisk. It is recommended to rebalance one path at a time.

   ```
   onappstore forget forgetlist=<member> vdi_uuid=<VD_UUID>
   ```

   where VD_UUID is a particular VDisk

3. Choose a new member on which to host the VDisk.

   ```
   onappstore repairmembership uuid=<uuid> memberlist=<member>
   ```

   Memberlist restricts the members that can be chosen to one or more members. A single member forces the VDisk to use that as the member to host content.

4. Perform the repair that copies content from the master to the slave. The master will be one of the remaining replicas that hosts VDisk content for a stripe. The slave will be the destination drive where the content is copied to.

   ```
   onappstore repair <uuid>
   ```

To forget storage node via CLI:

Check if there are sufficient replicas and good paths for all vDisks that reside on that disk before removing a physical drive. Then:

If there is a path for all stripe members, run the following command:

```
onappstore forget forgetlist=<memberlist_csv>onappstore repairmembership <UUID>onappstore repair <UUID>
```

Check the disk status as before with the repair operation:

```onappstore resynchstatus
uuid=mq98y0trhi5bxostatus={u'3335881780':{u'4142566975':59},u'138773005':{u'433710490':66}}result=SUCCESS
```
22 CloudBoot OS Template

Starting with OnApp version 5.0, there is CloudBoot OS template, from which you can create a VS for building drivers and binaries.

The VS, created from such template, has identical kernel, packages and other files as the CloudBoot images. Also the VS has all the tools necessary for compiling of custom drivers and binaries.

You can compile a driver or binary file that can be later inserted in the overlay directory of the CloudBoot compute resource, and this file will be available after reboot.

Two templates are available:

- For CloudBoot versions 5.0.0-* under CentOS 6.7 and kernel version 2.6.32-573.26.1.el6. The template is available at: http://templates.repo.onapp.com/Linux/centos-6.7-clb_kmod-x64-1.0-xen.kvm_virtio.tar.gz (also available via the Template Manager)

- For CloudBoot versions 4.2.0-* and 4.2.1-* under CentOS 6.5 and kernel version 2.6.32-573.7.1.el6. The template is available at: http://templates.repo.onapp.com/Linux/centos-6.5-clb_kmod-x64-1.0-xen.kvm_virtio.tar.gz (also available via the Template Manager)
23 Integrated Storage Auto Healing

OnApp introduces auto healing - an auto-scheduling option to repair degraded vdisks. This functionality can be used only in case there are no serious issues with Integrated Storage. The following conditions should be met (it can be checked using the compute zone diagnostics):

- No disks with partial memberlist found
- No disks with no stripe replicas found
- No disks with no redundancy found
- No partially online disks found
- No disks in other degraded states found
- No partial nodes found
- No inactive nodes found
- No nodes with delayed ping found
- No nodes with high utilization found
- No out of space nodes found
- No inactive controllers found
- No unreferenced NBDs found
- No reused NBDs found
- No dangling device mappers found
- No disks with inactive cache
- No stale cache volumes

It is recommended to disable auto healing before Integrated Storage upgrade.

On this page:

- Configure auto healing for data store
- Emails about auto healing events

23.1 Configure auto healing for data store

To enable auto healing for data store:
1. Go to your Control Panel > Admin > Settings menu.
2. Click the Data Stores icon. You'll see a list of the data stores on your system.
3. Click the Actions button next to the data store you want to change, then click Edit.
4. Move the Auto Healing slider to the right to enable auto healing.
5. Click the **Save Data Store** button to finish.

To disable auto healing for data store:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Data Stores** icon. You'll see a list of the data stores on your system.
3. Click the **Actions** button next to the data store you want to change, then click **Edit**.
4. Move the **Auto Healing** slider to the left to disable auto healing.
5. Click the **Save Data Store** button to finish.

AutoHealing script is performed every 1 hour on each IS Datastore marked as auto_healing. Auto healing repairs disks one by one for each datastore, where it is enabled. There are several conditions, when auto healing will not proceed:

- if diagnostics fails
- if there are active repair or rebalance transactions
- if there are no degraded disks in datastore
- auto healing will not try to repair disk if its last repair transaction is failed in last 24 hours

23.2 Emails about auto healing events

You will receive the following email notifications about auto healing process:

- hourly emails about degraded vdisks
- if auto healing is impossible because of issues with Integrated Storage, you will receive an email with the following text: "Degraded vdisks found, but there are problems with Integrated Storage and Auto Healing will not start until you log in and investigate/repair the problems. "
- if auto healing is running, you will receive an email with the following text: "Degraded vdisks found" and auto healing will start processing the list of degraded vdisks.
24 SSD Caching

SSD caching increases disk I/O performance. It uses NVMe or Solid State Disks (SSDs) to cache frequently used data.

There are two basic cache modes of operation:

- **Write-through**: improves read I/O performance, no impact on reliability
- **Write-back**: improves both read and write I/O performance, small chance of data loss.

**On this page:**

- [Enable caching for data store](#)
- [Enable caching for disk](#)

Be aware that if you have automatic failover of VSs and write-back caching mode configured, then there is a risk of some data loss. In the case of a compute resource failure with write-back mode configured and failover enabled, the cache will be ‘forgotten’ so that the VS can be automatically started up again on another node. You must explicitly accept this constraint when configuring write-back mode. If automatic failover is not enabled, then it is not possible to start a VS with an old cache until either:

a) The compute resource comes back online
or
b) The cache drive is physically moved to a new compute resource and the cache settings are adjusted (requires support assistance)
or
c) The cache is explicitly forgotten from the CLI.

**Requirements**

- KVM CloudBoot compute resource only
- At least one spare fast drive per compute resource
- Reboot upgrade to OnApp Storage version 4.2.0 is needed

Caching can be configured on two levels: per data store and per disk.

### 24.1 Enable caching for data store

Make sure that you have the *Override Integrated Storage cache settings* permission enabled to be able to edit the default data store cache settings per VS.
To configure caching for data store:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Data Stores icon. You'll see a list of the data stores on your system.
3. Click the Actions button next to the store you want to change, then click Edit.
4. Move the Integrated Storage Cache enabled slider to the right to enable caching.
   Configure the following parameters:
   - set cache line size (in KB) - the underlying size of I/O used by the cache. Default value is 512 KB.
   - specify migration threshold (in MB) - the amount of memory to use for moving data to and from the cache device. Default value is 128 MB.
   - set cache size (in %) - the size of the cache as a percentage of the vDisk size. Default value is 10%.
5. Click the Save Data Store button to finish.

After editing the Cache settings, it is required to reboot your Virtual Server to apply the settings.

These settings are applied to all vdisks within the configured data store.

### 24.2 Enable caching for disk

To configure caching for disk:

1. Go to your Control Panel > Admin > Settings > Disks menu.
2. Click the Actions > Edit button next to the required disk.
3. Move the Override Integrated Storage Cache settings and Integrated Storage Cache enabled sliders to the right to enable caching.
4. Specify cache mode: Write-through or Write-back.
5. Set cache line size (in KB).
7. Set cache size (in %).
8. Click the Save Disk button.

After editing the Cache settings, it is required to reboot your Virtual Server to apply the settings.

Also you can assign disk to Cache during CloudBoot compute resource creation. For more information refer to the Create CloudBoot Compute Resource section.

After you assign disks to the cache, it is required to update the configuration by running the SAN controller service.
This can be done from CLI on this compute resource by running the following command:

```
/etc/init.d/SANController updateconfig
```
25 Using NVMe on KVM

You can use NVMe (Non-Volatile Memory Express) both as a storage and cache device on CentOS 6/7 KVM compute resources. However, since NVMe benefits most from a direct connection between internal physical server peripherals, we recommend using NVMe as a cache device and SATA SSD as a storage device.

NVMe SSD has an advantage over older storage protocols. NVMe speeds up operations and reduces CPU overhead that allows achieving lower latency and higher IOPS. NVMe also provides a more efficient mechanism for queuing messages. For instance, SAS and SATA support only one I/O queue at a time. The SAS queue can include up to 256 outstanding commands and the SATA queue up to 32. NVMe can support up to 65535 queues and up to 64000 commands per queue.

You can use NVMe as a storage device but it may cause some performance issues because of the Integrated Storage overhead; network and driver latency. Depending on the testing method, hardware, and network configuration, the expected performance drop in linear speeds may be up to 17%. However, it can be barely noticeable on production workloads.

OnApp doesn't provide support for NVMe Over Fabrics at the moment. When the NVMe Over Fabrics support is announced, it will provide a huge performance boost to Integrated Storage.
26 Epochs for Data Stores

Epochs is a mechanism to decrease VDisk repair time. It works by periodically flushing (e.g. every 4 hours) a changed block bitmap of an online VDisk on the backend. If the VDisk needs to be repaired, the latest common epoch between the master and the slave is determined and then all subsequent epochs on the master are collapsed onto the latest common epoch bitmap. The resulting bitmap is effectively a diff bitmap, so only the blocks indicated into that bitmap need to be re-synchronized. If any error occurs during VDisk repair, the epochs optimization is disabled and VDisk repair switches to full re-synchronization.

To enable epochs for a data store:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Data Stores icon. You'll see a list of the data stores on your system.
3. Click the Actions button next to the store you want to change, then click Edit.
4. On the following page move the Epoch slider to the right to enable epochs.
5. Click the Save Data Store button to finish.
27 Kernel Crash Dumping Mechanism on KVM Compute Resources

Kdump is a kernel crash dumping mechanism designed for saving the system's memory contents for later analysis. It is especially helpful for the purposes of debugging when you want to discover the cause of a crash. At OnApp, Kdump feature allows you to create and collect kernel crash dumps on the CloudBoot compute resources. This feature is implemented for CentOS6 KVM and CentOS7 KVM compute resources only.

27.1 Enable KDump

The feature availability is controlled by the `crashkernel` kernel option for the particular compute resource in its /tftpboot/pxelinux.cfg/<MACADDR> file. The `crashkernel` option should be added to the config file manually.

To enable Kdump:

1. Access the /tftpboot/pxelinux.cfg/<MACADDR> file and set the amount of memory to "crashkernel=auto".

   ```
   # cat /tftpboot/pxelinux.cfg/<MACADDR>
   default centos7-ramdisk-kvm
   label centos7-ramdisk-kvm
   kernel images/centos7/ramdisk-kvm/vmlinux
   append initrd=images/centos7/ramdisk-kvm/initrd.img
   NFSNODEID=<NFSNODEID> NFSROOT=<NFSROOTIP>:/tftpboot/export/centos7/kvm
   CFGROOT=<CFGROOTIP>:/tftpboot/images/centos5/diskless/snapshot
   ADDTOBRIDGE=mgt pcie_aspm=off selinux=0 cgroup_disable=memory
   net.ifnames=0 biosdevname=0 NTPSERVER=<CFGROOTIP> crashkernel=auto
   ```

2. Reboot the compute resource.

Dump(s) are automatically generated if the compute resource crashes (with the enabled kdump). You can view the generated file in NFS resources in the /data/clb-hv-crash directory:

   ```
   # ls -l /data/clb-hv-crash
   <HVIPADDR>-2018-04-16-20:32:49
   <HVIPADDR>-2018-04-16-21:15:26
   ```

Note that the feature requires about 550 MB of extra RAM space on a compute resource:

- 128 MB of RAM is reserved to capture a kernel crash dump.
- The Kdump service creates custom `initramfs/initrd` image which is about 20 MB.
- The `/boot`'s content (kernel and initrd) requires extra 400 MB.
28 Manual Integrated Storage Network Configuration

If you have a complex network configuration that is not compatible with the way Integrated Storage network works, but you still want to use IS, you may configure networks manually.

Use these instructions only if you are absolutely certain about what manual network setup you need.

On this page:

• IS network configuration with one network interface
• IS network configuration with network interfaces bonding

See also:
• Network Health Check
• Manage CloudBoot Compute Resource Devices
• Manage Static Compute Resource Devices

28.1 IS network configuration with one network interface

If you have one interface that you wish to assign to SAN network, following this instruction:

1. Unassign all network interfaces from the compute resource at Control Panel > Admin > Settings > Compute Resources > label of the compute resource > Tools > Edit hardware devices > set the Unassigned option for all network interfaces.
2. Reboot compute resource.
3. Prepare configuration in the Control Panel and collect the following data:
   - MAC address - to check it, go to Control Panel > Admin > Settings > Compute Resources > label of the compute resource > Tools > Manage Devices.
   - MTU - you may check it in the Integrated Storage Settings section.
   - SAN network bridge name - onappstoresan by default; you can change it by modifying option in onappstore.conf file on CP: /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf file:

```
cat << EOF > /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf
sanbridgename=<bridge name>
EOF
```

- <HV MAC> - MAC address of the compute resource's management NIC
- <bridge name> - SAN network bridge name

   - hostid - you can get it from the onappstore.conf file:
cat /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf | grep hostid

<HV MAC> - MAC address of the compute resource's management NIC

  o Interface name - name of compute resource interface connected to SAN network

4. Access the compute resource via SSH.
5. Add and configure bridge:

   brctl addbr <bridge name>
   brctl stp <bridge name> off
   ifconfig <bridge name> 10.200.<hostid>.254 netmask 255.255.0.0
   ifconfig <bridge name> up

<bridge name> - SAN network bridge name
<hostid> - host ID from the onappstore.conf file

6. Set firewall rules for SAN network 10.200.0/16 and multicast channels 224.0.0.0/8:

   iptables -D FORWARD -j ACCEPT -s 10.200.0.0/16 -d 10.200.0.0/16
   iptables -A FORWARD -j ACCEPT -s 10.200.0.0/16 -d 10.200.0.0/16
   iptables -D FORWARD -j ACCEPT -s 10.200.0.0/16 -d 224.0.0.0/8
   iptables -A FORWARD -j ACCEPT -s 10.200.0.0/16 -d 224.0.0.0/8

7. Set NOTRACK for bridge:

   iptables -t raw -D PREROUTING -i <bridge name> -j NOTRACK
   iptables -t raw -D OUTPUT -o <bridge name> -j NOTRACK
   iptables -t raw -A PREROUTING -i <bridge name> -j NOTRACK
   iptables -t raw -A OUTPUT -o <bridge name> -j NOTRACK

<bridge name> - SAN network bridge name

8. Disable rp filter at interface (which will be used for SAN) and bridge:

   sysctl net.ipv4.conf.<bridge name>.rp_filter=0
   sysctl net.ipv4.conf.<interface name>.rp_filter=0

<bridge name> - SAN network bridge name
<interface name> - name of compute resource interface connected to SAN network

9. Set arptables:

   arptables -A FORWARD -j ACCEPT -i <interface name>
   arptables -A FORWARD -j ACCEPT -o <interface name>

<interface name> - name of compute resource interface connected to SAN network
10. Set MTU:

```
ifconfig <bridge name> mtu <MTU>
ifconfig <interface name> mtu <MTU>
```

<bridge name> - SAN network bridge name
@interface name> - name of compute resource interface connected to SAN network
<MTU> - MTU of a compute resource

11. Add interface to the bridge:

```
brctl addif <bridge name> <interface name>
```

<bridge name> - SAN network bridge name
@interface name> - name of compute resource interface connected to SAN network

12. Set up multicast at bridge and interface:

```
echo 2 > /sys/class/net/<interface name>/brport/multicast_router
echo 2 > /sys/class/net/<bridge name>/bridge/multicast_router
echo 1 > /sys/class/net/<bridge name>/bridge/multicast_querier
echo 0 > /sys/devices/virtual/net/<bridge name>/bridge/multicast_snooping
```

<bridge name> - SAN network bridge name
@interface name> - name of compute resource interface connected to SAN network

13. Bring interface up:

```
ifconfig <interface name> up
```

@interface name> - name of compute resource interface connected to SAN network

14. Finally, restart network and SAN service:

```
systemctl restart network.service
/etc/init.d/SANController stop
/etc/init.d/SANController start
```

Once network and SAN service is restarted, your network is configured for Integrated Storage and can be used further.
28.2IS network configuration with network interfaces bonding

In case you have network interfaces bonding, you should prepare a bond interface first. To configure a complex network with bonding for Integrated Storage manually, use the following instruction:

1. **Unassign all network interfaces from CP UI:** go to your Control Panel > **Admin** > **Settings** > **Compute Resources** > label of the compute resource > **Tools** > **Edit hardware devices** > set the Unassigned option for all network interfaces.

2. **Reboot** compute resource.

3. Prepare configuration at CP and collect the following data:
   - **MAC address** - to check it, go to Control Panel > Admin > Settings > Compute Resources > label of the compute resource > Tools > Manage Devices.
   - **MTU** - you may check it in the Integrated Storage Settings section.
   - **SAN network bridge name** - onappstoresan by default; you can change it by modifying option in onappstore.conf file on CP:
     ```
     cat << EOF /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf
     sanbridgename=<bridge name>
     EOF
     ```
   - **SAN network bond device name** - onappstorebond by default, but you can change it by modifying option in onappstore.conf file on CP:
     ```
     cat << EOF /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf
     sanbondname=<bond name>
     EOF
     ```
   - **hostid** - you can get it from the onappstore.conf file:
     ```
     cat /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf | grep hostid
     ```
   - **Interface name1 Interface name2** - names of compute resource interfaces connected to SAN network

4. Access the compute resource via SSH and prepare config files for slave interfaces and bond device:
cat <<< EOF > /etc/sysconfig/network-scripts/ifcfg-<bond name>
  DEVICE=<bond name>
  TYPE=Bond
  NAME=<bond name>
  BONDING_MASTER=yes
  BOOTPROTO=none
  ONBOOT=yes
  BONDING_OPTS="mode=0"
EOF

cat <<< EOF > /etc/sysconfig/network-scripts/ifcfg-<interface1 name>
  DEVICE=<interface1 name>
  HWADDR=<interface1 mac>
  USERCTL=no
  BOOTPROTO=none
  ONBOOT=yes
  MASTER=<bond name>
  SLAVE=yes
EOF

cat <<< EOF > /etc/sysconfig/network-scripts/ifcfg-<interface2 name>
  DEVICE=<interface2 name>
  HWADDR=<interface2 mac>
  USERCTL=no
  BOOTPROTO=none
  ONBOOT=yes
  MASTER=<bond name>
  SLAVE=yes
EOF

systemctl restart network.service

<bond name> - SAN network bond device name
<interface1/2 name> - names of compute resource interfaces in bonding connected to SAN network

5. Add and configure bridge:

brctl addbr <bridge name>
brctl  stp <bridge name> off
ifconfig <bridge name> 10.200.<hostid>.254 netmask 255.255.0.0
ifconfig <bridge name> up

<bridge name> - SAN network bridge name
<hostid> - host ID from the onappstore.conf file

6. Set firewall rules for SAN network 10.200.0.0/16 and multicast channels 224.0.0.0/8:

iptables -D FORWARD -j ACCEPT -s 10.200.0.0/16 -d 10.200.0.0/16
iptables -A FORWARD -j ACCEPT -s 10.200.0.0/16 -d 10.200.0.0/16
iptables -D FORWARD -j ACCEPT -s 10.200.0.0/16 -d 224.0.0.0/8
iptables -A FORWARD -j ACCEPT -s 10.200.0.0/16 -d 224.0.0.0/8

7. Set NOTRACK for bridge:
iptables -t raw -D PREROUTING -i <bridge name> -j NOTRACK
iptables -t raw -D OUTPUT -o <bridge name> -j NOTRACK
iptables -t raw -A PREROUTING -i <bridge name> -j NOTRACK
iptables -t raw -A OUTPUT -o <bridge name> -j NOTRACK

<bridge name> - SAN network bridge name

8. Disable rp filter also at enslaved interfaces and <bond name>:

```sh
sysctl net.ipv4.conf.<bridge name>.rp_filter=0
sysctl net.ipv4.conf.<bond name>.rp_filter=0
sysctl net.ipv4.conf.<interface1 name>.rp_filter=0
sysctl net.ipv4.conf.<interface2 name>.rp_filter=0
```

<bridge name> - SAN network bridge name
<bond name> - SAN network bond device name
<interface1/2 name> - names of compute resource interfaces in bonding connected to SAN network

9. Set arptables and ebtables (you can get <bond mac> running ifconfig <bond name>):

```sh
arptables -A FORWARD -j ACCEPT -i <bond name>
arptables -A FORWARD -j ACCEPT -o <bond name>
arptables -A FORWARD -j ACCEPT -i <interface1 name>
arptables -A FORWARD -j ACCEPT -o <interface1 name>
arptables -A FORWARD -j ACCEPT -i <interface2 name>
arptables -A FORWARD -j ACCEPT -o <interface2 name>
ebttables -t broute -A BROUTING -s <bond mac> -i <bond name> -j DROP
ebttables -t broute -A BROUTING -s DE:AD:BE:EF:<host id>:0/ff:ff:ff:ff:ff:ff:ff:0
   -i <bond name> -j DROP
```

<bond name> - SAN network bond device name
<interface1/2 name> - names of compute resource interfaces in bonding connected to SAN network

10. <bridge name> - SAN network bridge name
<bond name> - SAN network bond device name
<interface1/2 name> - names of compute resource interfaces in bonding connected to SAN network

11. Set MTU:

```sh
ifconfig <bridge name> mtu <MTU>
ifconfig <bond name> mtu <MTU>
ifconfig <interface1 name> mtu <MTU>
ifconfig <interface2 name> mtu <MTU>
```

<bridge name> - SAN network bridge name
<bond name> - SAN network bond device name
<interface1/2 name> - names of compute resource interfaces in bonding connected to SAN network
network
<MTU> - MTU of a compute resource

12. Add interface to the bridge:

   ```
   brctl addif <bridge name> <bond name>
   ```

   `<bridge name>` - SAN network bridge name
   `<bond name>` - SAN network bond device name

13. Set up multicast at bridge and interface:

   ```
   echo 2 > /sys/class/net/<bond name>/brport/multicast_router
   echo 2 > /sys/class/net/<bridge name>/bridge/multicast_router
   echo 1 > /sys/class/net/<bridge name>/bridge/multicast_querier
   echo 0 > /sys/devices/virtual/net/<bridge name>/bridge/multicast_snooping
   ```

   `<bridge name>` - SAN network bridge name
   `<bond name>` - SAN network bond device name

14. Bring interface up:

   ```
   ifconfig <interface name> up
   ```

   `<interface name>` - name of compute resource interface connected to SAN network

15. Finally, restart network and SAN service:

   ```
   systemctl restart network.service
   /etc/init.d/SANController stop
   /etc/init.d/SANController start
   ```

Once network and SAN service is restarted, your complex network with network interfaces bonding is configured for Integrated Storage and can be used further.