OnApp Cloud 6.7 Storage Home
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1 Features

OnApp Storage is designed for cloud workloads. It provides high performance, resilience, and cost benefits in comparison to open-source SANs.

**Hardware Independence**
No vendor lock for storage devices and network cards built in, although our software cannot work with any hardware.

**Redundancy and Striping**
To satisfy the need for redundancy, we can set up to four physical mirrors for a virtual vDisk. For performance needs, we can use up to four stripes for a virtual disk.

**Caching**
You can use high-speed storage devices as cache for HDD data store to obtain high capacity and optimal speed for virtual servers.

**Local Read Path**
Set up a data store to always have at least one mirror of your virtual disk on the same compute resource, which ensures less network load and better performance.

**Hyper-Converged Infrastructure**
The disks from servers in a compute zone can be used by other servers within this compute zone and rebalanced to other servers without downtime. Additionally, you can increase the size of your data store or replace malfunctioned disks with new disks without virtual server downtime.

**Snapshots**
Snapshots allow you to make up to three COW (copy-on-write) snapshots of a vDisk and are used to make backups without interrupting the work of a virtual server.

**Faster Repair with EPOCH**
The EPOCH feature ensures even faster repair of vDisks in case it got degraded due to a hardware disk failure or compute resource reboot. It uses bitmaps to trace changed blocks and transfers only them during the repair process.

**Scalability**
OnApp Storage has a modular design - you can add additional storage capacity when you need it and without having to rebuild the whole SAN. You can add multiple disks to any servers connected to the platform.

**Flexibility of Software Defined Storage**
You can organize your hardware by speed or location and create data stores with different settings (mirrors stripes and caching) for various purposes (high performance of virtual servers or slow performance but with great redundancy and disk size). Additionally, you can easily migrate your virtual disks from one compute resource to another one.

**Rebalance**
Allows manual control of the location of virtual disk parts. You can move disk parts to other physical or hardware disks or compute resources, as well as distribute them within the cloud.

**Diagnostic**
Most issues with IS can be detected and, basically, fixed with built-in diagnostic tools.

**Performance Benchmarks**
You can test the performance of your data store by means of built-in performance tests or use our repo with the performance test framework to run the tests by yourself.

**Open Source**
Integrated storage is built on top of open-source solutions, such as NBD and Device Mapper.  
https://github.com/OnApp/  
https://github.com/OnApp/dm-mirror_sync
2 Integrated Storage Architecture

OnApp Storage is a distributed SAN for cloud providers that allows you to turn your existing cloud infrastructure into a 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 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 Admin Guide.

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

- Architecture Requirements
- Architecture
- Examples of Architecture in Use
- Hardware Requirements
- Distributed Data Base

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

Integrated Storage is a distributed block storage system that uses existing commodity cloud hardware to meet the requirements of virtual servers.
The main components of the Integrated Storage are the following:

- Device mapper
- Network block device
- Custom API service
- Custom distributed DB

Integrated Storage uses many components to deliver data written and read by a virtual server to hardware storage devices and from storage devices back to virtual servers.

With the custom kernel module dm-mirror-sync, a device mapper splits a write or read request according to the number of mirrors or stripes of a vDisk. The dm-mirror-sync kernel module ensures the redundancy of the disk, storing several copies of the disk.

NBD (Network Block Device), an open-source protocol, transfers data from the device mapper to NBD servers through the network. NBD servers (rsapid instances) are hosted on IS controllers. They are lightweight virtual servers that consist of BusyBox and a minimal set of binaries optimized for I/O.

The device mapper passes hardware storage devices to IS controller virtual servers to ensure the smooth and uninterrupted hot plugging of new disks.

Thus, the virtual server is entirely independent of the physical disk, provided that the virtual server and the physical disk are in the same compute zone.

**Figure 1. Integrated Storage Architecture**

**2.2.1 Configuration**

Virtual servers, device mappers, and NBD servers are configured through a single configuration file `/onappstore/onappstore.conf`. It is located on all compute resources and backup servers with the enabled Integrated Storage.

The `/etc/init.d/SANController` service ensures the work of virtual servers, that is, Integrated Storage controllers, while the `/etc/init.d/storageAPI` service is used for API.

After the `/etc/init.d/storageAPI` service starts up, API listens on 8080 port. Then, the IS can be configured through API.
2.2.2 Abstractions

Compute zones can be used to create different tiers of service and have data stores and networks attached to them. The combination of compute resources, data stores, and network groups can be used to create private clouds for customers.

Abstractions are used to configure IS. There are two types of nodes:

- Front-end nodes - compute resources and backup servers
- Back-end nodes - hardware disks

Data stores are a joint of back-end nodes that work as a single space for virtual disk creation and can be configured to use many stripes or mirrors.

For the creation of a data store, back-end nodes should be within the same compute zone and servers should be connected to the same SAN network.

Virtual disks are created within the data store that has back-end nodes as members. Also, data can be written to a virtual disk or can be read if a vDisk is online only. vDisks can be made online on a compute resource and attached to a virtual server or on a backup server to take a backup.

Figure 2. Applied Abstraction

All compute resource backup servers and IS controllers within a compute zone share the same distributed database (DDB). For more information on the distributed database, refer to the Distributed Data Base page.

2.2.3 Network

A SAN network ensures the work of the IS. Compute resources and backup servers are managed through a management network from CP.

Figure 3. Network
2.2.4 API

- API is represented by the Python web library and a bunch of scripts.
- API supports GET, PUT, POST, DELETE requests in JSON format.
- API redirects a request to the node according to the UUID within the compute zone.
- API request example:

  ```bash
curl 192.168.1.2:8080/is/Datastore/n3qlhk1vypdr5s
  ```

The following diagram shows how an API call is redirected. Control Panel refers to a backup server to get information on the node with its ID. The backup server uses /onappstore/DB and finds the IP of the compute resource, where the node is located, and redirects the request to the compute resource. The compute resource responses, and the backup server sends this response to CP.

**Figure 4. API Call Redirection**

For more information on benchmarks, refer to the [Performance Benchmarks](#) page.
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.

```
<table>
<thead>
<tr>
<th>Datastores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back-end</td>
</tr>
<tr>
<td>Hypervisor</td>
</tr>
<tr>
<td>Storage Devices</td>
</tr>
</tbody>
</table>
```

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.

```
<table>
<thead>
<tr>
<th>Datastores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back-end</td>
</tr>
<tr>
<td>Hypervisor</td>
</tr>
<tr>
<td>Storage Devices</td>
</tr>
</tbody>
</table>
```

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.
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. You should also prepare a separate network for SAN. In Integrated Storage and Cash, you can use SCSI, SATA, and NVMe discs supported by the current CentOS version.

The minimum disk capacity is 20 GB. Disk must meet requirements: can be formatted with mkfs.xfs, mounted, and our binary onapp_scsi_id returns not empty ID_SERIAL=, at centos7 64bit environment.

The following table shows the ratio of drives and compute resources required to support different configurations. It is possible to have fewer compute resources, but this will reduce a distributed storage system efficiency.
Hypervisor should have at least 200 MB RAM per hard drive.

<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>
</tr>
</thead>
<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>2</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>4</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>4</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>8</td>
</tr>
<tr>
<td>4R-0S</td>
<td>4</td>
<td>0</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>4</td>
</tr>
<tr>
<td>4R-2S</td>
<td>4</td>
<td>2</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>8</td>
</tr>
<tr>
<td>4R-4S</td>
<td>4</td>
<td>4</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>16</td>
</tr>
</tbody>
</table>

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 8 TB
There is no minimum required size for a data store member, however, the smallest template for a single virtual server has a 7 GB 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 2 TB.

2.5 Distributed Data Base

All compute resource backup servers and IS controllers within compute zone share the same distributed database (DDB).

It is tmpfs volume mounted at /onappstore/DB folder. The size of the database can be configured in /onappstore/onappstore.conf by changing parameter dbsize=256.

The database is created and populated with data during the IS startup process inside the SAMController service as shown below.
DDB is FS based data stored in folders as text files.

### 2.5.1 [FS_DB] Datastore Subdir

```
/onappstore/DB/Datastore: jdhbxnvc7zr86 /onappstore/DB/Datastore/jdhbxnvc7zr86:
  description members name overcommit replicas sector_size stripes uuid vdisks
/onappstore/DB/Datastore/jdhbxnvc7zr86/members:
  1308341613 1638717502 3789723832 3830220270 4284135282 976785243
/onappstore/DB/Datastore/jdhbxnvc7zr86/vdisks:
  awoeuctr854pmd qksozqw8yaji l03obar8v249sz n8k74ulq5my1w2 r6vpuag910syn4 t2sb e73qmki1du
```

### 2.5.2 [FS_DB] v2 Subdir

This folder contains information about vDisks in JSON format it also stores metadata about these files. It is a new way of storing data inside DDB, but for now, it is only for snapshot information.

```
ls /onappstore/DB/v2/VDisk/
12kaws896bte4y.json 12kaws896bte4y.json.mtd 243zhavwnfb6p.json 243zhavwnfb6p.json.mtd q9c7ny6fa842g.json q9c7ny6fa842g.json.mtd
```

### 2.5.3 [FS_DB] locks Subdir

This folder holds locks for resources (nodes, data stores, vDisks, etc.) to prevent transaction interference and race conditions. In general, operation files are not stored here for a long time. Accordingly, many files inside this folder may indicate problems or overload. Locks are moved from /tmp folder to DB for better performance and reliability.

### 2.5.4 [FS_DB] Node Subdir

```
/onappstore/DB/Node:
  1152875907 1308341613 1638717502 1855767384 3789723832
  3830220270 4284135282 976785243
```

```
/onappstore/DB/Node/1308341613:
```
backupchannel datastore member freespace hblt hostid ipaddr lastping model nodestat
us performance revision serial size status utilization uuid vdisks vendor version
/onappstore/DB/Node/1308341613/vdisks:
awoeuctr854pmd n8k74ulq5my1w2 t2sbe73qmki1du

2.5.5 [FS_DB] VDisk Subdir
/onappstore/DB/VDisk:
awoeuctr854pmd qksozqwm8yaji l03obar8v249sz n8k74ulq5my1w2 r6vpuag9i0syn4 t2sb
e73qmki1du
/onappstore/DB/VDisk/awoeuctr854pmd:
datastore description highest_gen_count memberinfo membership name replicas sector
size snapshot snapshots st_mems st_size uuid
/onappstore/DB/VDisk/awoeuctr854pmd/memberinfo:
1308341613 1638717502 4284135282 976785243
/onappstore/DB/VDisk/awoeuctr854pmd/memberinfo/1308341613:
frontend membership_gen_count nodestatus numkeys port seqno snap_limit st_mem
status
.....
/onappstore/DB/VDisk/awoeuctr854pmd/snapshots:
n8k74ulq5my1w2 t2sbe73qmki1du

DDB stores data about virtual objects used for IS configuration and management. Accordingly,
tmpfs are stored in RAM, so we store persistent data at disks attached to IS:
- Node metadata is stored at the node itself (file: STORAGENODE)
- Datastore metadata is stored at its members (file: DS-<UUID>)
- VDisk metadata stored at its members (file: vdisks/<UUID>.xml)

At startup, this persistent data is transferred to /onappstore/DB folder by the local update script.
SD daemon syncs it within compute zone via the multicast channel. Syncs are periodical 120-
sec timeout or at any metadata changing event like vDisk allocation or online.
3 Integrated 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.

3.1 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:

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

- 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.

3.2 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: \( \text{physical\_disk\_size} + \text{overcommit\_value\_in\_percentage} - \text{allocated\_space} \)

b) Formula without overcommit: \( \text{physical\_disk\_size} - \text{allocated\_space} \)
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).

### 3.3 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.

### 3.4 View Storage Node Details

#### 3.4.1 View 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.
   - **Storage Node IO statistics**
3.4.2 Get IP Address of Storage Node

SSH into the compute resource and run:

```bash
onappstore nodes | grep -A3 <node_id>
```

The output will look similar to:

```
Node: 0123456789
    status: ACTIVE
    IP addr: 10.10.10.10
    Role: BACKEND node
```

Where:

- **IP addr** - the node's IP

The procedure above is useful for clearing VS's errors:

*Failed to detect control path for vdisk*

If you need to know the actual device name, use the following script to receive information on each hard drive for each storage controller:

```bash
[root@10.10.100.101 ~]# diskhotplug list
Controller 0
  Slot 0 - /dev/sda
    (SCSIid:35000c5002065ee1c_9QJ7XBEK,NodeID:2308528827)
  Slot 1 - /dev/sdb
    (SCSIid:35000c500207afaac_9QJ7ZHJC,NodeID:539870777)
  Slot 2 - EMPTY
  Slot 3 - EMPTY
```

If you want to view all the details on a particular drive used for integrated storage, use `onapp_scsi_id`:

```bash
[root@10.10.100.101 ~]# onapp_scsi_id /dev/sda
ID_VENDOR=ATA
ID_REVISION=SN06
ID_MODEL=ST31000340NS
ID_SERIAL=35000c5002065ee1c
ID_SCSI_SERIAL=9QJ7XBEK
```

3.5 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.
3.5.1 Forget Storage Node via UI

To forget one 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.

3.5.2 Forget Storage Node via CLI

1. Check if 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:
     \[ \text{onappstore forget forgetlist=<UUID> vdisk_uuid=<VDISK_UUID} \]
   - To forget a node member from all VDisks:
     \[ \text{onappstore forgetfromall forgetlist=<UUID}> \]
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:
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
```

### 3.5.3 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.

### 3.6 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.

### 3.7 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**.

### 3.8 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**.
4 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).

4.1 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:

\[(1024 -128) = 896 \text{ MB for NBD device paths}\]

\[896 \div 4 = 224.\]
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 / 8 = 28 Linux virtual servers
- 224 / 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.

### 4.2 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:

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:
4.3 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
- Add disks
- Edit data store
- Delete 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.
The list of data store disks

4.4 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.
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.
   o Filter by performance - use this to filter the nodes available for inclusion in this data store by performance.

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.

### 4.5 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.

### 4.6 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.

### 4.7 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.
## 5 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 the size of Integrated Storage data store disks.

Starting with OnApp 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 a multiple of 5 between 5 and 100.

### 5.1 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](#)
- [VDisk Status Codes (insyncstatus)](#)

**See also:**

- [Add Disks to Integrated Storage Data Store](#)
- [Repair VS Disks Assigned to Integrated Storage Data Store](#)
5.1.1 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

5.1.2 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
Allocated space is the space that is allocated to vDisks. This space is equal to the size of all vDisk stripes on a back-end node.

Utilized space is the space that is used when data is written to a vDisk. The space the data consumes is reflected in the back-end node utilization.

Below you can see storage nodes and **Rebalance Disk** button, which allows to move the data from one node to another.

### 5.1.3 VDisk Status Codes (insyncstatus)

Each VDisk gives a status code which reflects its current status. This can be pulled using the `onappstore` command on any compute resource or backup server that is integrated storage enabled and part of the relevant compute resource zone:

```
onappstore diskinfo uuid=<UUID> filter=insyncstatus
```

Click here to see a list of the possible outputs

# vdisk sync statuses
OUT_OF_SYNC = 0
IN_SYNC = 1
MISSING_ACTIVE_MEMBERS = 2
MISSING_INACTIVE_MEMBERS = 3
MISSING_PARTIAL_MEMBERS = 4
MISSING_UNKNOWN_MEMBERS = 5
PARTIAL_MEMBERSHIP_GOOD_CONTENT = 6
PARTIAL_MEMBERSHIP_BAD_CONTENT = 7
MEMBERSHIP_GEN_COUNT_MISMATCH = 8

### 5.2 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.

### 5.3 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.

### 5.4 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.

#### 5.4.1 Repair VDisks from UI

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).

---

**5.4.2 Parallel VDisks Repairing in CLI**

Parallelrepairvdisks enables you to repair up to 10 degraded VDisks simultaneously in CLI directly on compute resource or backup server. It's recommended to run in 'screen':

Also, you may indicate what data store will be repaired first or indicate the sequence of data stores. To repair VDISks in CLI:

1. Log onto the compute resource via SSH.
2. Get the list of the degraded VDisk with the following command:

   ```bash
   getdegradedvdisks
   ```

3. Run the following command. To choose a number of parallel repairs, you can use the numthreads option. For example, to start five repairs at once, you should type numthreads=5.

   ```bash
   parallelrepairvdisks [datastores=DS_UUID1,DS_UUID2,...], [numthreads=<<1..10>>]
   ```

   Please note that it could increase the load on compute resources, so if your compute resources are highly loaded, you can run `parallelrepairvdisks` in 4-5 threads.

---

**5.4.3 Detect and Repair Out of Sync/Degraded VDisks**

If you login to any compute resource from the CP server as root for a zone, you can use:

- the `getdegradedvdisks` CLI tool tells you which VDisks are in a degraded path state and are repairable.
- the `parallelrepairvdisks` repairs up to ten VDisks in parallel.
- the `repairvdisk` tool repairs all VDisks, one after another. You can safely run this periodically, for example as a cron task regardless of whether there are degraded VDisks or not.

---

**5.5 Rebalance VDisks Assigned to Integrated Storage Data Store**

Rebalancing a VDisk assigned to the 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.
5.5.1 Rebalance 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 the current nodes).
6. Click Rebalance Disk button to start the process. The disk will be shown as degraded while the rebalancing is taking place.

5.5.2 Rebalance 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 host VDisk content for a stripe. The slave will be the destination drive where the content is copied to.
   
   ```
   onappstore repair uuid=<identifier>
   ```

5.6 Integrated Storage Disk Snapshots

During the backup process, we take a snapshot of the virtual disk to be backed up. The snapshot occupies 10% of the virtual disk size in the data store. Thus, in order to make a backup, you should have had a free space of at least 10% of virtual disk size at nodes where virtual disk is allocated.

Zombie Disks

Zombie disks are disks that do not show up in the OnApp database. Typically they are snapshots taken of a VS's disk that OnApp uses to make backups. They become zombie disks after a backup process completes or fails, and the system cannot remove them.
5.6.1 Clean Up Zombie Disk

To remove zombie disks you can use the "Some zombie disks found clean up option (Delete ALL)" in the Disk Health section:
https://yourwebsite.com/storage/3/health_checks#

If that fails, backend cleanup will be needed. This can be done from any compute resource or backup server in the zone.

1. Look up the zombie disk info:

   onappstore diskinfo uuid=<identifier> readable=true

   Then look up the "parent" line:

   parent = xxxxxxxxxxxx

   If the disk has the parent parameter, then it is a backup snapshot (zombie disk), and it is safe to remove it.

2. Once you have found the snapshot identifier, you can turn it off:

   onappstore offline uuid=<identifier>

   Turning off the disk may fail with an error.

Click here to see additional information

Sample error:

   [root@0.0.0.0.0 ~]# onappstore offline uuid=xxxxxxxxxxx
   result=FAILURE error=onappstore offlineVDisk xxxxxxxxx failed on frontend 2956989790 with error map: {} and optional error: API call failed for a subset of nodes. Failures: ["2956989790", u'Failed to detect device mapper node [/dev/mapper/4msa57bjlxxciz] disappear. out:, err:None']
   completion_time=51

   You can find the possible solution here.

   90% of the time, it fails to offline the disk because of the stale mount, device mappers, or stuck processes, which can be found and removed following the link provided.

   If the stuck process has a /bdev in the process line, it is best to open a support ticket.

   In the above error log, it actually gives you the identifier of the compute resource/backup server, where the issue is: frontend 2956989790

   To find which resource this is, run the following command on all compute resources/backup servers:

   onappstore getid | grep <frontend identifier>

   Example: onappstore getid | grep 2956989790

   This will output something like this on the correct resource:
Then, you need to ssh to that resource, or if you are on the same resource, you will need to check for the stuck processes, device mappers or mounts, as described in the document.

3. Once you have cleaned up all the stuck processes keeping the vDisk active, you may turn off the disk:

```
onappstore offline uuid=
```

4. Remove the zombie disk with the following command:

```
onappstore delete uuid=<identifier>
```

### 5.7 Replace Integrated Storage Disk Drive

Replacing an Integrated Storage (IS) disk drive is a step-by-step procedure to replace one drive with another. There are two methods that you can apply to replace an IS disk drive, either via UI or via CLI.

#### Before you begin

Ensure that all content on a storage node is redundant and no last copy of any existing virtual disk resides there. You can check it, using one of the following methods:

- **Storage Health Check** that is available at the Diagnostics page on your Control Panel UI or directly on a backup server or a compute resource where the drive should be replaced by running the `getdegradedvdisk` command.
- After you check the content on a storage node, you can follow one of the next procedures.

#### 5.7.1 Replace IS Disk Drive via UI

1. Forget a storage node that is the same disk drive you need to replace. Go to your Control Panel > Integrated Storage > Nodes menu. Click the Actions button for the required node and select Forget.

2. Unassign the disk drive from the Integrated Storage Controller:
   - Go to Settings > Compute Resources icon and click the label of a destination compute resource.
   - Click the Actions button, point to Resource Options, then select Manage Hardware Devices.
   - On the following page, click Edit Hardware Device Configuration.
   - In the Disks section, click Unassigned next to Status for a destination disk.
   - Click Next and then click Finish.

3. Replace the disk physically on the compute resource. If a compute resource does not support live disk hotplug from the physical layer, then other VDisks on other storage nodes on the compute resource have to be redundant, the virtual servers - migrated from the compute resource, and the compute resource - brought to maintenance.
4. Assign the new disk drive to the Integrated Storage Controller:
   - Go to Settings > Compute Resources icon and click a label of a destination compute resource.
   - Click Actions, point to Resource Options, then select Manage Hardware Devices.
   - On the following page, click Edit Hardware Device Configuration.
   - In the Disks section, click Assign and select the Format checkbox next to Status for a destination disk.
   - Click Next and then click Finish.

Sometimes when you try to assign drives to Storage Controllers the transaction fails with such errors as result=FAILURE error=Connection refused by the API on node 10.200.18.3. As a result, drives are missing inside Storage Controller. Click here to see more about the issue.

**Issue**

```
[root@10.0.20.31 ~]# diskhotplug assign 2 0 /dev/sde result=FAILURE error=Connection refused by the API on node 10.200.18.3.
[root@10.0.20.31 ~]# diskhotplug assign 2 1 /dev/sdf result=FAILURE error=Connection refused by the API on node 10.200.18.3.
[root@10.0.20.31 ~]# diskhotplug list Controller 0 Slot 0 - /dev/sda
   (SCSIid:36000c29ed0e339c68949d027388da6d2,NodeID:3664104930)
   Slot 1 - /dev/sdb
   (SCSIid:36000c29b6b9d4979512e409b7c2af7b7,NodeID:3860830766)
Controller 2 Slot 0 - /dev/sde
   (SCSIid:3500a075125445421_194825445421,NodeID:3713670630)
   Slot 1 - /dev/sdf
   (SCSIid:3500a075125444f04_194825444f04,NodeID:3926860425)
```

**Resolution**

It may be fixed by rebooting compute resources, however, you can resolve the issue without a reboot as follows:

Before, make sure that all VDisks are healthy because we need to stop affected storage VS/Controller.
Reduction in number of drives in the `/onappstore/onappstore.conf` file to the one that one controller can hold. For example, if your Storage Controller can hold two drives, leave only two drives in the file.

To reduce the number of drives in the file, you can use the `diskhotplug initNewController` command. This command will remove the extra drives and update the configuration file accordingly.

```
[root@10.0.20.31 ~]# diskhotplug initNewController
Complete: added new controllers [1]
```

Then you can back original `onappstore.conf` file from `/rw`

**Cause**
The error happens due to the difference in sequence numbering of Storage Controllers and their IP addresses. If 'Controller 1' is skipped and the system expects 'Controller 2' to have 10.200.18.3 IP address. But it only has 10.200.18.2 IP address and so the sequence is broken.
When you are finished, the storage node should be recognized by the Storage Controller. Telnet to the Storage Controller and check mount to see if xvdX or vdx is mounted correctly. If the node is mounted correctly, its OnApp UUID will be reported to other compute resources. After all compute resources are updated, you can add the node to the datastore.

To add the node to a destination datastore:

1. Go to **Integrated Storage > Data Stores**.
2. Click **Edit** next to the target data store.
3. Select a checkbox next to the node that you want to add and click **Save**.

### 5.7.2 Replace IS Disk Drive via CLI

1. Forget a storage node that is the same disk drive you need to replace. Run the following command to forget the node for all virtual disks:

   ```
   forgetfromall forgetlist=<UUID>
   ```

2. Unassign a particular disk drive from the Integrated Storage Controller by running the `diskhotplug` directly on the compute resource:

   ```
   HV> diskhotplug list #shows storage controllers and slots of disks
g. Slot 0 - /dev/sda
   (SCSIid:Z2AAL2M41BC14_Z2AAL2M4,NodeID:1337660081)
   ```

   The NodeID corresponds to the OnApp UUID and the SCSI ID corresponds to the result of `onapp_scsi_id`. You can check which Storage Controller the config maps to in the `storagenode` config files at `/onappstore/VMconfigs/...`

   ```
   HV> diskhotplug unassign <Controller> <slot> #deselects the disk drive, closes down the paths
   ```

3. Replace disk physically on compute resource.

   If a compute resource does not support live `diskhotplug` from the physical layer, then other VDisks on other storage nodes on the compute resource have to be redundant, the virtual servers - migrated from the compute resource, and the compute resource - brought to maintenance.

4. Assign the new disk drive to the Integrated Storage Controller, using the `formatandconfigure` and `diskhotplug` utilities.

   ```
   HV> formatandconfigure /dev/<sdX>
   HV> diskhotplug assign <controller> <free-slot> /dev/<sdX>
   ```

   When you are finished, the storage node should be recognized by the Storage Controller. Telnet to the Storage Controller and check mount to see if xvdX or vdx is mounted correctly. If the node is mounted correctly, its OnApp UUID will be reported to other compute resources. After all compute resources are updated, you can add the node to the datastore.

5. Run the following command on the current compute resource or on backup server:
OnApp Cloud 6.7 Storage Home

onappstore addnode uuid=<DS UUID> member_uuid=<NODE UUID>

Where:
- **DS UUID** - IS Datastore identifier
- **NODE UUID** - node ID identifier

See Also:
- Forget Storage Node
- Manage Compute Resource Devices
- Add Disks to Data Store
- Edit Integrated Storage Data Store

5.8 Detect Broken Disks and Pre-Failure State

Some physical disks degrade during their work. To prevent disk failure, we use the S.M.A.R.T. tool. Additionally, the **Diagnostics** page includes tools that collect information on a disk data store, so you can detect the issue and replace the disk before its complete failure. These tools help identify the cause of a disk failure.

Suppose no disk problems are detected in UI, but you have degraded disks or other issues periodically appearing at the **Diagnostics** page. In that case, it means that something is wrong, as not all disks have a S.M.A.R.T. check, and RAID controllers may not report S.M.A.R.T. errors. To find out if there are I/O errors, which testify to a failed disk, log in to the compute resource, which has suspicious disks, and run the `dmesg` command:

```bash
# dmesg | grep critical | grep I/O
```

**Example of I/O Errors**

```
blk_update_request: I/O error, dev sdf, sector 3907026080
[127497.911003] sd 0:0:5:0: [sdf] FAILED Result: hostbyte=DID_OK
driverbyte=DRIVER_SENSE
[127497.911019] sd 0:0:5:0: [sdf] Sense Key : Aborted Command [current]
[127497.911029] sd 0:0:5:0: [sdf] Add. Sense: Logical block guard check failed
[127497.911037] sd 0:0:5:0: [sdf] CDB: Read(32)
[127497.911045] sd 0:0:5:0: [sdf] CDB[00]: 7f 00 00 00 00 00 18 00 09
 20 00 00 00 00
[127497.911052] sd 0:0:5:0: [sdf] CDB[10]: e8 e0 7c a0 e8 e0 7c a0 00 00 00 00 0
```

If a disk fails, complete the following steps via UI or CLI:

1. Find the node ID with S.M.A.R.T. errors or I/O errors (use the **diskhotplug list** on the compute resource to map the `/dev/XXXX` device to the required node ID).
2. **Rebalance all virtual disks** from the detected node.
3. **Forget the node** from the Integrated Storage controller:
4. **Unassign the disk** from the IS controller.
5. **Replace the disk physically on the compute resource** if it supports diskhotplug.
6. **Assign a new disk** to the IS controller.
7. **Add the new disk to the data store.**
8. **Repair the disks** in case any degradation occurs during the process.
9. Rebalance virtual disks to a new node.
6 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.

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
7 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 on the page.

The Diagnostics page 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 < 2 GB free)
- Snapshot and vDisk zombies/orphans

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

- Check and clear old transaction files.
- Repair vDisks.
- Repair degraded vDisks in a data store zone.
- Check that all compute resources 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 compute resources are all on the same version of OnApp.
- Check that the failover settings are set to the minimum recommended value of 2mins + if IS and failover are enabled.

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

7.1 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

7.1.1 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)tripe *(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>
</tbody>
</table>
### Diagnostics

<table>
<thead>
<tr>
<th>Details</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disks in other degraded states</td>
<td>No repair action available</td>
</tr>
<tr>
<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>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>Shows the list of stale cache volumes.</td>
<td>No repair action available</td>
</tr>
<tr>
<td>Disks with inactive cache</td>
<td>No repair action available</td>
</tr>
<tr>
<td>Shows the list of disks within active cache.</td>
<td>No repair action available</td>
</tr>
</tbody>
</table>

### 7.1.2 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 <strong>Rebalance</strong> link in Actions column leading to list of disks located on the node, so that the 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 <strong>Repair</strong> action will forget the content of one of the VDisks that is redundant and in sync.</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>Details</td>
<td>Action</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Missing drives</td>
<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>
</tr>
<tr>
<td>Extra Drives</td>
<td>The drives that are disk-hotplugged into the system.</td>
<td>No repair action available from UI.</td>
</tr>
<tr>
<td>Inactive controllers</td>
<td>The list of controllers that cannot be reached but the host compute resource is responding.</td>
<td>Restart the controller.</td>
</tr>
<tr>
<td>Unreferenced NBDs</td>
<td>The list of NBD data paths that are active but not referenced by a device mapper.</td>
<td>To fix, schedule a CP transaction which will try to clean up the unreferenced NBDs by disconnecting from the frontend. Delete all.</td>
</tr>
<tr>
<td>Reused NBDs found</td>
<td>The list of multiple uses of the same NBD connection.</td>
<td>No repair action available from UI.</td>
</tr>
<tr>
<td>Dangling device mappers found</td>
<td>The list of device mappers that are not in use.</td>
<td>Click the <strong>Clean all</strong> 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.</td>
</tr>
<tr>
<td>S.M.A.R.T.</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>- 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- For MegaRAID controllers, please add the following line to /onappstore/onappstore.conf file on each Cloudboot Compute Resource: devhealthopt=[GENTYPE:sat+megaraid,0</td>
<td>SCANOPT:-d sat+megaraid,0</td>
</tr>
<tr>
<td></td>
<td>- For other controllers, please check the smartmontools page or contact OnApp support.</td>
<td></td>
</tr>
</tbody>
</table>
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.

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.

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.

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.

The list of CloudBoot compute resources and their storage versions.

Update CloudBoot compute resources via the reboot or live upgrade procedure for them to have identical storage versions.

Indicates that all CloudBoot compute resources have identical storage versions.

No repair action is required.

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.
7.2.1 Run 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.

7.2.2 View Results of 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.

7.2.3 Delete Diagnostics

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.

### 7.3 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>
<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</td>
</tr>
</tbody>
</table>
Content is not uniformly distributed within compute resources

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.

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.

Use **rebalance** to redistribute the content between nodes so that each node has the same amount of free space which is equal to the average value.

Some Virtual Servers are not placed in an optimal way

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 "Local Read Path" there.

Use **migrate** option to migrate the virtual server to the compute resource where its disks are located.

7.3.1 Automated Content Rebalancing

Automated content rebalancing is now provided through diagnostics UI for IS. Below you can see how automated content rebalancing works:

- Phase 1: Co-locate stripes or distribute content evenly
- Phase 2: Balance load across compute resources
- Phase 3: Balance load across drives with a compute resource
- Phase 4: Migrate VSs to optimal content location (read—local path enabled)

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

7.4 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 Status</th>
<th>POST types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk Health:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>URL</td>
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<td>Response Status</td>
<td>POST types</td>
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<tr>
<td>on App Cloud 6.7 Storage Home</td>
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<td>URL</td>
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<td>Response Status</td>
<td>POST types</td>
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<td>-------------------------------------------------------------------</td>
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</tr>
<tr>
<td>s.json -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td>zombie_snaps</td>
<td>200/204</td>
<td>delete ALL</td>
</tr>
<tr>
<td>1. curl -i -X GET -u admin:password <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>2. 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>
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</tr>
</tbody>
</table>
Drive Health:

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

2. curl -i -X POST -d
   '{"node_id":911788171}' -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partial_nodes/repairs.json
   -H 'Accept: application/json' -H 'Content-type: application/json'

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

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>POST types</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 'Content-type: application/json'</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 3. curl -i -X POST -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/stale_cache_volumes/repair_all.json
   -H 'Accept: application/json' -H 'Content-type: application/json' |                         |                  |          |

Drive Health:

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

2. curl -i -X POST -d
   '{"node_id":911788171}' -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partial_nodes/repairs.json
   -H 'Accept: application/json' -H 'Content-type: application/json'

curl -i -X GET -u admin:password
http://onapp.test.com/storage/:hypervisor_group_id/health_check/inactive_nodes.json
-H 'Accept: application/json' -H 'Content-type: application/json'

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

2. curl -i -X POST -d
   '{"node_id":911788171}' -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/delayed_ping_nodes/repairs.json
   -H 'Accept: application/json' -H 'Content-type: application/json'

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

2. curl -i -X POST -d
   '{"node_id":3857498339}' -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/high_utilization_nodes/repairs.json
   -H 'Accept: application/json' -H 'Content-type: application/json'

<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>POST types</th>
<th>Status</th>
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</table>
| curl -i -X GET -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/partial_nodes.json
   -H 'Accept: application/json' -H 'Content-type: application/json' | partial_nodes           | 200/204    | Repair ID |
| curl -i -X GET -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_check/inactive_nodes.json
   -H 'Accept: application/json' -H 'Content-type: application/json' | inactive_nodes          |          | no repair action available |
| curl -i -X GET -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/delayed_ping_nodes.json
   -H 'Accept: application/json' -H 'Content-type: application/json' | delayed_ping_nodes      | 200/204   | repair ID |
| curl -i -X GET -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/high_utilization_nodes.json
   -H 'Accept: application/json' -H 'Content-type: application/json' | high_utilization_nodes | 200       | rebalance button just leads to disks page |
| curl -i -X GET -u admin:password
   http://onapp.test.com/storage/:hypervisor_group_id/health_checks/out_of_space_nodes.json
   -H 'Accept: application/json' -H 'Content-type: application/json' | out_of_space_nodes      | 200/204   | repair ID |
<table>
<thead>
<tr>
<th>URL</th>
<th>ID</th>
<th>POST types</th>
<th>Response STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. curl -i -X POST -d '{&quot;hypervisor_id&quot;:146, &quot;id&quot;:0}' -u admin:password <a href="http://onapp.test.com/storage/:hypervisor_group_id/health_checks/inactive_controllers/repairs.json">http://onapp.test.com/storage/:hypervisor_group_id/health_checks/inactive_controllers/repairs.json</a> -H 'Accept: application/json' -H 'Content-type: application/json'</td>
<td></td>
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<tr>
<td>URL</td>
<td>ID</td>
<td>POST types</td>
<td>Response Status</td>
</tr>
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</tr>
<tr>
<td>Content Balance:</td>
<td>uniform_node_capacity</td>
<td>200</td>
<td>No repair action available from UI.</td>
</tr>
<tr>
<td>URL</td>
<td>ID</td>
<td>Response STATUS</td>
<td>POST types</td>
</tr>
<tr>
<td>-------------------------------------------------------------------</td>
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<td>---------------------------------------</td>
</tr>
<tr>
<td>application/json -H 'Content-type: application/json'</td>
<td>virtual_machine_placement_optimization</td>
<td>200/204</td>
<td>repair ALL -&gt; local_read_policy(migrate)</td>
</tr>
</tbody>
</table>
8 Compute Resources

8.1 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 your Control Panel > Admin > Settings menu.
2. Click the Configuration icon.
3. Click the System tab and in the OnApp Storage section, move the 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 page.

8.1.1 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

8.1.1.1 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, in maintenance mode, or locked (means that some of the services are yet to be started; this status appears during hot migration or when starting a compute resource)
- **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 the 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.

---

8.1.1.2 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 select **Hardware Info**. Also, you can click the label of a specific compute resource, then click the **Actions** button, point to **Resource Options**, and select **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.

### 8.1.2 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:
  a. Go to **Settings > Configuration > System**.
  b. In the OnApp Storage section, move **Enable OnApp Storage** slider to the right to enable the OnApp storage on the cloud.

#### 8.1.2.1 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, in maintenance mode, or locked (means that some of the services are yet to be started; this status appears during hot migration or when starting a compute resource)
- **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.

---

**8.1.2.2 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, 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)
8.1.2.3 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
8.1.3 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:
   - **Label** - enter a compute resource label
   - **IP Address** - add an IP address
   - **Compute Resource Type** - choose a compute resource type (KVM)
   - **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
   - **Backups IP address** - add a provisioning network IP address
   - **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
   - **Enabled** - move the slider to the right to enable a compute resource. Compute resources that are not enabled cannot be used to host VSs
   - **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 failover on this compute resource (failover is automatic VS migration to another compute resource if this one goes down)
   - **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 Power Cycle compute resource option, which will execute the entered command, will appear at Admin > Settings > Compute Resources > label of a compute resource > Actions > Resource Options
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** page.

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**.

### 8.1.4 Edit Static Compute Resource

**8.1.4.1 Edit 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 name of the compute resource
   - **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
- **Integrated Storage** - move the slider to the right to enable Integrated Storage on static compute resources
- **Collect Stats** - enable or disable the ability to collect statistics for this compute resource
8.1.4.2 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 your Control Panel > Admin > Settings menu.
2. Click the Configuration icon.
3. Click the System tab and in the OnApp Storage section, move the Enable OnApp Storage slider to the right to enable the OnApp storage on the cloud.

To edit integrated storage settings:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon.
3. On the following page, you will see the list of compute resources available in your cloud. Click the Actions button next to the label of the required compute resource and select Integrated Storage Settings.
4. Click the Edit button.
5. On the page that appears, edit the following parameters:

- **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

- **Power Cycle Command** - arbitrary command string to be executed by IPMI from the CP server. If the command is entered, a new Power Cycle compute resource option, which will execute the entered command, will appear at Admin > Settings > Compute Resources > label of a compute resource > Actions > Resource Options.

  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 the user onapp, this may be any script created in bash.

5. Click Save.
- **SAN bonding mode** - choose bonding mode type from the drop-down list
- **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
- **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

**Cache**
- **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**
- **Controller RAM** - specify the 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.
- **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.

6. Click **Save**.

---

### 8.1.5 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**.

#### 8.1.5.1 Edit Static Compute Resource Hardware Devices Configuration

1. Go to your Control Panel > Admin > Settings menu.
2. Click the **Compute Resources** icon.
3. On the following page, click the label of the required compute resource.
4. On the page that appears, click the **Actions** button, point to **Resource Options**, then select **Manage Hardware Devices**.
5. 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.
6. Click the **Edit Hardware Device Configuration** button.

7. 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

8. 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.

9. Click **Next**.

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

To disable a SAN network, unassign all network interfaces from the compute resource at Control Panel > **Admin** > **Settings** > **Compute Resources** > label of the compute resource > **Actions** > **Resource Options** > **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.

### 8.1.5.2 Advanced Network Interfaces

If you cannot find network interfaces, which should be assigned to SAN, at Control Panel > **Settings** > **Compute Resources** > label of the necessary compute resource > **Actions** > **Resource Options** > **Manage Hardware Devices**, you can move the Advanced Network Interfaces slider to the right, and the system will detect all physical and virtual interfaces. In case that your interface is not seen, you can add it manually:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon.
3. Click the label of the necessary compute resource.
4. On the following page, click the **Actions** button, point to **Resource Options**, then select **Manage Hardware Devices**.
5. On the page that appears, click the **Create New Custom Network Interface Device** button.
6. Specify the following details:
   - Name
   - PCI address
   - MAC address
7. Click **Save**.

To edit the network interface label, PCI address, 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.

### 8.1.6 Mitigate Security Vulnerabilities on Static Compute Resources

Due to the increasing number of speculative execution attacks on Intel processors, we highly recommend running CPU microcode update on every server boot. The best practice is **updating the microcode at an early stage by using extra initrd**, but it assumes a reboot of the server.

You can also **update the microcode during each boot without a server reboot**.

#### 8.1.6.1 Update Microcode at Early Stage

1. Install **iucode_tool** utility (EPEL repo):

   ```
   yum install iucode-tool
   ```

2. Get the latest microcode:

   ```
   # git clone https://github.com/intel/Intel-Linux-Processor-Microcode-Data-Files.git
   ```

3. Prepare early initrd image:

   ```
   # iucode_tool -S --write-earlyfw=/boot/intel-ucode.img ./Intel-Linux-Processor-Microcode-Data-Files/intel-ucode/
   iucode_tool: system has processor(s) with signature 0x000106a5
   iucode_tool: Writing selected microcodes to: /boot/intel-ucode.img
   ```

4. Add image to boot loader:

   **For CentOS 6 compute resources**

   Edit the `/boot/grub/grub.conf` file:
For CentOS 7 compute resources

Edit the /boot/grub2.grub.cfg file:

```
title CentOS 7 (3.10.0-957.21.3.el7.x86_64) 7 (Core) --class rhel fedora --class gnu-linux --class gnu --class os --unrestricted
$menuentry_id_option 'gnulinux-3.10.0-223.el7.x86_64-advanced-1a2c9c41-0702-4984-ba9d-25b6efb4b10a' {
    load_video
    set gfxpayload=keep
    insmod gzio
    insmod part_msdos
    insmod xfs
    set root='hd0,msdos1'
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root --hint-bios=hd0,msdos1 --hint=efi=hd0,msdos1 --hint=baremetal=ahci0,msdos1 --hint='hd0,msdos1'
        6d72c808-95dc-4fb0-9bcb-fce4aedd595
    else
        search --no-floppy --fs-uuid --set=root 6d72c808-95dc-4fb0-9bcb-fce4aedd595
    fi
    linux16 /vmlinuz-3.10.0-957.21.3.el7.x86_64
    root=/dev/mapper/centos-root ro rd.lvm.lv=centos/root
    rd.lvm.lv=centos/swap crashkernel=auto rhgb quiet LANG=en_US.UTF-8
    initrd16 /intel-ucode.img/initramfs-3.10.0-957.21.3.el7.x86_64.img
}
```

5. Reboot the server.

8.1.6.2 Update CPU Microcode on Static Compute Resources

For CentOS 6 compute resources

1. Install microcode_ctl utility from Intel's side:

   ```bash
   # yum install microcode_ctl
   ```

2. Restart microcode_ctl to load microcode shipped with microcode_ctl utility:

   ```bash
   # microcode_ctl -u
   # dmesg | tail -f
   ```

For CentOS 7 compute resources

1. Install microcode_ctl utility and iucode_tool from EPEL repo:
# yum install microcode_ctl
# yum install iucode-tool

2. Restart `microcode_ctl` to load microcode shipped with `microcode_ctl` utility:

```
# systemctl restart microcode
# dmesg | tail -f
[7936965.675820] microcode: updated to revision 0x1d, date = 2018-05-11
[7936965.686019] FEATURE SPEC_CTRL Present
[7936965.686026] FEATURE IBPB_SUPPORT Present
[7936965.686160] Speculative Store Bypass: Mitigation: Speculative Store Bypass disabled via prctl and seccomp
[7936965.688720] Spectre V2 : Mitigation: Full retpoline
```

3. Get the latest microcodes:

```
# git clone https://github.com/intel/Intel-Linux-Processor-Microcode-Data-Files.git
```

4. Copy necessary microcode and apply it:

```
# iucode_tool -S -k -K Intel-Linux-Processor-Microcode-Data-Files/intel-ucode/
iucode_tool: system has processor(s) with signature 0x000106a5
iucode_tool: Uploading selected microcodes to: /dev/cpu/microcode
iucode_tool: Writing microcode firmware file(s) into /lib/firmware/intel-ucode
```

Another way of CPU microcode update is via BIOS or UEFI, but not all BIOS/Server Platform vendors include microcode upgrades into their BIOS/UEFI.

8.2 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.

8.2.1 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

8.2.1.1 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, in maintenance mode, or locked (means that some of the services are yet to be started; this status appears during hot migration or when starting a compute resource)
   - 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 the 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.

### 8.2.1.2 View Compute Resource Hardware Information

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, then click **Hardware Info**. Also, you can click the label of a specific compute resource, then click the **Actions** button, point to **Resource Options**, and select **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.
8.2.1.3 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 your 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** - bonding mode type
   - **MTU** - the maximum transportation unit size
   - **VLAN id** - the ID of a VLAN number
   - **Integrated Storage DB size** - the controller DB size value
   - **SAN bridge name** - the SAN bridge name for the compute resource
   - **SAN bond name** - the SAN bond name for the compute resource

**Cache**

- **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**

- **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.
8.2.2 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

8.2.2.1 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.

8.2.2.1.1 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.

### 8.2.2.1.2 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.

### 8.2.2.1.3 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**.

### 8.2.2.2 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.
8.2.2.2.1 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.

8.2.2.2.2 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.

8.2.2.2.3 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 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.

- **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 at Admin > Settings > Compute Resources > label of a compute resource > Actions > Resource Options

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.

### 8.2.2.2.4 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 > Actions > Resource Options > Manage devices).

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

#### 8.2.2.2.4.1 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.
8.2.2.4.2 Cache Settings
Cache settings include the following options:

- Number of cache mirrors
- Number of cache stripes

8.2.2.4.3 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.

8.2.2.5 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.

8.2.3 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 label of the required compute resource and select Edit.

On this page:

- Edit CloudBoot Compute Resource
- Edit Integrated Storage Settings

8.2.3.1 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
- **Power Cycle Command** - arbitrary command string to be executed by IPMI from the CP server. If the command is entered, a new Power Cycle compute resource option, which will execute the entered command, will appear at Admin > Settings > Compute Resources > label of a compute resource > Actions > Resource Options.

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.

- **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.

- **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 CloudBoot compute resource custom config.

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

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**.

### 8.2.3.2 Edit Integrated Storage Settings

To view Integrated Storage settings on CloudBoot compute resources:

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

To edit integrated storage settings:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon.
3. On the following page, you will see the list of compute resources available in your cloud. Click the **Actions** button next to the label of the required compute resource and select **Integrated Storage Settings**.
4. Click the **Edit** button.
5. On the page that appears, edit the following parameters:
   - **SAN bonding mode** - choose bonding mode type from the drop-down list
     
     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.

   - **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.

   - **VLAN id** - specify the ID of a VLAN number

     After editing VLAN id, it is required to reboot your compute resource to apply settings. By default, VLAN id 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 VLAN id 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.
• **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

**Cache**

- **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**

- **Controller RAM** - specify the 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.
- **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.

6. Click **Save**.

### 8.2.4 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.

#### 8.2.4.1 Edit CloudBoot Compute Resource Devices Configuration

To edit CloudBoot compute resource devices configuration:

1. Go to your Control Panel > **Admin** > **Settings** menu.
2. Click the **Compute Resources** icon.
3. On the following page, click the label of the required compute resource.
4. On the page that appears, click the **Actions** button, point to **Resource Options**, then select **Manage Hardware Devices**.
5. 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, MAC address, and PCI address
6. Click the **Edit Hardware Device Configuration** button.
7. Configure disks:
   - **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. For disks assigned to the cache, specify the number of mirrors and stripes.
8. 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.
- **Passthrough to Guest** - this option is available for smart CloudBoot compute resources. The network interface will be added to the smart server.

9. Click **Next**.

10. 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 > Actions > Resource Options > 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.**

---

8.2.4.2 Advanced Network Interfaces

If you cannot find network interfaces, which should be assigned to SAN, at Control Panel > Settings > Compute Resources > label of the necessary compute resource > Actions > Resource Options > Manage Hardware Devices, you can move the Advanced Network Interfaces slider to the right, and the system will detect all physical and virtual interfaces. In case that your interface is not seen, you can add it manually:

1. Go to your Control Panel > Admin > Settings menu.
2. Click the Compute Resources icon.
3. Click the label of the required compute resource.
4. On the following page, click the Actions button, point to Resource Options, then select Manage Hardware Devices.
5. On the page that appears, click the Create New Custom Network Interface Device button.
6. Specify the following details:
   - **Name**
   - **PCI address**
   - **MAC address**
7. Click **Save**.

To edit the network interface label, PCI address, 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.

---

8.2.5 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:

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

   Choose Ethernet mode, and run:

   ```bash
   HV# mkdir -p /.rw/overlay/etc/infiniband
   HV# cp -a /etc/infiniband/connectx.conf /.rw/overlay/etc/infiniband
   HV# init 6
   ```

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:

   ```bash
   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.

**8.2.6 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.

8.2.7 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 Xen/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 the label of the compute resource you are interested in.
4. Click the **Actions** button, point to **Resource Options**, and select **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 the label of the compute resource you are interested in.
4. Click the **Actions** button, point to **Resource Options**, and select **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.

### 8.2.8 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 VSs 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.

### 8.2.8.1 Prerequisites

- **8.2.8.1.1 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.

8.2.8.1.2 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 Actions menu, point to Power and click the Shut down Virtual Server button.
3. Repeat this action for each virtual server in the compute zone.

8.2.8.2 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:
OnApp

Cloud 6.7

Storage Home

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


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<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>centos5</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>centos5</td>
</tr>
</tbody>
</table>

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;

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>
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<th>label</th>
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<th>hypervisor_type</th>
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<td>48</td>
<td>xen</td>
<td>centos6</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>centos6</td>
</tr>
</tbody>
</table>

rows in set (0.00 sec)

8.2.8.3 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.

8.2.8.4 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.

8.2.8.5 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.

8.2.8.6 Update Packages after CentOS 5.x EoL

Update of packages using default repositories (base, update, etc.) is no longer applicable as centos.org has stopped the support of CentOS 5.x.. You should switch boxes, run on CentOS 5.x., to so-called Vault repositories. At least it will give a possibility to install packages, which are necessary because of different dependencies.

To switch to Vault repository:

1. Disable base, updates, and other enabled repositories (where enabled=1 is set) in the CentOS-Base.repo:

   ```
   sed -i 's/enabled=1/enabled=0/g' /etc/yum.repos.d/CentOS-Base.repo
   ```

   Then check the `/etc/yum.repos.d/CentOS-Base.repo`, and upend 'enabled=0' into every repository with no 'enabled' option.

2. Enable c5.11-base and c5.11-updates:
8.2.9 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

8.2.9.1 Prerequisites

8.2.9.1.1 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.

8.2.9.1.2 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 Actions menu, point to Power, and click the Shut down Virtual Server button.
3. Repeat this action for each virtual server in the compute zone.

8.2.9.2 Migrate CloudBoot OS

After all virtual servers are shut down, log in to your Control Panel database and update CloudBoot OS for CentOS 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:

   ```
   mysql -p
   mysql> use onapp;
   ```

3. Select the CentOS 6 KVM 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 = "kvm";
   ```
4. Update the CloudBoot OS on selected compute resources in the compute zone with the next command:

```sql
update hypervisors set cloud_boot_os = "centos7" where hypervisor_type = "kvm" and hypervisor_group_id = 48;
```

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
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>
```

8.2.9.3 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.
8.2.9.4 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.

8.2.9.5 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.

8.2.10 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 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
8.2.10.1 Prerequisites

8.2.10.1.1 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 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.

8.2.10.1.2 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 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 Actions menu, point to Power, and click the Shut down Virtual Server button.
3. Repeat this action for each virtual server in the compute zone.

8.2.10.2 Migrate CloudBoot OS

After all virtual servers are shut down, log in to your Control Panel database and update CloudBoot OS for CentOS 6 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:

```
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 6 X encompute resources with the following command:
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;
```

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>
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<th>hypervisor_type</th>
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<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>
```

rows in set (0.00 sec)

8.2.10.3 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.

### 8.2.10.4 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.

### 8.2.10.5 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.

Be aware that after upgrading your compute resources running on CentOS 6 to CentOS 7, the DM-Cache might not be working. This doesn’t affect new compute resources running on CentOS 7, only the existing one. **Click here to see how to resolve the issue.**

Perform the following steps to fix the issue:

1. Wipe the disk that is assigned to cache:

   ```
   [root@192.168.1.40 ~]# dd if=/dev/zero bs=1M oflag=direct count=16
   of=/dev/sda status=progress
   16+0 records in
   16+0 records out
   16777216 bytes (17 MB) copied, 0.182174 s, 92.1 MB/s
   ```

2. Restart groupmon or reboot the compute resource:

   ```
   [root@192.168.1.40 ~]# /etc/init.d/groupmon restart
   ```
8.2.11 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.

8.2.11.1 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

8.2.11.2 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
o **Network address** - the network address of the IP net
o **Network mask** - the network mask of the IP net
o **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.

---

### 8.2.11.3 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 required 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**.

### 8.2.11.4 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.

8.2.11.5 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 and 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.

8.2.11.6 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.
### 8.2.11.7 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.

### 8.2.12 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 deploy one or more backup servers for backups and VS provisioning when using CloudBoot functionality.
- Before backup server creation, create a 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.

#### 8.2.12.1 Create CloudBoot Backup Server

To create a CloudBoot backup server:

1. Go to your Control Panel > Admin > Settings menu, then click the 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.
8.2.12.2 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
   - **Enabled** – move this slider to the right to enable the backup server or to the left to disable the backup server

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

   - **Enable Integrated Storage on Static Backup Server** - move the slider to the right to enable Integrated Storage on a static 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 a static backup server.

   - Click the Save Backup server button to save changes.

8.2.12.3 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 the deletion.
All the backups stored on that backup server will be deleted.

Troubleshooting

When using Integrated Storage and Windows VSs with large VDisks, sometimes the Cloudboot backup server might crash during backups.

Click here to see more about the problem.

This issue is related to the fact that `ntfsclone` does not handle read IO errors properly during data being copied off a VDisk snapshot. The read error is generated when the VDisk snapshot reservation space is exhausted during backup, due to a large amount of IO writes during the backup process or due to a long backup process on slow storage devices.

If you have Windows VS and you frequently experience backup server crashes or backup operation failures, you might consider implementing these solutions:

1. Scheduling the Windows VS backups during the idle times, when there are not many IO writes to the live VDisk. Disk IOPS can be viewed at Cloud > Virtual Servers > label of required VS > Storage tab > Disks > Actions button near needed disk > IOPS.

2. Increasing the snapshot reservation space for the VDisk(s) on the backup server CLI:

```
onappstore snapreserve uuid=<UUID>
reserve=<SNAP_RESERVE_IN_PERCENTAGE>
```

The default percentage is 10%, and it can be increased to the desired value for the specific VDisks.

There are no definite values, as each proper value depends on:

- Size of the VDisk
- IOPS on the VDisk or storage device
- Performance of the storage devices and network (backups last longer on slow devices)

In case of Backup server issues, we recommend increasing the snap_reserve of that VDisk to 20% and, if the issues persist, to 30%.

Snapshot reserve space must be reserved at the time of snapshot creation in order to prevent any data corruption for backups. Having corrupted backups is worse than having none.

Increasing the `snap_reserve` space to high values may reserve more storage space than necessary for snapshots, resulting in wasted storage capacity, so it should be slowly increased only on VDisks with backup problems to find the proper value that resolves the backup issues.

If you would prefer to have the support team perform the task for you, please submit a request.

8.2.13 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)

8.3 Delete Compute Resource

Compute resources can be removed from your cloud if required. 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 Performance Analysis

9.1 Performance Measurement Steps:

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.

9.2 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 health check 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:

   ```
   root@<ipaddr_hv_2> ~]# iperf -c <ipaddr_hv_1> -N
   ```

   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.


9.3 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> -j# brctl show
```

2. If there is a network bond, run:

```
root@<ipaddr_hv_1> -j# 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> -j# ethtool -k <onappstorebond>
root@<ipaddr_hv_1> -j# ethtool -k <eth0>
```

Output example for <eth0>:

```
Cannot get device rx csum settings: Operation not supported
rx-checksumming: off
tx-checksumming: on
catter-gather: on
cp segmentation offload: on
dp 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> -j# ethtool -k <eth0> tso on
```

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

```
root@<ipaddr_hv_1> -j# ethtool -k <eth0> gso on
```

You can enable both TSO and GSO at the same time:

```
root@<ipaddr_hv_1> -j# ethtool -k <eth0> tso on gso on
```

Currently TSO and GSO bonding is disabled on Xen/CentOS 5 HVs with NIC bonding.

9.4 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.

9.5 Measuring Raw Disk Performance

Follow this 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 to 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.

   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/sd<x>
```

After that, drive devices will be ready for use in onappstorage.

6. Restart the OnApp storage service:

```bash
root@<ipaddr_hv_1> ~]# service groupmon start
```

9.6 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:

```bash
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:

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

2. Create a 4GB VDisk:
The following details will be returned on successful VDisk creation: disk owner's details, vdisk_uuid and and result=SUCCESS. For example:

```
uuid=ctcm3ly5fi46ebj owners=<9929993183> Datastore=<lag3m5dqoh86yc>
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:**

```
root <10218> 0.0 0.0 850 80 ? Ss 12:12 0:00 /usr/sbin/bdevclient
<10.200.1.1> <59051> /dev/nbd0 -b 65536 -U <tcm3ly5fi46ebj>
```

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
7?0 records in
6?0 records out
973741824 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:

```
6+0 records in
6+0 records out
073741824 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_uuid=<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.
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.

9.7 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_vml> ~]# swapoff -a
```

Otherwise, disable a single swap drive:

```
[root@<ipaddr_vml> ~]# 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:
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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

root@<ipaddr_hv_1> ~ # onappstore delete 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 heaving 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/.
- PV drivers if present in the image can also improve the performance of the virtual servers.
9.8 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
```

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
```

9.9 Enabling Caching on 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:**

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

   `root@[ipaddr_hv_1] ~]$ virsh shutdown <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>`

   `/ # vi </DB/NODE-2900573203/vdisks/730nmaq5z82uj.xml>`

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

10. Save changes for each entry.

    Now caching should be enabled for those VDisks.

9.10 Results

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

<table>
<thead>
<tr>
<th></th>
<th>Read</th>
<th>Write</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>N/W</td>
<td>HV1</td>
<td>HV2</td>
</tr>
<tr>
<td></td>
<td>Dom0</td>
<td>HV2</td>
</tr>
<tr>
<td></td>
<td>SN0</td>
<td>HV2</td>
</tr>
<tr>
<td></td>
<td>VM</td>
<td>HV2</td>
</tr>
<tr>
<td>Disk</td>
<td>HV1</td>
<td>HV2</td>
</tr>
<tr>
<td></td>
<td>Dom0</td>
<td>HV2</td>
</tr>
<tr>
<td></td>
<td>SN0</td>
<td>HV2</td>
</tr>
<tr>
<td>Read</td>
<td>Write</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>VM</td>
<td>HV2</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.

**Notes**

Tests like bonnie++ ([http://www.googlux.com/bonnie.html](http://www.googlux.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.
# 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.
# 11 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></td>
<td>DS</td>
<td>LVM</td>
<td>IS</td>
<td>LVM</td>
</tr>
<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>LVM</th>
<th>IS</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></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>Static</td>
<td>-</td>
<td>A</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cloudboot</td>
<td>-</td>
<td>A</td>
<td>A</td>
<td>Y</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Op</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>
</tbody>
</table>
### OnApp Cloud 6.7 Storage Home

<table>
<thead>
<tr>
<th>Op</th>
<th>Static</th>
<th>Cloud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup</td>
<td>A</td>
<td>A</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
12 Integrated Storage Common Scenarios

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

12.1 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

12.1.1 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
   rpm -Uvh http://rpm.repo.onapp.com/repo/onapp-repo.noarch.rpm
   ```

4. Install CloudBoot dependencies:

   ```bash
   yum update onapp-store-install
   /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).

12.1.2 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
#> rpm -Uvh http://rpm.repo.onapp.com/repo/onapp-repo.noarch.rpm
```

4. Install CloudBoot dependencies:

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

12.1.3 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.
13 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**

13.1I. 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.

13.2II. 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`.

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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):

```bash
tar ztf UnifiedDriver_6.904.09_RHEL6.tar.gz | grep src.rpm
mod-megaraid_sas_rhel6.5 x86_64/megaraid_sas-06.904.09.00_rhel6.5-2.src.rpm
mod-megaraid_sas_rhel6.6 x86_64/megaraid_sas-06.904.09.00_rhel6.6-2.src.rpm
mod-megaraid_sas_rhel6.7 x86_64/megaraid_sas-06.904.09.00_rhel6.7-2.src.rpm
mod-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:

```bash
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`:

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

The installation completes successfully.

```
# megaraid_sas
########################################### [100%]
```

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`):

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

The build could fail with the following error:

```bash
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-8EuVv (%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 2.6.32-642.6.2.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
```

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.

13.3III. Compile/Build custom driver (using tools we provide)

If you 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
40e-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`.

- `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:

```
 rpm -qpl /root/rpmbuild/RPMS/x86_64/onapp-ramdisk-centos6-kvm-kmod-i40e-1.6.42-1.x86_64.rpm
tftpboot/export/centos6/kvm/lib/modules/2.6.32-642.6.2.el6.x86_64
tftpboot/export/centos6/kvm/lib/modules/2.6.32-642.6.2.el6.x86_64/extra/earlyboot-i40e.sh
tftpboot/export/centos6/kvm/lib/modules/2.6.32-642.6.2.el6.x86_64/extra/i40e
```

5. Run the tool with `-h` for help and more options:
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```bash
./onapp-ramdisk-kmod-build.sh -h

-d DISTRO : Distributive and its version.
  The default is: centos6
  Supported are: centos5 centos6 centos7

-t VIRT : Virtualization name.
  The default is: kvm
  Supported are: xen, kvm

-n NAME : Driver short name
-v VERSION : Driver version
-b BUILD : RPM package build number. The default is: 1

-r KVERSION : Kernel version to compile driver's kmod against. The default is: 2.6.32-642.6.2.el6.x86_64
-o RPMBUILD_OPTS : Additional options for the 'rpmbuild' utility. The default are: --define="__findRequires %nil" --define='release 1' --define='kversion 2.6.32-642.6.2.el6.x86_64' --define='distro centos6' --define='virt kvm' --define='MAKEROOT /opt/OnApp' --define='CMAKE_INSTALL_DIR /opt/OnApp' --define='CMAKE_INSTALL_SYSLIB /opt/OnApp/lib'

-C MAKEFILE_PATH : Path to the driver's sources main Makefile - the directory where 'make' utility is called.
  By default isn't set. Usefull values are: src, ...

The path could be determined by running (remove leading KMOD_NAME-KMOD_VERSION dir):
tar ztf KMOD_NAME-KMOD_VERSION.tar.gz | grep Makefile

-h|--help : print this info
```

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
```

13.4IV. 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
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
  /bin/sh
  #!/bin/sh
  export PATH
  insmod /megaraid/megaraid_sas.ko
  
  root@cp-onapp overlay]# cat earlyboot.sh
  !/bin/sh
  #!/bin/sh
  PATH=/sbin:/usr/sbin:/bin:/usr/bin
  export PATH
  insmod /megaraid/megaraid_sas.ko
  
  o When changing an existing module:

  ```bash
  rmmod megaraid_sas
  insmod /megaraid/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.
14 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 the Integrated Storage upgrade.

14.1 Configure Auto Healing for Data Store

To enable auto healing 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 in 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 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 in 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 data store marked as *auto healing*. Auto healing repairs disks one by one for each data store, 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 a data store
- Auto healing will not try to repair disk if its last repair transaction is failed in the last 24 hours

### 14.2 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
15 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 disks that are being used for virtual servers.

You can test the performance of your data store by means of built-in performance tests or use our repo with the performance test framework to run the tests by yourself.

15.1 View 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** - click to view the test results and activity log

15.2 Run 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:

   **Disk Options**
   - **Size (MB)**
   - **Prefer local reads** - move the slider to the right to create a virtual disk with local to test VS mirrors
   - **Integrated storage cache enabled** - move the slider to the right to enable integrated storage cache
   - **Cache mode** - choose cache mode
   - **Cache line size** - the size of a single line in cash
   - **Migration threshold** - the threshold to write data from cache to origin device
   - **Cache percentage** - the size of the cache in % of the size of virtual disk created for test

   **Benchmark**
   - **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.

- **Hypervisor** - chose the compute resource on which the test will be performed

- **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

- If you have chosen the xddwrapper in the **Type** field, specify the following details:
  - **Xddwrapper type** - choose the type of operation to run: read, write, or a ratio test that compares the read to write speed
  - **Read/Write ratio** - the 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 the 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

7. Click the **Perform** button to run this benchmark test.

### 15.3 Delete 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**.
15.4 Performance Test Suite and Benchmarks with Other SAN Networks

A performance test suite is based on FIO and carried out with different software on the same HW. Test results provide information on bandwidth, IOPS, and latency in CSV format. Periodic regression tests are taken on TOB. The tests are taken at:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAS SSD</td>
<td>4 x 1.92 TB PM1643</td>
<td><a href="https://www.samsung.com/semiconductor/ssh/enterprise-ssd/MZILT1T9HAKQ-00007/">https://www.samsung.com/semiconductor/ssh/enterprise-ssd/MZILT1T9HAKQ-00007/</a></td>
</tr>
<tr>
<td>RAM</td>
<td>DDR4 12x64GB</td>
<td><a href="https://www.micron.com/products/dram-modules/ldimm/part-catalog/mta72ass8g7212z-2g3">https://www.micron.com/products/dram-modules/ldimm/part-catalog/mta72ass8g7212z-2g3</a></td>
</tr>
</tbody>
</table>
For more information on test cases, refer to the Performance Test Suite for Integrated Storage page.

See also:

- SSD Caching
16 SSD Caching

It is best to use NVMe or Solid State Disks (SSDs) for SSD caching to increase disk I/O performance.

The minimum disk capacity is 20 GB. Disk must meet requirements: can be formatted with mkfs.xfs, mounted, and our binary onapp_scsi_id returns not empty ID_SERIAL=, at centos7 64bit environment.

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.

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 and static compute resource
- 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.

Also you can assign disk to the cache during the creation of a CloudBoot compute resource. 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
```

16.1 Enable Caching for Data Store

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 vdisk within the configured data store.

### 16.2 Enable Caching for Disk

**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 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 serves with the disks on the data store to apply the settings.
17 Epochs for Data Stores

Epochs are a mechanism to decrease vDisk repair time. It works by periodically flushing (for example, 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 the vDisk repair, the epochs optimization is disabled, and the 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 the list of data stores on your system.
3. Click the Actions button next to the store you want to change, then select Edit.
4. On the following page, move the Epoch slider to the right to enable epochs.
5. Click Save Data Store.

17.1 Repair Performance with and Without Epochs

When testing repair performance with and without epochs, 20% of a disk with the following parameters was rewritten:

- With HDD devices 2R2S
- Disks: 5 GB, 50 GB, 500 GB
- With SSD devices 2R2S
- Disks: 5 GB, 50 GB, 500 GB
- With NVMe devices 2R
- Disks: 5 GB, 50 GB

The test results are provided in the table below:

<table>
<thead>
<tr>
<th>Disk Type</th>
<th>With Epochs</th>
<th>Without Epochs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSD 5 GB</td>
<td>0:52</td>
<td>3:02</td>
</tr>
<tr>
<td>SSD 50 GB</td>
<td>1:57</td>
<td>23:57</td>
</tr>
<tr>
<td>SSD 500 GB</td>
<td>14:14</td>
<td>4:00:02</td>
</tr>
<tr>
<td>HDD 5 GB</td>
<td>1:12</td>
<td>3:48</td>
</tr>
<tr>
<td>HDD 50 GB</td>
<td>1:47</td>
<td>26:33</td>
</tr>
<tr>
<td>HDD 500 GB</td>
<td>14:20</td>
<td>6:21:57</td>
</tr>
<tr>
<td>NVMe 5 GB</td>
<td>1:14</td>
<td>5:21</td>
</tr>
<tr>
<td>NVMe 50 GB</td>
<td>3:35</td>
<td>44:49</td>
</tr>
</tbody>
</table>
18 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.

18.1 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/vmlinuz
       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.
19 Command-Line Interface

The command-line interface is a collection of command-line utilities that you can use to configure, manage, and check the status of Integrated Storage directly at compute resources and/or backup servers without UI.

Please note that some commands are experimental or potentially dangerous.

We do not recommend you to use CLI as it is not a fully tested way to do manage storage. It can be used only as a last resort since there are possible DATA losses.

Some commands may be helpful if you meet problems that can not be solved from the Diagnostics page or for a complex setup.

This section contains the pages that relate to Integrated Storage CLI.

- Monitoring Tool
- Cron Tasks
- Diskhotplug
- ISD Daemon
- Tools Present at CP
- Onappstore Commands
- Tools Present at Compute Resource and Backup Server

19.1 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:

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

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.

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:

19.2.1 IS Controller Crontab

<table>
<thead>
<tr>
<th>Task</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>*/2 * * * * root localupdate</td>
<td></td>
<td>syncs database state with the state on the physical disks</td>
</tr>
<tr>
<td>*/1 * * * * root check_active_sync</td>
<td></td>
<td>checks for ongoing repairs and performs online refresh at the end of resyncs</td>
</tr>
<tr>
<td>*/1 * * * * root nbd_stats</td>
<td></td>
<td>collects NBD devices stats</td>
</tr>
<tr>
<td>*/2 * * * * root stale_devices</td>
<td></td>
<td>checks NBD devices and update free devices list in /tmp/NBDdevs, compare the actual NBD devices and device mapper references</td>
</tr>
<tr>
<td>*/1 * * * * root timeout_nodes</td>
<td></td>
<td>checks for nodes we have not heard isd ping from in 2 mins, and change their status according to timeout</td>
</tr>
<tr>
<td>*/2 * * * * root delete_storage_files</td>
<td></td>
<td>during delete metadata and files moved to /deleted/ folder the script actually deletes them from disk</td>
</tr>
<tr>
<td>*/4 * * * * root epoch.pyc</td>
<td></td>
<td>compacting Epoch bitmaps to ensure validity and preserve space</td>
</tr>
</tbody>
</table>

19.2.2 Hypervisor Crontab

<table>
<thead>
<tr>
<th>Task</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 * * * * root devhealth_cache_update</td>
<td></td>
<td>updates devhealth information for all disks in the local system</td>
</tr>
<tr>
<td>*/2 * * * * root localupdate</td>
<td></td>
<td>syncs database state with the state on the local disks</td>
</tr>
<tr>
<td>*/1 * * * * root check_active_sync</td>
<td></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></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></td>
<td>collects NBD stats</td>
</tr>
<tr>
<td>*/2 * * * * root stale_devices</td>
<td></td>
<td>cleans up NBD device counters in /tmp/NBDdevs with the actual NBD devices and device mapper references</td>
</tr>
</tbody>
</table>
19.3 Diskhotplug

`diskhotplug` is a command-line utility that you can use to manage IS Controller.

Starting from the 6.0 version, OnApp Cloud supports `diskhotplug` for CloudBooted compute resources using the Integrated Storage platform. You can assign and unassign hardware disks from the IS Controllers on the compute resources, using the CLI utility.

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

```bash
diskhotplug
```

You will see the list of all commands related to the `diskhotplug` utility.

To avoid warning messages such as `DELAYED_PING` showing at 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.

19.3.1 List of Available diskhotplug Commands

- **diskhotplug list** - lists existing Controllers. Following is an example for a system with 6 disk drives set with default 4 drives per controller:

  ```bash
  [root@x.x.x.x ~]# /diskhotplug list
  Controller 0
  Slot 0  -  /dev/sda (SCSIid:Z2A7VJQD_Z2A7VJQD,NodeID:130322041)
  Slot 1  -  /dev/sdb (SCSIid:9WM6B5WQ5_9WM6B5WQ5,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:350025386500786eb_S1D9NEAD904298P,NodeID:235613508)
  Slot 1  -  /dev/sdf (SCSIid:35000cca0220b54c8_KPV675RF,NodeID:2574447922)
  Slot 2  -  EMPTY
  Slot 3  -  EMPTY
  ```

- **diskhotplug assign <Controller> <Slot> <device>** - assigns disks to Controller
diskhotplug assign 3 0 /dev/sdh
result=SUCCESS

- diskhotplug unassign <Controller> <Slot> - unassigns disk from Controller.
  You can use the command when you face some mechanical disk failure or to move it to another server manually.

In the example below, /dev/sdf is being removed:

```
[root@x.x.x.x ~]# /diskhotplug unassign 1 1
result of diskhotplug unassign:
[root@x.x.x.x ~]# /diskhotplug list
Controller 0
  Slot 0  - /dev/sda (SCSIid:22A7VJQD_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_S1D9NEAD904298P,NodeID:235613508)
  Slot 1  - EMPTY
  Slot 2  - EMPTY
  Slot 3  - EMPTY
```

- diskhotplug assign <Controller> <Slot> <device> - assigns disks to Controller

```
[root@x.x.x.x ~]# /diskhotplug assign 1 1 /dev/sdf
[root@x.x.x.x ~]# /diskhotplug list
Controller 0
  Slot 0  - /dev/sda (SCSIid:22A7VJQD_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_S1D9NEAD904298P,NodeID:235613508)
  Slot 1  - /dev/sdf
    (SCSIid:35000cca0220b54c8_KPV675RF,NodeID:2574447922)
  Slot 2  - EMPTY
  Slot 3  - EMPTY
```

- diskhotplug initNewController - creates a new one Controller

```
diskhotplug initNewController
  complete: added new controller: 4
```

- diskhotplug restartController <Controller> - restarts existing Controller
Diskhotplug restartController 3
Stopping Controller 3...DONE
re-initialising config...DONE
Starting Controller 3...DONE

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.

19.4 ISD Daemon

ISD is a small, compact C---based daemon which is the main part of distributed DB stored in /onappstore/DB.
ISD listens on a multicast channel or unicast port, updates local DB based on received ping messages, and sends out ping messages based on local DB content.

ISD configuration is automatized inside the SANController service; we have separated ISD service /etc/init.d/isd only for compatibility of IS controllers.

19.4.1 ISD Config Details

Default ISD configuration file:

/onappstore/etc/isd.conf

Settings for isd.conf generation are stored in:

/onappstore/onappstore.conf

Settings for ISD in IS controller passed through:

/proc/cmdline

isd.conf generated by SANController service:

/etc/init.d/SANController start

To restart ISD, regenerate config, do not degrade disks, and reboot controllers, use this command (works at compute resources and controllers)

/etc/init.d/SANController updateconfig

19.4.2 ISD Debugging

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

You may run it manually in the foreground with:
Then:
   1. stop ISD
   2. killall ISD

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

19.4.3 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=0/0 PING=0/0 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

19.5 Tools Present at CP

This page provides the command-line utilities present at the Control Panel console.

liveUpdate - is a command-line utility that you can use to manage the upgrade procedures

```
liveUpdate -h
```

19.5.1 List of Available liveUpdate Commands

- liveUpdate listHVs [-nc] - lists all compute resources connected to CP

- liveUpdate updateToolstack <HV IP Addr> force - updates the scripts related to IS:
liveUpdate updateToolstack 192.168.1.91 force

STEP1 - Copied liveupdate archive onto HV
STEP2 - Untarring toolstack version file from liveupdate tarball: SUCCESS
STEP3 - Check whether toolstack version has changed: True
STEP3.1 - Stop crond: FAIL bash: /etc/init.d/crond: No such file or directory
STEP4 - Untarring liveupdate archive: SUCCESS
STEP5 - Removing liveupdate archive: SUCCESS
STEP5.1 - Updating storageAPI.service unit file: SUCCESS
STEP5.2 - Reloading systemd manager configuration: SUCCESS
STEP6 - Stopping SANController: SUCCESS
STEP7 - Stopping storageAPI: SUCCESS
STEP10 - Cleaning stale locks
STEP - Restarting SNMP services
STEP11 - Restarting SANController: SUCCESS
STEP12 - Recording runtime toolstack version: SUCCESS
STEP13 - Convert storage controllers to enable hotplug
STEP14 - wait for 3 minutes while Nodes DB gets re-populated

........................................ Minute 1 complete
........................................ Minute 2 complete
........................................ Minute 3 complete
Final step - Starting storageAPI: SUCCESS

Please note that the following commands are potentially dangerous and may cause data loss or disks degradation. Please use with caution:

- liveUpdate restartControllers <HV IP Addr> force <timeout_in_secs> <Controller ID> - restarts IS Controllers
- liveUpdate refreshControllers <HV IP Addr> - updates scripts at IS Controllers and restarts them
- liveUpdate updateDrivers <HV IP Addr> - updates kernel modules NBD and dm-mirror for compute resources
- liveUpdate liveRestartBackends <HV IP Addr> - restarts Rspamd instances at IS Controllers, may cause massive disk degradation, please use with caution

19.5.2 Usage Example Run from CP Console

- If you need to check the compute resources and their upgrade status, use the following command:
To restart controllers at target compute resource, use the following command (this may cause data loss or vDisks degradation):

```bash
liveUpdate restartControllers 192.168.1.1
```

# 19.6 Onappstore Commands

`onappstore` is a command-line utility that you can use for all common IS functions. To see all available commands related, run

```bash
onappstore -h
```

## 19.6.1 List of Available onappstore Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Required Parameters</th>
<th>Additional Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>help</td>
<td>prints info about all command s</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>list</td>
<td>lists virtual disks in compute zone</td>
<td>-</td>
<td>minimal=true/false - output as comma-separated list datastore=&lt;DS_UUID&gt; - list vDisks in data store with DS_UUID type=is/lvm - list vDisks from LVM or IS only</td>
</tr>
<tr>
<td>getid</td>
<td>gets UUID of frontend node (works on compute resource or backup server only), also shows Backend nodes IP’s</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>lists</td>
<td>lists data stores in compute zone</td>
<td>-</td>
<td>minimal=true/false - output as comma-separated list</td>
</tr>
<tr>
<td>Command</td>
<td>Description</td>
<td>Required Parameters</td>
<td>Additional Parameters</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>---------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>createds</td>
<td>creates data store within compute zone</td>
<td>name=&lt;NAME&gt; - specify DS name membership_count=&lt;# of disks&gt; - specify how much Backend nodes (hardware disks) should include new data store</td>
<td>type=is/lvm - list data stores from LVM or IS only</td>
</tr>
<tr>
<td>deleteds</td>
<td>deletes data store</td>
<td>uuid=&lt;DS UUID&gt; - UUID of data store to delete</td>
<td>type=is/lvm - type of storage force=true - do not check if vDisks present in datastore</td>
</tr>
<tr>
<td>addnode</td>
<td>adds Backend node to existing DS</td>
<td>uuid=&lt;DS UUID&gt; - UUID of data store you want add node to member_uuid=&lt;NODE UUID&gt; - Backend node UUID you want to add to DS</td>
<td>type=is/lvm - type of storage</td>
</tr>
<tr>
<td>removeno node</td>
<td>removes a node from datastore</td>
<td>uuid=&lt;DS UUID&gt; - UUID of data store from what you want to remove node member_uuid=&lt;NODE UUID&gt; - Backend node UUID you want to remove from DS</td>
<td>type=is/lvm - type of storage</td>
</tr>
<tr>
<td>create</td>
<td>creates virtual disk at existing DS</td>
<td>name=&lt;NAME&gt; - name of vDisk size=&lt;SIZE (MB)&gt; - size in Megabytes Datastore=&lt;DS UUID&gt; - datastore at which you want to create vDisk</td>
<td>type=is/lvm - type of storage snap_limit=&lt;percent of disk size(0-100)&gt; - size of snapshots in percentage of vDisk size default 10%</td>
</tr>
<tr>
<td>online</td>
<td>online vDisk, actually allocates space bring up all</td>
<td>uuid=&lt;UUID&gt; - UUID of vDisk we want online frontend_uuid=&lt;FRONTEND_NODE_UUID&gt; - UUID of frontend node compute resource or BS at which we want online vDisk</td>
<td>type=is/lvm - type of storage allow_parallel_connects=true/false - allow online at two instances at same time</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Required Parameters</th>
<th>Additional Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>offline</td>
<td>offlines vDisk, flushes all data to backend nodes, stops all processes related to vDisk</td>
<td>uuid=&lt;UUID&gt; - UUID of vDisk we want offline</td>
<td>type=is/lvm - type of storage frontend_uuid=&lt;FRONTEND_NODE_UUID&gt; - UUID of frontend node HV or BS at which we want offline vDisk</td>
</tr>
<tr>
<td>snapshot</td>
<td>makes COW snapshot of vDisk; up to 3 snapshots can exist at the same time; to access snapshot you should online it</td>
<td>uuid=&lt;UUID&gt; - UUID of vDisk we want snapshot</td>
<td>type=is/lvm - type of storage snap_limit=&lt;percent of disk size(0-100)&gt; - size of snapshot in percentage of vDisk size default 10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Required Parameters</th>
<th>Additional Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>needed processes (rspamd, nbd, dm cache), so vDisk can be used by VS</td>
<td>refresh=true/false - regenerate data about vDisk at backend nodes cache=passthrough/writethrough/writeback - choose cache type cls=CACHE_LINE_SIZE - cache line size cache_percentage=&lt;0-100&gt; - size of cache % of vDisk size restore=true/false - restore cache settings nbd_timeout=0-1000 - NBD connection timeout in seconds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19.6.2 Basic Functionality Test
You can also use onappstore to test the basic functionality of your Integrated Storage. To do that, follow the next procedure:

1. Create data store:
onappstore createds name=testds membership_count=12 replicas=2 stripes=2 result=SUCCESS uuid=qbvyeOhmog8wd
owners=92501251,547980777,846279239,3131933319,1196498418,3480892458,755168543,1550962108,2849269270 replicas=2
stripes=2 overcommit=0 completion_time=3

2. List data stores:

onappstore listds
Datastore [qbvyeOhmog8wd]
Name: testds
Description: testds
Sector-size: 65536 Bytes
VDisk replicas: 2
VDisk stripes: 2
Overcommit: 0
Members:
2849269270,683656722,1245111051,2570842711,1550962108,755168543,3480892458,1196498418,3131933319,846279239,547980777,92501251
Max new vdisk 952372

3. Create virtual disk:

onappstore create name=testvdisk size=10000 Datastore=qbvyeOhmog8wd
result=SUCCESS uuid=dt9my0v16op7wc
owners=755168543,1550962108,2849269270,92501251 Datastore=qbvyeOhmog8wd
stripesize=256 completion_time=4

4. Get UUID of compute resource:

onappstore getid
result=SUCCESS uuid=3587714074 ipaddr=192.168.1.93
backends=10.200.4.3,10.200.4.2,10.200.4.1 unicasthosts= completion_time=0

5. Online virtual disk:

onappstore online uuid=dt9my0v16op7wc frontend_uid=3587714074
result=SUCCESS completion_time=6

6. Write data to a virtual disk:

dd if=/dev/urandom of=/dev/mapper/dt9my0v16op7wc bs=1M count=1000
1000+0 records in
1000+0 records out
1048576000 bytes (1.0 GB) copied, 14.2606 s, 73.5 MB/s

See also:

- Forget Storage Node via CLI
- Parallel VDisks Repairing in CLI
- Rebalance VDisk Using CLI
- Replace IS Disk Drive via CLI
19.7 Tools Present at Compute Resource and Backup Server

This page provides the command-line utilities present at the compute resource and backup server.

- **onapp_scsi_id** - utility gets disk UUID, reads disks ID’s, and presents this in readable form
  
  You can not use disk for IS if this utility does not return **ID_SERIAL** or **ID_SCSI_SERIAL**

```bash
onapp_scsi_id /dev/sda
ID_VENDOR=HP
ID_REVISION=3.00
ID_MODEL=LOGICAL_VOLUME
ID_SERIAL=3600508b1001030393638323042301400
ID_SCSI_SERIAL=50014380096820B0
```

- **formatandconfigure** - prepares raw disks for IS. It will format it with xfs, so all data on the disk will be lost

```bash
formatandconfigure /dev/sdh
SUCCESS
```

- **getdegradedvdisks** - checks if degraded vDisks are present in compute zone. If degraded vDisks are present, you will see the following response:

```bash
getdegradedvdisks
Datastore: qbvye0hnmg8wd
vdisks: 1 (dt9my0v16op7wc)
degraded_vdisks: 1 (dt9my0v16op7wc)
```

If no degraded vDisk is present, you will see the following response:

```bash
getdegradedvdisks
Datastore: qbvye0hnmg8wd
No degraded VDisks
```

- **parallelrepairvdisks** - utility for the parallel repair of virtual disks
parallelrepairvdisks
Usage: parallelrepairvdisks [numthreads=NUM_OF_PARALLEL_REPAIRS]
[force=true] [datastores=DS_UUID1,DS_UUID2,...] [version=<1,2>]

parallelrepairvdisks
Number of threads: 10
Datastore: qbvye0hnmg8wd
Degraded Vdisks: 1 (dt9my0v16op7wc)
** Initiating repair for VDisk number 1: dt9my0v16op7wc
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {'2849269270': {'755168543': 2}}, 'drstatus': {}, 'vdiskstate':
'Degraded', 'replication': 0}
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {'2849269270': {'755168543': 3}}, 'drstatus': {}, 'vdiskstate':
'Degraded', 'replication': 0}
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {'2849269270': {'755168543': 5}}, 'drstatus': {}, 'vdiskstate':
'Degraded', 'replication': 0}
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {'2849269270': {'755168543': 7}}, 'drstatus': {}, 'vdiskstate':
'Degraded', 'replication': 0}
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {'2849269270': {'755168543': 9}}, 'drstatus': {}, 'vdiskstate':
'Degraded', 'replication': 0}
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {'2849269270': {'755168543': 100}}, 'drstatus': {}, 'vdiskstate':
'Degraded', 'replication': 0}
Repair number 1 - VDisk: dt9my0v16op7wc, status: {'result': 'SUCCESS',
'status': {}, 'drstatus': {}, 'vdiskstate': 'Degraded', 'replication': 0}
** Repair successful for VDisk: dt9my0v16op7wc
Repaired: 1 (dt9my0v16op7wc)

New improved version of parallelrepair are recomend to use:
parallelrepairvdisks version=2
parallelrepairvdisks version=2
Using version 2 of parallelrepairvdisks
Start repair threads: 10 at Datastores dict_keys(['qbvye0hnmg8wd'])
Datastore: qbvye0hnmg8wd
Degraded Vdisks: 1 ([{'disk_uuid': 'dt9my0v16op7wc', 'ds_uuid':
'qbvye0hnmg8wd'}])
** Initiating repair for VDisk: dt9my0v16op7wc
get_master_and_slavelist Master {'uuid': '92501251', 'segno': 3072000} ||
slaveList |||
All stripe members up to date for stripe 1, nothing to repair
get_master_and_slavelist Master {'uuid': '755168543', 'segno': 3072000} ||
slaveList [{2849269270}]|||
Enabling sync for vdisk dt9my0v16op7wc on master 755168543 slaves:
[2849269270] for stripe member: 0
Repair - VDisk: dt9my0v16op7wc from DS qbvye0hnmg8wd, status: {'result':
'SUCCESS', 'status': {'2849269270': 0}, 'drstatus': {}, 'vdiskstate': 'Degraded',
'replication': 0}
Repair - VDisk: dt9my0v16op7wc from DS qbvye0hnmg8wd, status: {'result':
'SUCCESS', 'status': {'2849269270': 0}, 'drstatus': {}, 'vdiskstate': 'Degraded',
'replication': 0}
Repair - VDisk: dt9my0v16op7wc from DS qbvye0hnmg8wd, status: {'result':
'SUCCESS', 'status': {'2849269270': 1}, 'drstatus': {}, 'vdiskstate': 'Degraded',
'replication': 0}
20 Integrated Storage Networking

20.1 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.

20.1.1 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 > Actions > Resource Options > Manage Hardware Devices > Edit Hardware Device Configuration** > set the *Unassigned* option for all network interfaces.

2. **Reboot** compute resource.

3. Prepare configuration in the Control Panel and collect the following data:

   o **MAC address** - to check it, go to Control Panel > Admin > Settings > Compute Resources > label of the compute resource > Actions > Resource Options > Manage Hardware Devices.

   o **MTU** - you may check it in the Integrated Storage Settings section.

   o **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
     ```

   o **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:
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```
xctl addbr <bridge name>
xctl 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

<br> - 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 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
<br> - 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:

```
fconfig <bridge name> mtu <MTU>
fconfig <interface name> mtu <MTU>
```

<bridge name> - SAN network bridge name
<br> - name of compute resource interface connected to SAN network
<br> - MTU of a compute resource

11. Add interface to the bridge:
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12. Set up multicast at bridge and interface:

```bash
brctl addif <bridge name> <interface name>
```

- `<bridge name>` - SAN network bridge name
- `<interface name>` - name of compute resource interface connected to SAN network

13. Bring interface up:

```bash
ifconfig <interface name> up
```

- `<interface name>` - name of compute resource interface connected to SAN network

14. Finally, restart network and SAN service:

```bash
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.

### 20.1.2 IS 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 > Actions > Resource Options > Manage Hardware Devices > Edit Hardware Device Configuration > 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 > Actions > Resource Options > Manage Hardware 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:
4. Access the compute resource via SSH and prepare config files for slave interfaces and bond device:

```
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

- **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
```

`<HV MAC>` - MAC address of the compute resource's management NIC

`<bond name>` - SAN network bond device 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

- **Interface name1 Interface name2** - names of compute resource interfaces connected to SAN network

```
cat << EOF > /tftpboot/images/centos5/diskless/snapshot/<HV MAC>/onappstore.conf
  Interface name1 Interface name2
EOF
```

`<HV MAC>` - MAC address of the compute resource's management NIC

`<Interface name1 Interface name2>` - names of compute resource interfaces connected to SAN network
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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
```

<bond name> - SAN network bond device name
@interface1/2 name> - names of compute resource interfaces in bonding connected to SAN network
<bond 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:

```
pftables -D FORWARD -j ACCEPT -s 10.200.0.0/16 -d 10.200.0.0/16
pftables -A FORWARD -j ACCEPT -s 10.200.0.0/16 -d 10.200.0.0/16
pftables -D FORWARD -j ACCEPT -s 10.200.0.0/16 -d 224.0.0.0/8
pftables -A FORWARD -j ACCEPT -s 10.200.0.0/16 -d 224.0.0.0/8
```

7. Set NOTRACK for bridge:

```
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
```
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
```

9. Set arptables and ebtables (you can get <bond mac> running ifconfig <bond name>):

```sh
arp -A FORWARD -j ACCEPT -i <bond name>
arp -A FORWARD -j ACCEPT -o <bond name>
arp -A FORWARD -j ACCEPT -i <interface1 name>
arp -A FORWARD -j ACCEPT -o <interface1 name>
arp -A FORWARD -j ACCEPT -i <interface2 name>
arp -A FORWARD -j ACCEPT -o <interface2 name>
arp -t broute -A BROUTING -s <bond mac> -i <bond name> -j DROP
arp -t broute -A BROUTING -s DE:AD:BE:EF:<host id>:0/ff:ff:ff:ff:0 -i <bond name> -j DROP
```

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>
```

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:

```bash
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:

```bash
ifconfig <interface name> up
```

<interface name> - name of compute resource interface connected to SAN network

15. Finally, restart network and SAN service:

```bash
systemctl restart network.service
cat/init.d/SANController stop
cat/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.

See also:

- [Network Health Check](#)
- [Manage CloudBoot Compute Resource Devices](#)
- [Manage Static Compute Resource Devices](#)