Acronis Software-Defined Infrastructure 2.5

Administrator's Guide

April 19, 2021

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Acronis patented technologies

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Contents

CHAPTER 1

About This Guide

This primary guide describes operations on Acronis Software-Defined Infrastructure that you can perform via the web-based admin panel. In particular, it explains how to:

- configure networking for both the storage and compute cluster;
- create and manage the storage cluster;
- set up and run storage services, including S3, iSCSI, NFS, and backup gateways;
- monitor the storage cluster;
- create and manage the compute cluster;
- create and manage virtual machines, volumes, images, and storage policies;
- perform auxillary tasks: set up high availability, enable RDMA, manage licenses, send problem reports, and such.

CHAPTER 2

Managing the Storage Cluster

Before you create the storage cluster, you need to set up the networks and assign them to network interfaces as recommended in the *Installation Guide*. Next, configure an external DNS server as described in *Adding External DNS Servers* (page 163). Next, enable high availability of the management node (see *Enabling High Availability* (page 152)). Finally, make sure that storage nodes are shown on the **NODES** screen and proceed to create the storage cluster.

If you have remote iSCSI devices you wish to connect to cluster nodes, you can configure them prior to cluster creation as described in *Connecting Remote iSCSI Devices to Storage Cluster Nodes* (page 162).

2.1 Managing Networks and Traffic Types

To balance and optimize networking in Acronis Software-Defined Infrastructure, you can assign different types of traffic to separate networks. Assigning a traffic type to a network means that a firewall is configured on nodes connected to this network, specific ports are opened on node network interfaces, and the necessary `iptables` rules are set. For example, nodes connected to a network with only the **S3 public** traffic type will accept incoming connections only on ports 80 and 443.

As described in the *Installation Guide*, is it recommended to have these networks in Acronis Software-Defined Infrastructure:

- For internal storage traffic (traffic types: **Storage**, **Internal management**, **OSTOR private**, **ABGW private**), assigned to the first bonded connection;

Note: If you plan to use RDMA over InfiniBand, move the traffic type **Storage** to a dedicated network

and assign that network to the IB interface. See *Enabling RDMA* (page 164).

- For overlay networking (traffic type **VM private**), assigned to a VLAN created on the second bonded connection;
- For management and API (traffic types: **Admin panel**, **SSH**, **SNMP**, **Compute API**), assigned to a VLAN created on the second bonded connection;
- For external networking (traffic types: **VM public**, **S3 public**, **ABGW public**, **iSCSI**, and **NFS**), assigned to a VLAN created on the second bonded connection.

You need to configure these networks on the **INFRASTRUCTURE** > **Networks** screen on the admin panel before you create the cluster (see *Creating, Editing, and Deleting Networks* (page 5)). By default, you have two preconfigured networks: **Public** and **Private**. They can be considered as templates that you can customize to create the desired (recommended) configuration.

Note: Some traffic types cannot be reassigned to a different network if they are in use.

After you create the networks, proceed to create the remaining of the recommended VLAN interfaces on each node and assign them to networks as described in *Creating VLAN Interfaces* (page 11).

An example of recommended networks and their traffic types is:

Table 2.1.1: Recommended network setup

Network	Traffic types
Public	Compute API, Admin panel, SSH, SNMP
Private	Storage, Internal management, OSTOR private, ABGW private
Overlay	VM private
Export	S3 public, iSCSI, NFS, ABGW public, VM public

The next three subsections describe all traffic types that can be assigned to networks.

2.1.1 Exclusive Traffic Types

Exclusivity means that such a traffic type can be added only to one network. Exclusive traffic types cannot be reassigned between networks if they are in use. To do that, you will have to delete the service that uses them first.

Internal management Internal cluster management and transfers of node monitoring data to the admin panel. Without this traffic type, the administrator cannot control and monitor the cluster. The cluster, however, continues working.

Storage Internal transfers of data chunks, high availability service heartbeats, as well as data self-healing. This is the most critical traffic type that defines storage performance and enables cluster HA.

OSTOR private Internal data exchange between multiple S3/NFS services.

ABGW private Internal management of and data exchange between multiple ABGW services.

VM private Network traffic between VMs in private virtual networks and VNC console traffic. Private virtual networks are implemented as VXLAN, overlay networking fully isolated on L2.

Compute API External access to standard OpenStack API endpoints. Opens TCP ports 8004, 5000, 8774, 8780, 6080, 9696, 8776, 9191, 9292.

2.1.2 Regular Traffic Types

The traffic types listed further are not exclusive and can be added to multiple networks.

S3 public External data exchange with the S3 access point. Uses TCP ports 80 and 443.

iSCSI External data exchange with the iSCSI access point. Uses TCP port 3260.

NFS External data exchange with the NFS access point. Uses TCP/UDP ports 111, 892, and 2049.

ABGW public External data exchange with Acronis Backup agents and Acronis Backup Cloud. Uses TCP port 44445.

Admin panel External access to the admin panel. Uses TCP port 8888.

VM public External data exchange between VMs and public networks (e.g., the Internet). When a node network interface is assigned to a network with this traffic type, an Open vSwitch bridge is

	created on that network interface.
SSH	Remote access to nodes via SSH. Uses TCP port 22.
SNMP	External access to storage cluster monitoring statistics via the SNMP protocol. Opens UDP port 161.

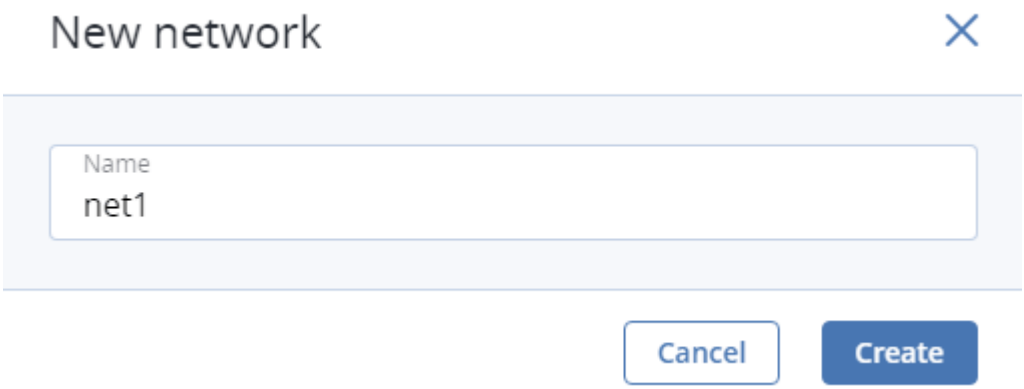
2.1.3 Custom Traffic Types

You can create custom traffic types that will open desired TCP ports. Such traffic types can be added to multiple networks. See *Creating, Editing, and Deleting Traffic Types* (page 6).

2.1.4 Creating, Editing, and Deleting Networks

If required, you can add a new network by doing as follows:

1. On the **INFRASTRUCTURE** > **Networks** screen, click **Edit** and then **Create network**.
2. In the **New network** window, specify a network name. Network names must be alphanumerical and 3-32 characters long.



3. Click **Create**.
4. Add the needed traffic types to the new network by ticking the corresponding checkboxes.
5. When finished, click **Save** to apply the changes.

To edit a network name or delete a custom network, click on the ellipsis icon next to it and select the action you want to perform.

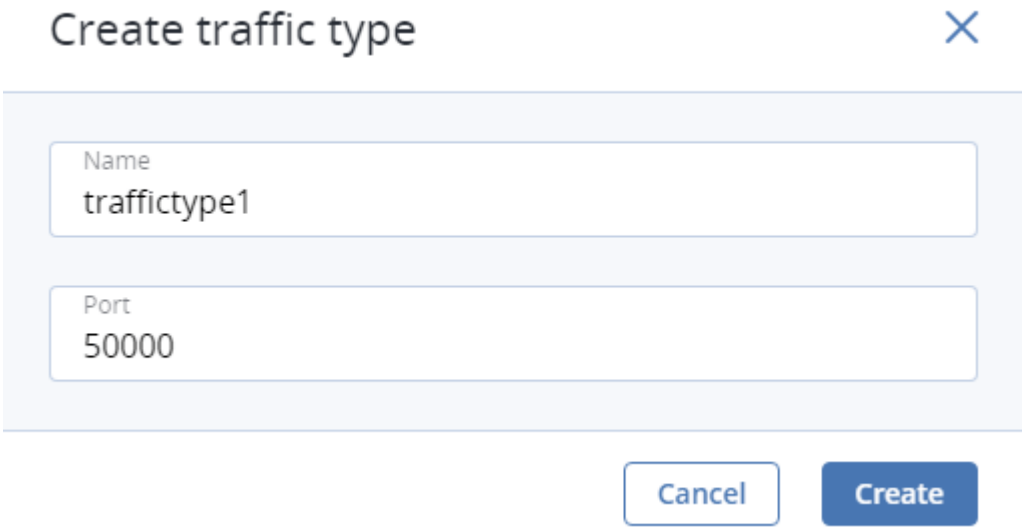
You can only delete networks that are not assigned to any network adapters.

2.1.5 Creating, Editing, and Deleting Traffic Types

If required, you can add a new traffic type by doing as follows:

1. On the **INFRASTRUCTURE** > **Networks** screen, click **Edit** and then **Create traffic type**.
2. In the **Create traffic type** window, specify a traffic type name and port to open.

   Traffic type names must be alphanumerical and 3-32 characters long.



3. Click **Create**.
4. Add the newly created traffic type to one or more of your networks by ticking the corresponding checkboxes.
5. When finished, click **Save** to apply the changes.

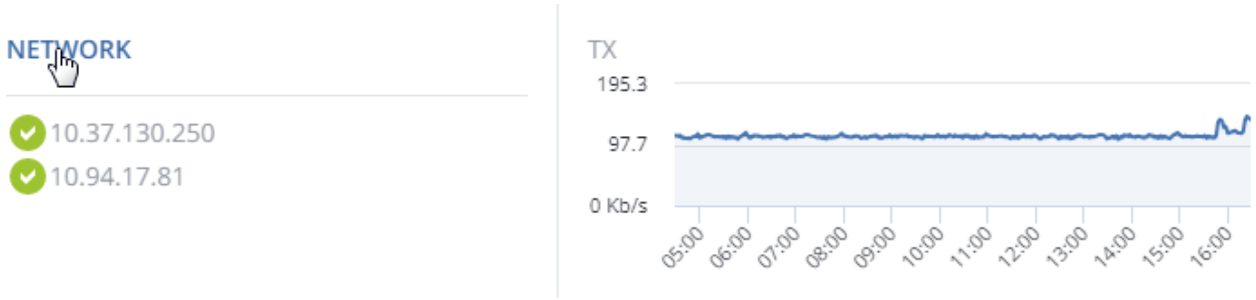
To edit or delete a custom traffic type, make sure it is excluded from all networks, click the ellipsis icon next to it, and select the desired action.

2.2 Configuring Node Network Interfaces

After configuring the networks, you need to assign them to the network interfaces on each node. A network can only be assigned to one network interface per node.

To assign a network to a network interface, do the following:

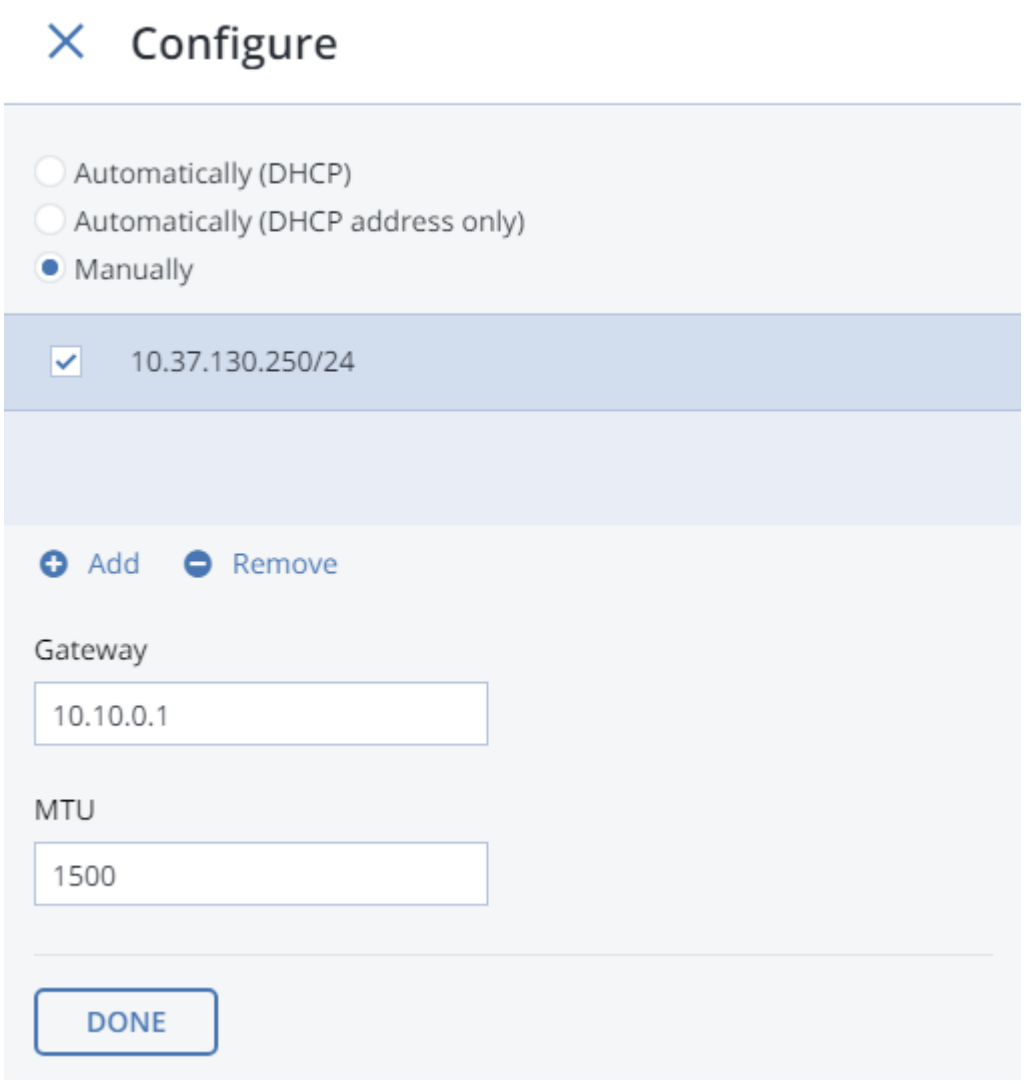
1. On the **NODES** screen, click a node to configure.
2. On the node overview screen, click **NETWORK**.



3. Select a network interface and click **Configure**.
4. On the **Configure** screen, do one of the following:
   - To obtain the IP address, DNS, and routing settings from the DHCP server, select **Automatically (DHCP)**.
   - To obtain just the IP address from the DHCP server, select **Automatically (DHCP address only)**.
   - To specify the IP address manually, select **Manual** and add the IP address.

Warning: Dynamic IP address allocation will cause network issues as soon as the IP addresses of cluster nodes will change. Configure static IP addresses from the start or as soon as possible.

Note: For information about configuring RDMA-enabled network interfaces, see *Enabling RDMA* (page 164).



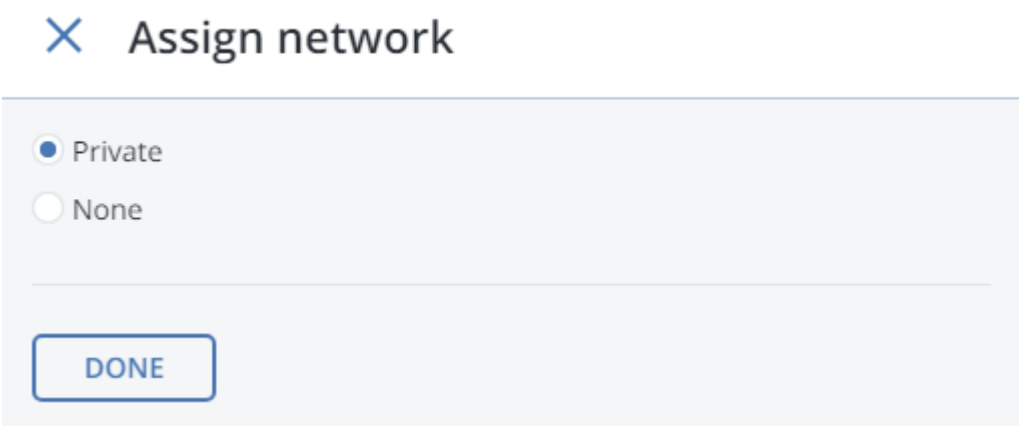
5. If necessary, set up a gateway and a DNS server. The provided gateway will become node's default.
6. If you have set a custom maximum transmission unit (MTU) on the network hardware, set the same value in the corresponding field.

> **Warning:** Setting a custom MTU in admin panel prior to configuring it on the network hardware will result in network failure on the node and require manual resetting. Setting an MTU that differs from the one configured on the network hardware may result in network outage or poor performance.

7. Click **Done** to return to the list of network interfaces, do not change the selection, and click **Assign**

network.

8. On the **Assign network** panel, select a network to connect the network interface to (for details, see *Managing Networks and Traffic Types* (page 2)) and click **Done**.



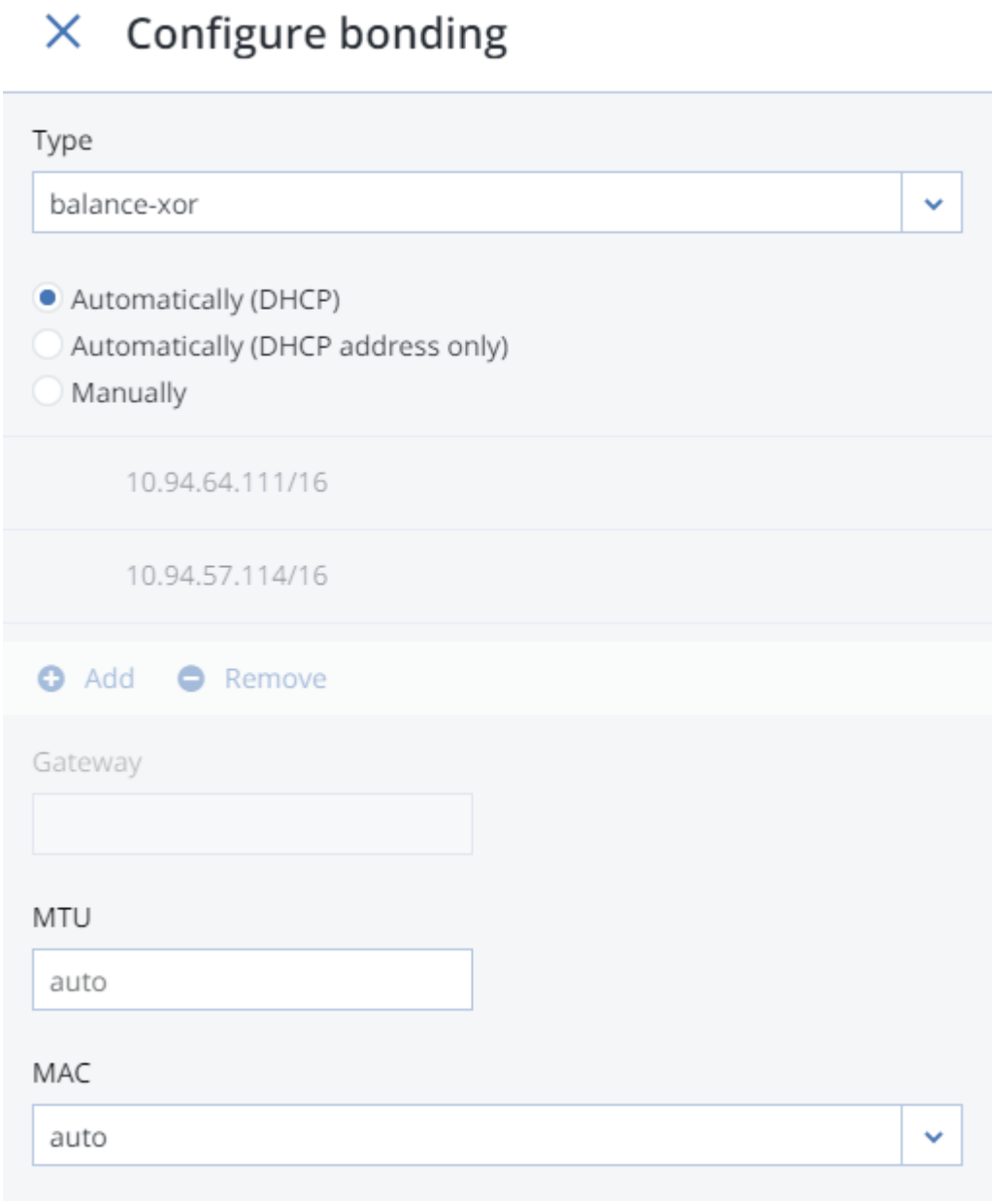
2.2.1 Setting Up Network Bonding

Bonding multiple network interfaces is optional but provides the following benefits:

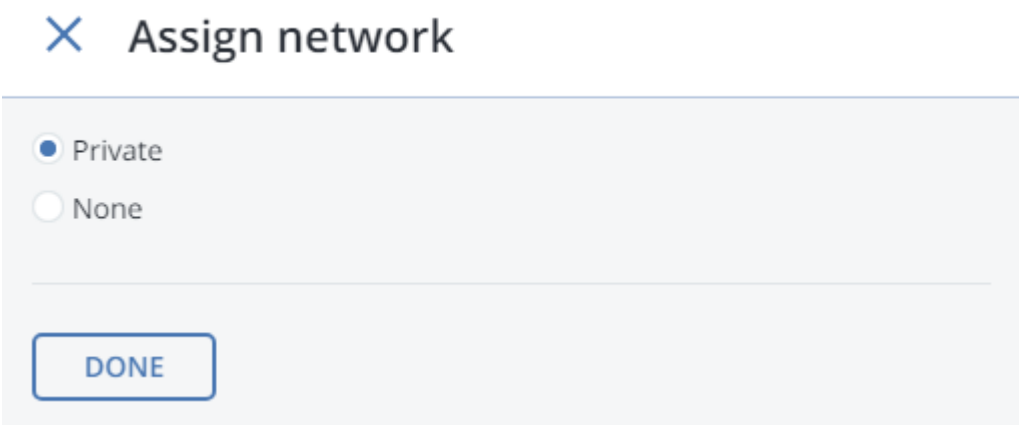
- High network availability. If one of the interfaces fails, the traffic will be automatically routed through the working interface(s).
- Higher network performance. For example, two bonded Gigabit interfaces will deliver the throughput of about 1.7 Gbit/s or up to 200 MB/s. For a storage node, the required number of network interfaces to bond may depend on the number of disks. For example, an HDD can deliver data at speeds of up to 1 Gbps.

To create a bond, do the following:

1. On the **NODES** screen, click the node to bond the network interfaces on.
2. On the node overview screen, click **NETWORK**.
3. In the **NETWORK** list, check network interfaces to bond, and click **Create bonding** in the menu to the right.
4. On the **Configure Bonding** panel, select the bonding type from the drop-down list. The balance-xor type is selected by default and recommended for both fault tolerance and good performance.



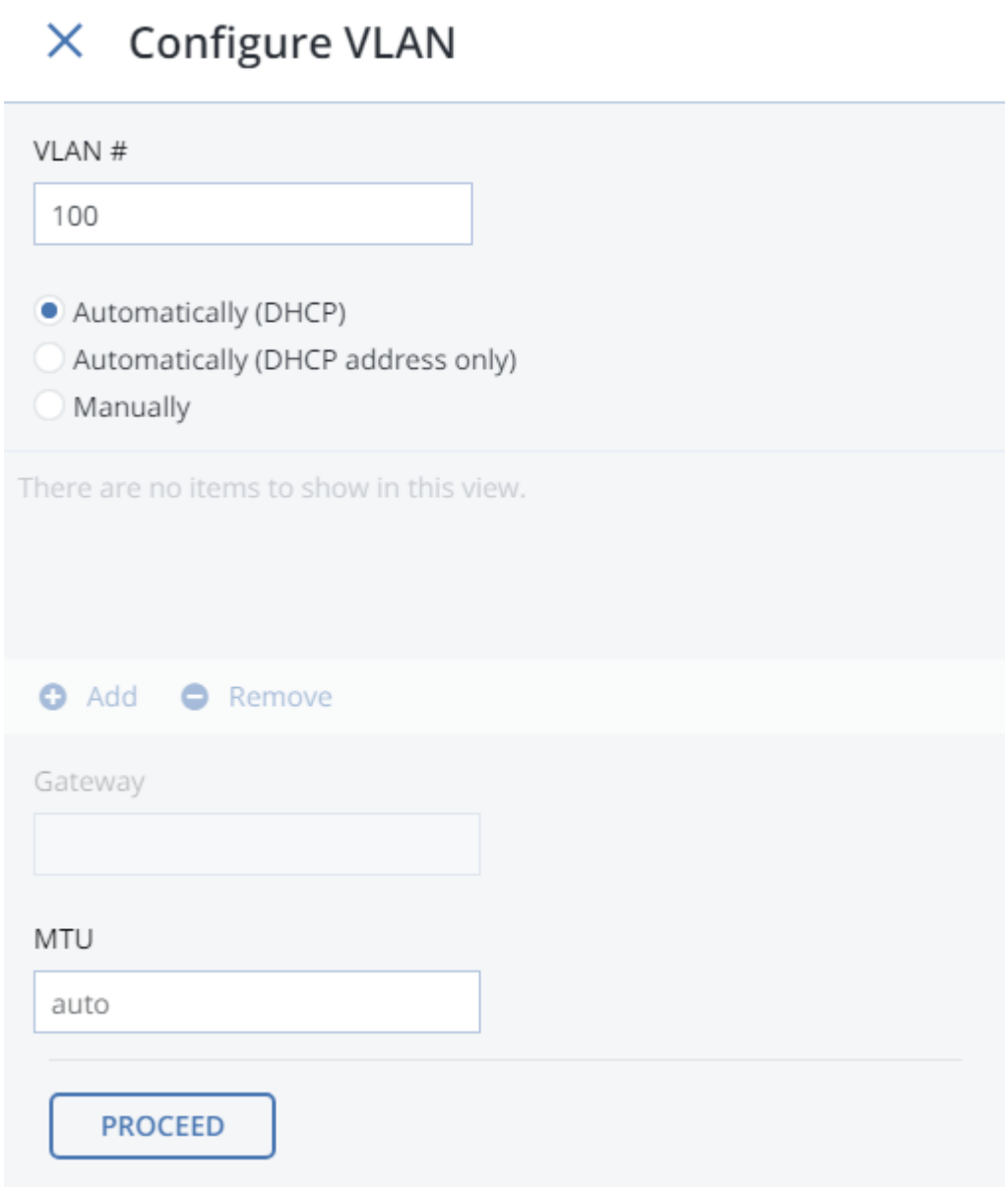
5. Set up network parameters as described in step 4 in *Configuring Node Network Interfaces* (page 7) and click **PROCEED**.
6. On the **Assign network** panel, select a network to connect the bonding network interface to (for details, see *Managing Networks and Traffic Types* (page 2)) and click **Done**.



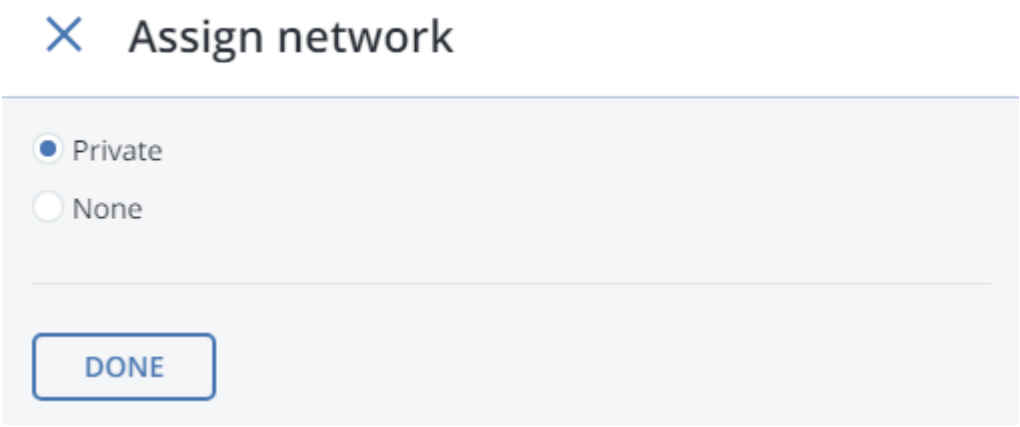
2.2.2 Creating VLAN Interfaces

To create a VLAN interface on a node, do the following:

1. On the **NODES** screen, click the node on which to configure VLAN.
2. On the node overview screen, click **NETWORK**.
3. Select a network interface and click **Create VLAN**.
4. On the **Configure VLAN** panel, specify a number for VLAN, add an IP address, and, if necessary, set up a gateway and a DNS server. The provided gateway will become node's default.



5. On the **Assign network** panel, select a network to connect the VLAN network interface to (for details, see *Managing Networks and Traffic Types* (page 2)) and click **Done**.



2.3 Creating the Storage Cluster

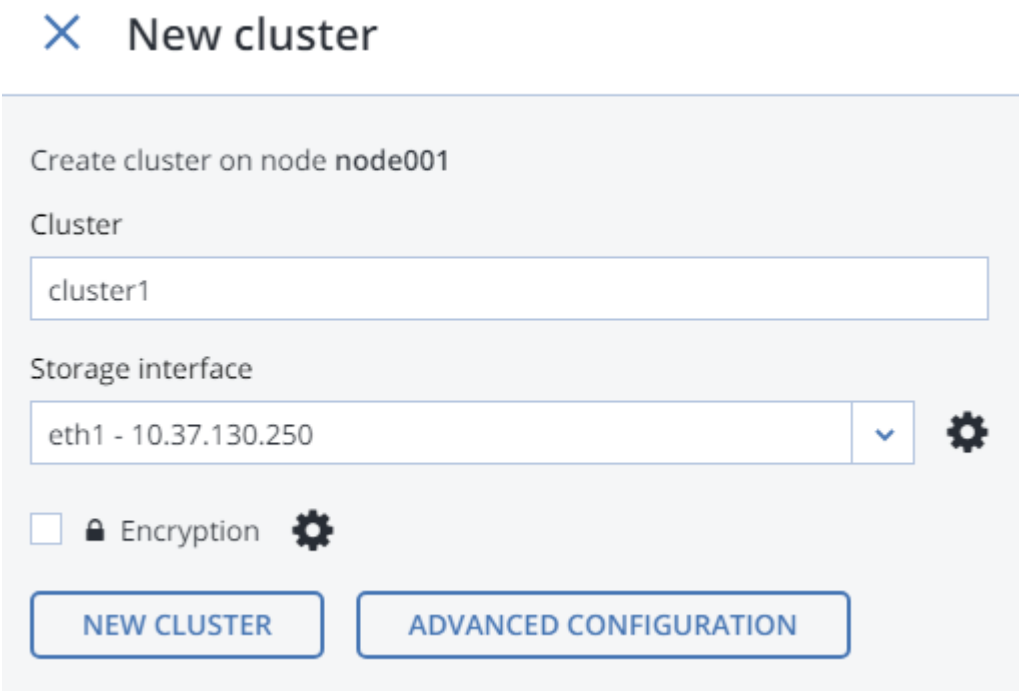
Before you create the storage cluster, enable high availability of the management node as described in *Enabling High Availability* (page 152).

To create a storage cluster, you need to create a basic storage cluster on one (first) node, then populate it with more nodes.

If networks adapters on your nodes support RDMA (via RoCE, iWARP or IB) and you want to enable this functionality, you must do so before creating the storage cluster as explained in *Enabling RDMA* (page 164).

2.3.1 Creating the Storage Cluster on the First Node

1. Open the **INFRASTRUCTURE** > **Nodes** screen and click a node in the **UNASSIGNED** list.
2. On the node overview screen, click **Create cluster**.
3. In the **Cluster** field, type a name for the cluster. The name may only contain Latin letters (a-z, A-Z), numbers (0-9), underscores (“_”) and dashes (“-“).



4. From the **Storage interface** drop-down list, select a node network interface connected to a network with the traffic type **Storage**.

   If node network interfaces are not configured, click the cogwheel icon and assign a network with the traffic type **Storage** to a node's network interface.

5. If required, enable data encryption. To do this, check the **Encryption** box (see *Managing Tier Encryption* (page 145)) and proceed to create the cluster. Encryption will be enabled for all tiers by default. To enable encryption for particular tiers, click the cogwheel icon to open the **Encryption Configuration** panel, select tiers to encrypt, and click **Done**. You can later disable encryption for new chunk services (CS) on the **SETTINGS** > **Advanced settings** panel.

6. Click **New cluster** to have Acronis Software-Defined Infrastructure assign the roles to disks automatically. Alternatively, click **Advanced configuration** to assign the roles to each drive manually and tweak other settings.

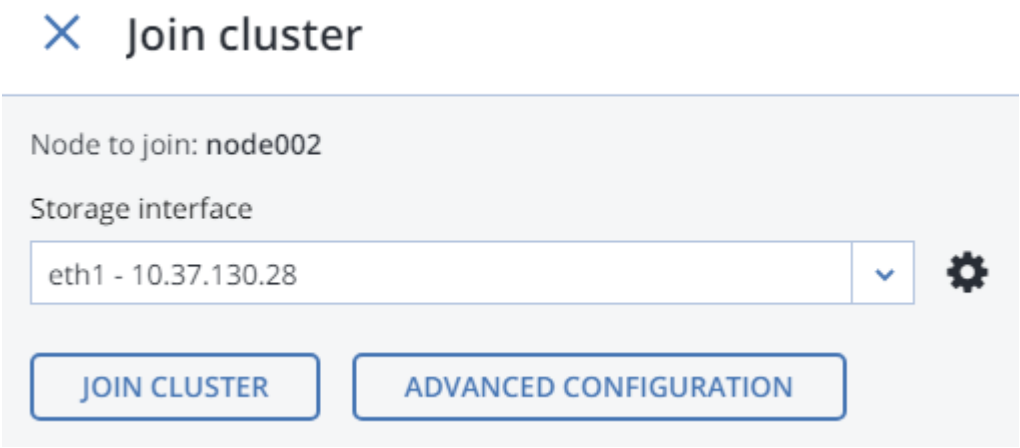
You can monitor cluster creation progress in the **HEALTHY** list of the **INFRASTRUCTURE** > **Nodes** screen. The creation might take some time depending on the number of disks to be configured. Once the automatic configuration is complete, the cluster is created.

2.3.2 Adding Nodes to Storage Cluster

To add an unassigned node to a cluster, do the following:

1. On the **INFRASTRUCTURE** > **Nodes** screen, click an unassigned node.
2. On the node overview screen, click **Join cluster**.
3. Make sure a network interface that is connected to a network with the traffic type **Storage** is selected from the **Storage interface** drop-down list.

   If node network interfaces are not configured, click the cogwheel icon and assign a network with the traffic type **Storage** to a node's network interface.

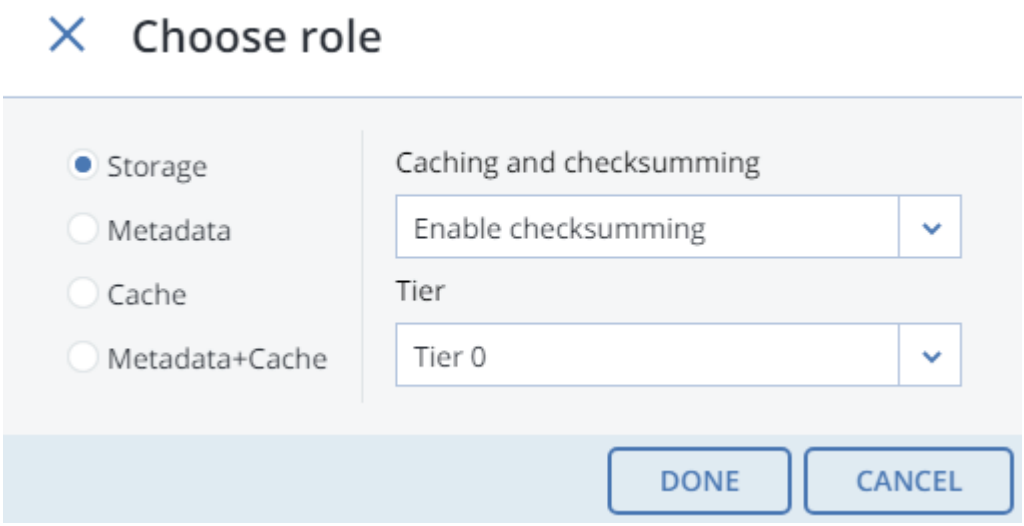


4. Click **Join cluster** to have Acronis Software-Defined Infrastructure assign the roles to disks automatically and add the node to the current cluster. Alternatively, click **Advanced configuration** to assign the roles to each drive manually (see *Assigning Disk Roles Manually* (page 15)).

2.3.3 Assigning Disk Roles Manually

If you clicked **Advanced configuration** while creating a cluster or adding nodes to it, you will be taken to the list of drives on the node where you can manually assign roles to these drives. Do the following:

1. On the **Join cluster** or **New cluster** panel, select a drive or check multiple drives in the list and click **Configure**.
2. On the **Choose role** screen, select one of the following roles for the disk:



- **Storage**. Use the disk to store chunks and run a chunk service on the node. From the **Caching and checksumming** drop-down list, select one of the following:
  - **Use SSD for caching and checksumming**. Available and recommended only for nodes with SSDs.
  - **Enable checksumming** (default). Recommended for nodes with HDDs as it provides better reliability.
  - **Disable checksumming**. Not recommended for production. For an evaluation or testing environment, you can disable checksumming for nodes with HDDs, to provide better performance.

  Data caching improves cluster performance by placing the frequently accessed data on an SSD.

  Data checksumming generates checksums each time some data in the cluster is modified. When this data is then read, a new checksum is computed and compared with the old checksum. If the two are not identical, a read operation is performed again, thus providing better data reliability and integrity.

  If a node has an SSD, it will be automatically configured to keep checksums when you add a node to a cluster. This is the recommended setup. However, if a node does not have an SSD drive, checksums will be stored on a rotational disk by default. It means that this disk will have to handle double the I/O, because for each data read/write operation there will be a corresponding checksum read/write operation. For this reason, you may want to disable checksumming on nodes without SSDs to gain performance at the expense of checksums. This can be especially useful for hot data storage.

To add an SSD to a node that is already in the cluster (or replace a broken SSD), you will need to release the node from the cluster, attach the SSD, choose to join the node to the cluster again, and, while doing so, select **Use SSD for caching and checksumming** for each disk with the role **Storage**.

With the **Storage** role, you can also select a tier from the **Tier** drop-down list. To make better use of data redundancy, do not assign all the disks on a node to the same tier. Instead, make sure that each tier is evenly distributed across the cluster with only one disk per node assigned to it. For more information, see the *Installation Guide*.

Note: If the disk contains old data that was not placed there by Acronis Software-Defined Infrastructure, the disk will not be considered suitable for use in Acronis Software-Defined Infrastructure.

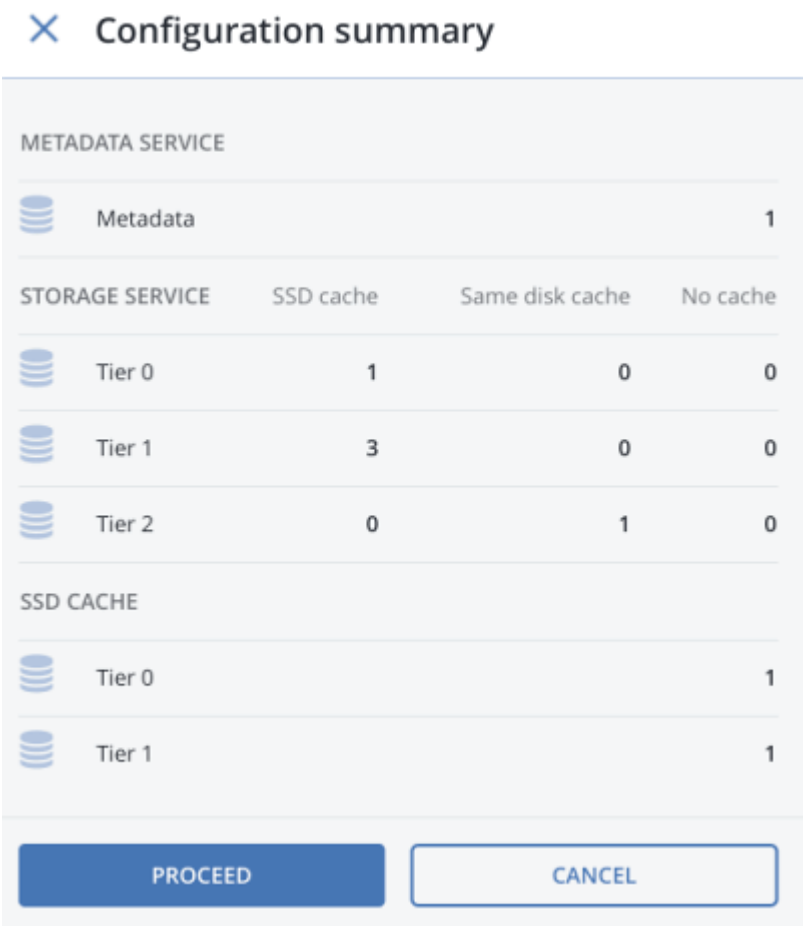
- **Metadata**. Use the disk to store metadata and run a metadata service on the node.
- **Cache**. Use the disk to store write cache. This role is only for SSDs. To cache a specific storage tier, select it from the drop-down list. Otherwise, all tiers will be cached.
- **Metadata+Cache**. A combination of two roles described above.
- **Unassigned**. Remove the roles from the disk.

Take note of the following:

- If a physical server has a system disk with the capacity greater than 100GB, that disk can be additionally assigned the **Metadata** or **Storage** role. In this case, a physical server can have at least 2 disks.
- It is recommended to assign the **System+Metadata** role to an SSD. Assigning both these roles to an HDD will result in mediocre performance suitable only for cold data (e.g., archiving).
- The **System** role cannot be combined with the **Cache** and **Metadata+Cache** roles. The reason is that is I/O generated by the operating system and applications would contend with I/O generated by journaling, negating its performance benefits.

3. Click **Done**.
4. Repeat steps 1 to 3 for every disk you want to be used in the storage cluster.
5. Click **NEW CLUSTER** or **JOIN CLUSTER**. On the **Configuration summary** screen, check the number of

disks per each configuration category.

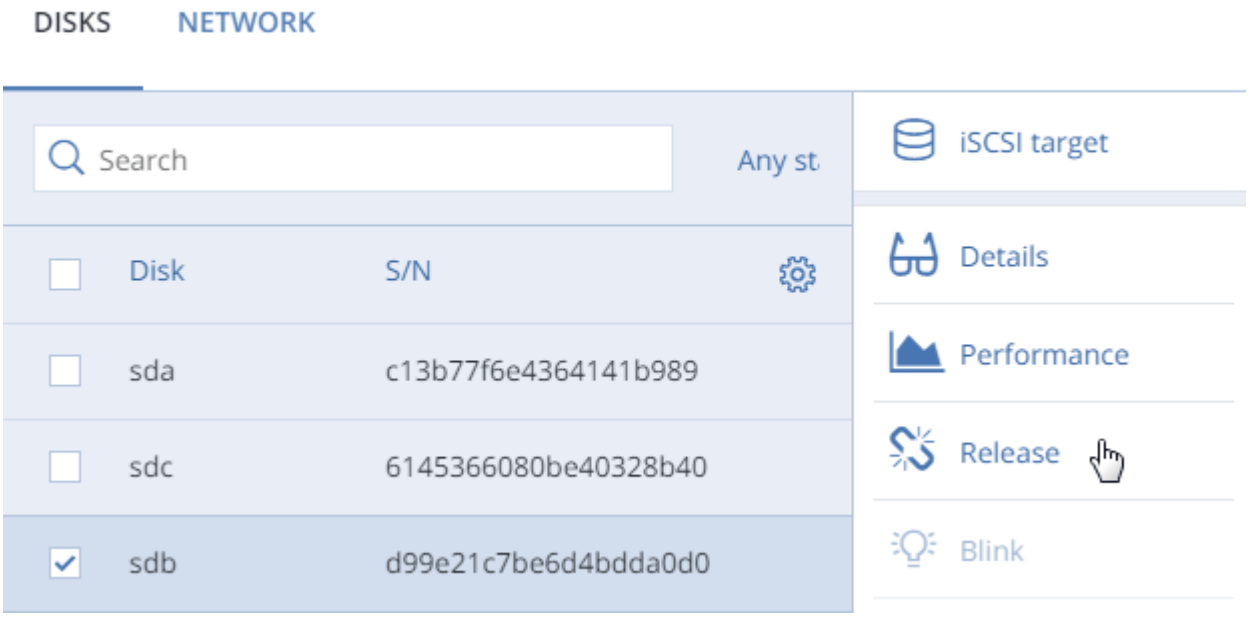


6. Click **PROCEED**. You can monitor disk configuration progress in the **HEALTHY** list of the **INFRASTRUCTURE** > **Nodes** screen.

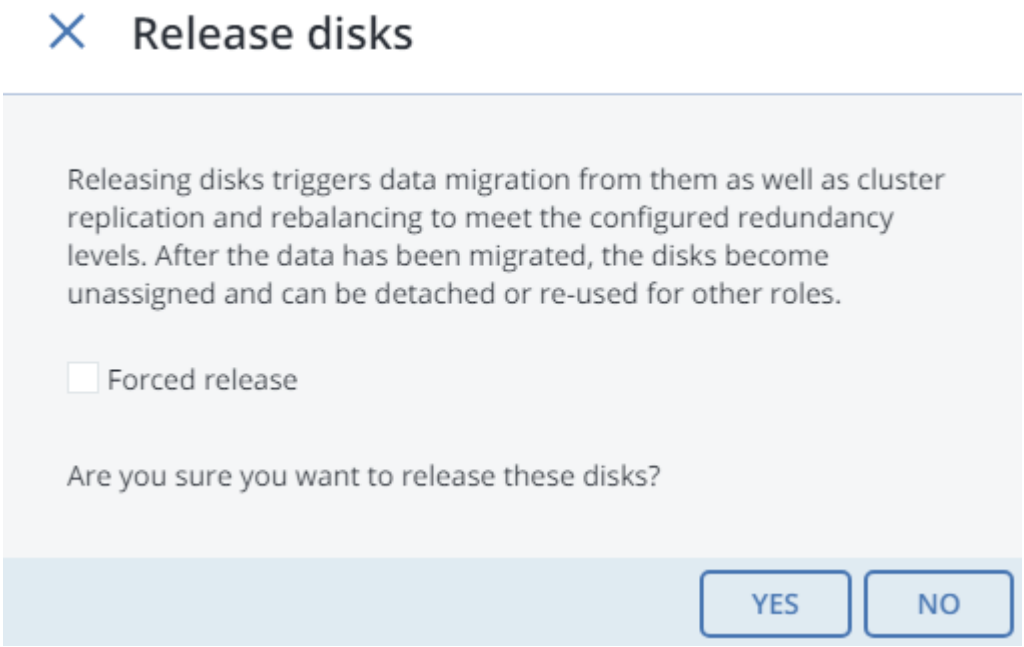
2.4 Replacing Node Disks

If a disk installed in a storage cluster node fails, replace it as follows:

1. Open **INFRASTRUCTURE** > **Nodes** > <node> > **Disks**.
2. Select the failed disk, click **Release**.

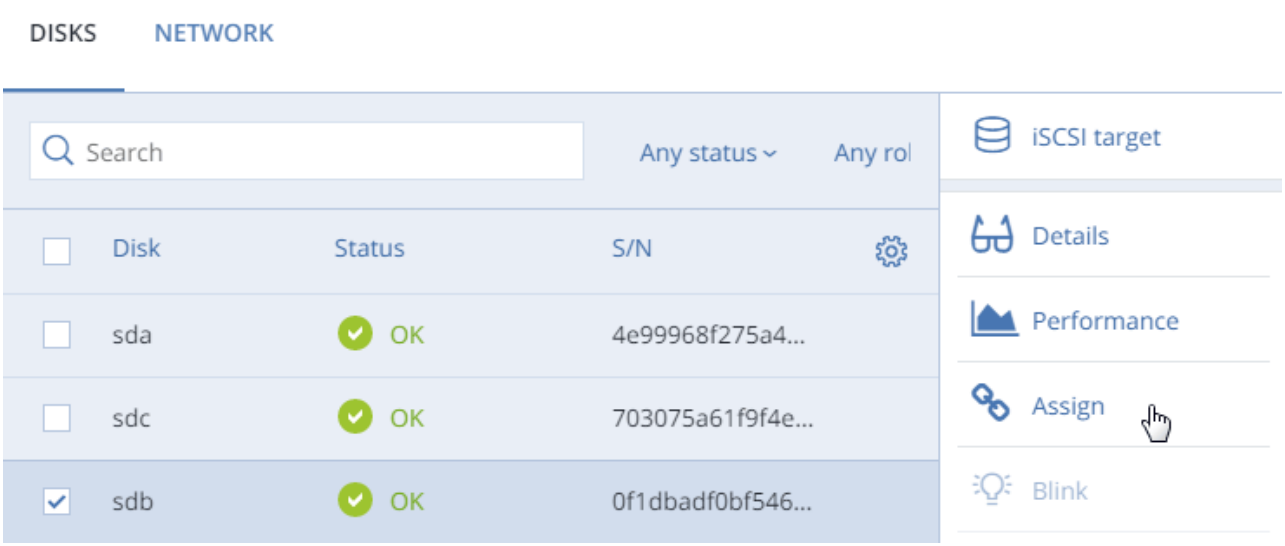


3. In the **Release disk** window, click **YES**.

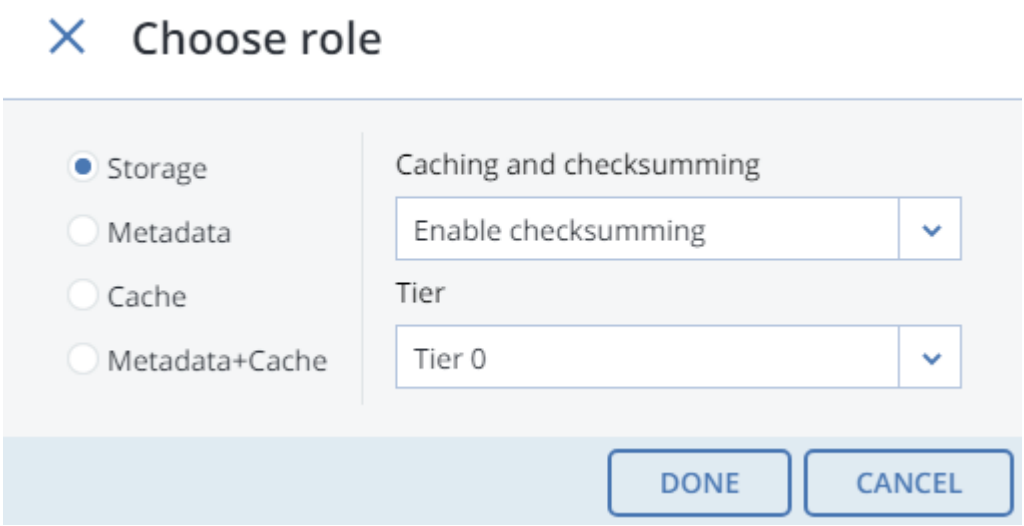


4. Replace the disk with a new one.

5. Back on **INFRASTRUCTURE** > **Nodes** > <node> > **Disks**, select the unassigned disk and click **Assign**.



6. In the **Choose role** window, select the required disk role and click **DONE**.



The disk will be assigned the chosen role and added to the cluster.

2.5 Releasing Nodes from the Storage Cluster

To release a node means to remove it from the cluster (e.g., for maintenance). As the node may be running services needed by the cluster, do the following prior to releasing it to avoid cluster degradation:

1. If the node runs one of the three required metadata services, add a metadata role to another node. You need to make sure that the cluster has at least three metadata services running at any time.

2. If the node has any access points, make sure that the same access points are configured on other nodes in the cluster as well.
3. If the node is in an iSCSI target group, remove it from the target group first.
4. If the node has an S3 gateway or ABGW, reconfigure DNS for S3 and ABGW access points to remove the node from DNS records. Next, release the node from S3 and ABGW in the corresponded sections of the **STORAGE SERVICES** screen.
5. If the node is in the compute cluster, remove it from the compute cluster first.
6. Make sure the cluster has enough storage space to accommodate the data from the released node.

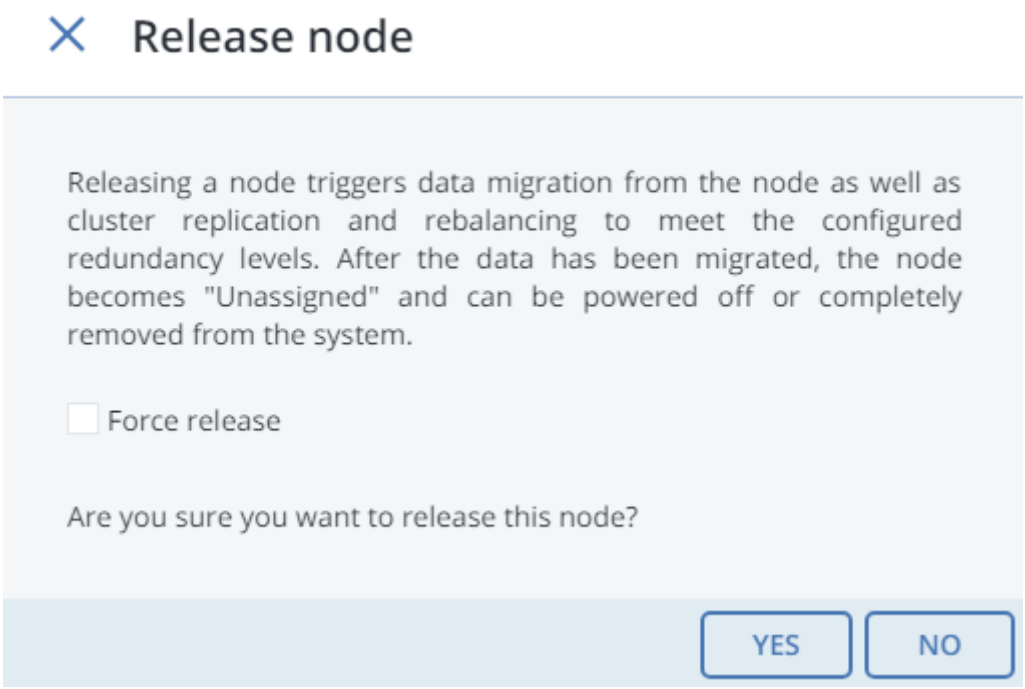
Once you initiate the release, the cluster will start replicating data chunks that were stored on the released node and distributing them among other storage nodes in the cluster. Depending on the amount of data to replicate, the process may take as much as several hours.

If necessary, you can also release a node forcibly, that is, without replication.

Warning: Releasing nodes forcibly may result in data loss.

To release a node from a cluster, do the following:

1. On the **INFRASTRUCTURE** > **Nodes** screen, click the node to release.
2. On the node overview screen, click **Release**.
3. If necessary, in the **Release** node window, check force to release the node forcibly (highly not recommended).
4. Click **Yes**. The released node will return to the **UNASSIGNED** list on the **INFRASTRUCTURE** > **Nodes** screen.



2.6 Removing Nodes from the Unassigned List

Nodes in the **UNASSIGNED** list can be completely removed from Acronis Software-Defined Infrastructure if they are not in the high availability cluster.

To completely remove a node, select it in the **UNASSIGNED** list on the **INFRASTRUCTURE** > **Nodes** screen and click **Remove (forget)**.

Nodes completely removed from Acronis Software-Defined Infrastructure can be re-added to the **UNASSIGNED** list in two ways:

- By logging in to the node via SSH and running `/usr/libexec/vstorage-ui-agent/bin/register-storage-node.sh -m MN_ADDRESS -t TOKEN` in the node's console (`MN_ADDRESS` is the management node IP address and `TOKEN` is the token obtained in the admin panel).
- By reinstalling Acronis Software-Defined Infrastructure on the node from scratch.

CHAPTER 3

Monitoring the Storage Cluster

Acronis Software-Defined Infrastructure uses the Prometheus monitoring system to monitor performance and availability of both the entire cluster and its components. It also generates alerts, which you can configure to be sent as notifications via e-mail.

3.1 Monitoring the Entire Cluster

The overall storage cluster statistics are available on the **MONITORING** > **Dashboard** screen. Pay attention to the storage cluster status that can be one of the following:

HEALTHY All cluster components are active and operate normally.

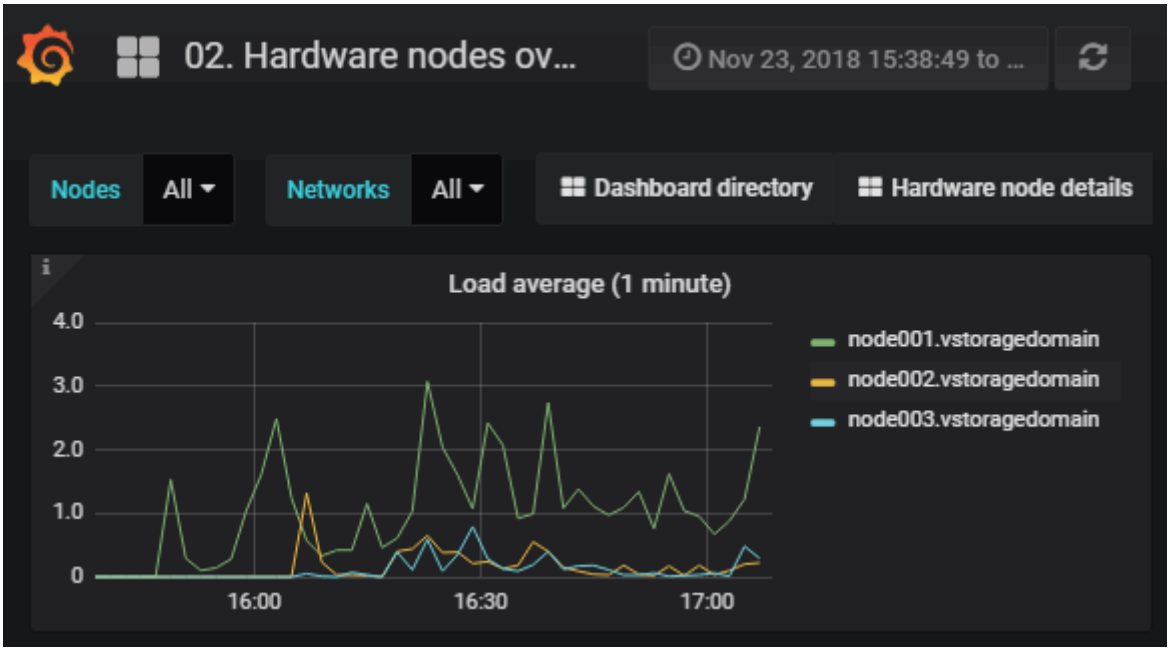
UNKNOWN Not enough information about the cluster state (e.g., because the cluster is inaccessible).

DEGRADED Some of the cluster components are inactive or inaccessible. The cluster is trying to heal itself, data replication is scheduled or in progress.

FAILURE The cluster has too many inactive services, automatic replication is disabled. If the cluster enters this state, troubleshoot the nodes or contact the support team.

To view the storage cluster statistics in full screen, click **Fullscreen mode**. To exit the fullscreen mode, press **Esc** or **Exit fullscreen mode**.

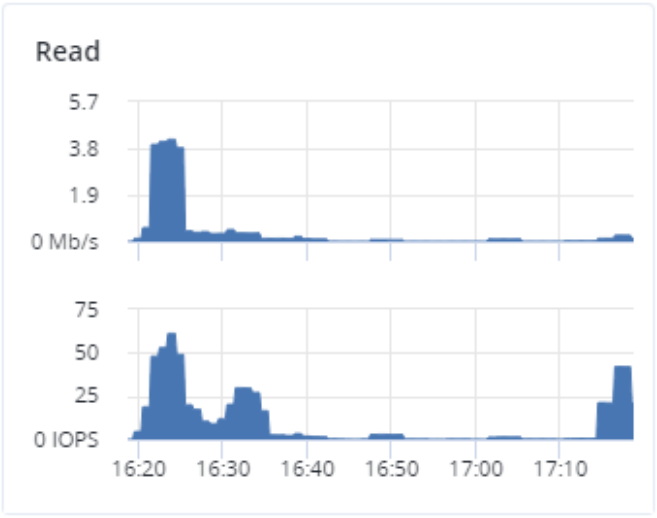
For advanced monitoring, click **Grafana dashboard**. A separate browser tab will open with preconfigured Grafana dashboards where you can manage existing dashboards, create new ones, share them between users, configure alerting, etc. For more information, refer to Grafana documentation .

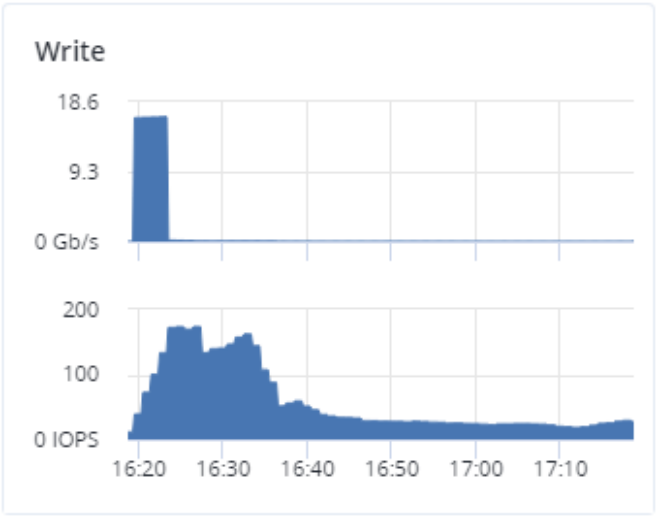


The default time interval for the charts is 12 hours. To zoom into a particular time interval, select the internal with the mouse; to reset zoom, double click any chart.

3.1.1 I/O Activity Charts

The **Read** and **Write** charts show the history of the cluster I/O activity as the speed of read and write I/O operations in megabytes per second and the number of read and write I/O operations per second (IOPS). For example:



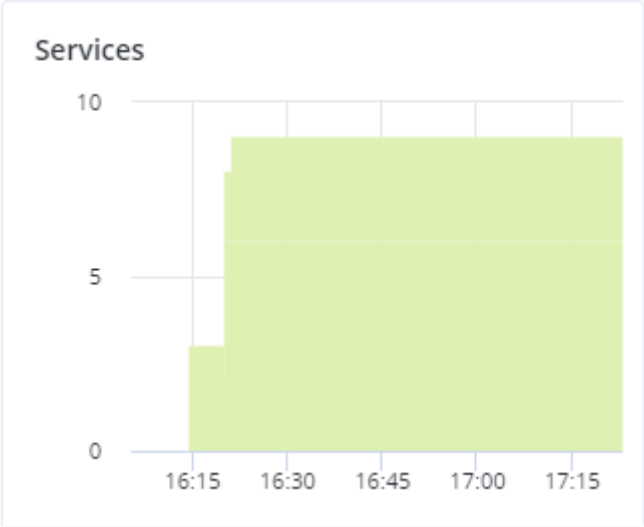


3.1.2 Services Chart

On the **Services** chart, you can monitor two types of services:

- Metadata services (MDS). The number all disks with the metadata role. Ensure that at least three MDSes are running at all times.
- Chunk services (CS). The number of all disks with the storage role.

Typical statistics may look like this:



If some of the services were not in the healthy state for some time, these time periods will be highlighted in red on the chart.

3.1.3 Chunks Chart

You can monitor the state of all chunks in the cluster on the **Chunks** chart. Chunks can be in the following states:

healthy Number and percentage of chunks that have enough active replicas. The normal state of chunks.

offline Number and percentage of chunks all replicas of which are offline. Such chunks are completely inaccessible for the cluster and cannot be replicated, read from or written to. All requests to an offline chunk are frozen until a CS that stores that chunk's replica goes online.

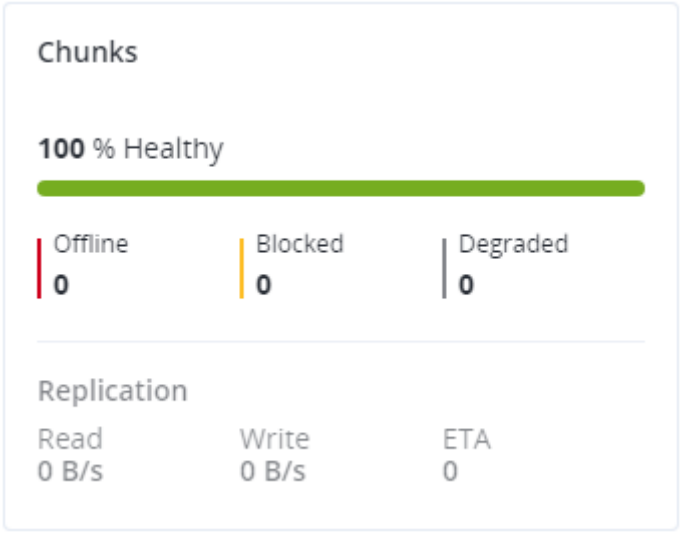
Get offline chunk servers back online as fast as possible to avoid losing data.

blocked Number and percentage of chunks which have fewer active replicas than the set minimum amount. Write requests to a blocked chunk are frozen until it has at least the set minimum amount of replicas. Read requests to blocked chunks are allowed, however, as they still have some active replicas left. Blocked chunks have higher replication priority than degraded chunks.

Having blocked chunks in the cluster increases the risk of losing data, so postpone any maintenance on working cluster nodes and get offline chunk servers back online as fast as possible.

degraded Number and percentage of chunks with the number of active replicas lower than normal but equal to or higher than the set minimum. Such chunks can be read from and written to. However, in the latter case a degraded chunk becomes urgent.

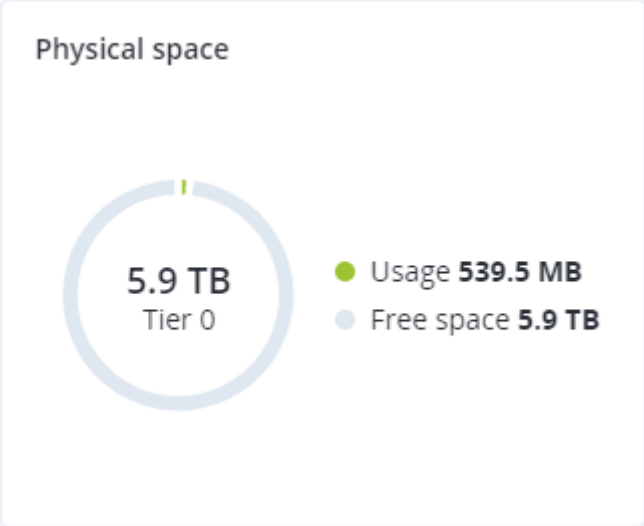
Healthy chunks are highlighted on the scale in green, offline in red, blocked in yellow, and degraded in grey. For example:



The **Replication** section shows the information about replication activity in the cluster.

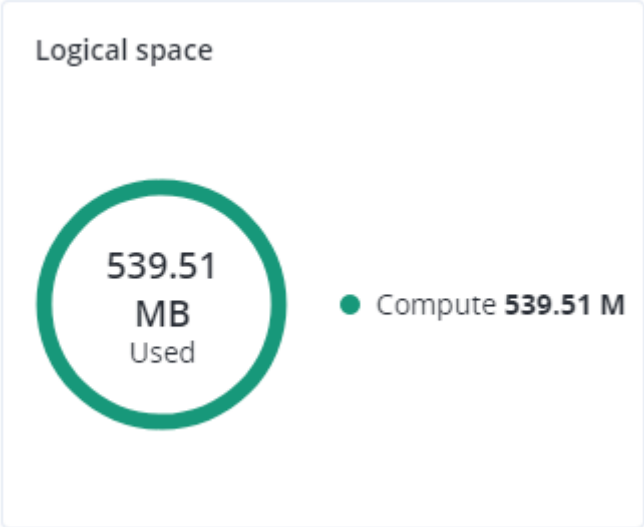
3.1.4 Physical Space Chart

The **Physical space** chart shows the current usage of physical space in the entire storage cluster and on each particular tier. The used space includes the space occupied by all data chunks and their replicas plus the space occupied by any other data.



3.1.5 Logical Space Chart

The **Logical space** chart represents all the space allocated to different services for storing user data. This includes the space occupied exclusively by user data. Replicas and erasure coding metadata are not taken into account.



3.1.5.1 Understanding Logical Space

When monitoring disk space information in the cluster, keep in mind that logical space is the amount of free disk space that can be used for storing user data in the form of data chunks and all their replicas. Once this space runs out, no data can be written to the cluster.

To better understand how logical disk space is calculated, consider the following example:

- The cluster has three disks with the storage role. The first disk has 200 GB of space, the second one has 500 GB, and the third one has 1 TB.
- If the redundancy mode is set to three replicas, each data chunk must be stored as three replicas on three different disks with the storage role.

In this example, the available logical disk space will be 200 GB, that is, equal to the capacity of the smallest disk with the storage role. The reason is that each replica must be stored on a different disk. So once the space on the smallest disk (i.e. 200 GB) runs out, no new chunk replicas can be created unless a new disk with the storage role is added or the redundancy mode is changed to two replicas.

With the two replicas redundancy mode, the available logical disk space would be 700 GB, because the two smallest disks combined can hold 700 GB of data.

3.2 Monitoring Nodes

Nodes added to the infrastructure are listed on the **NODES** screen, grouped by status. If the storage cluster has not been created yet, you will only see nodes in the **UNASSIGNED** list. If the storage cluster exists, its nodes will be listed on the screen.

The default time interval for the charts is 12 hours. To zoom into a particular time interval, select the internal with the mouse; to reset zoom, double click any chart.

3.2.1 Node Statuses

A node can have one of the following statuses:

HEALTHY All the storage services on the node are running.

OFFLINE The node cannot be reached from the admin panel, although it may still be up and its services may be running.

FAILED One or more storage services on the node have failed.

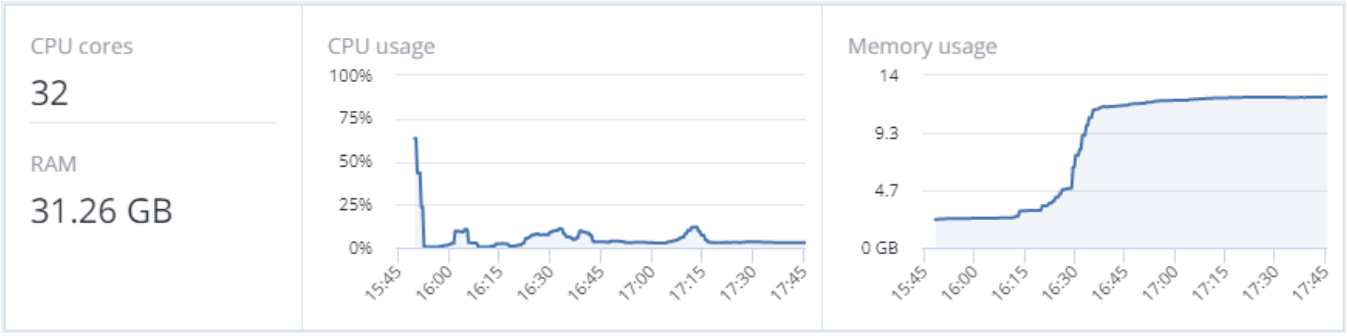
UNASSIGNED The node is not assigned to a cluster.

3.2.2 Monitoring Node Performance

To monitor the performance of a cluster node, open the **NODES** screen and click the node. On the node overview screen, you will see performance statistics described below.

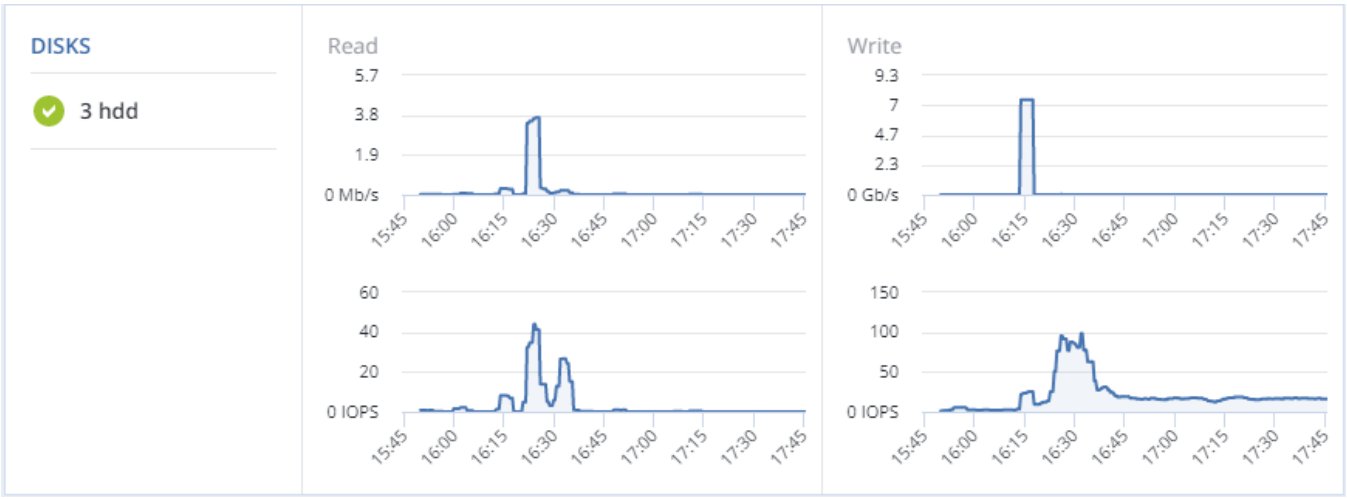
The overall statistics include:

- the number of CPUs and the amount of RAM,
- CPU usage, in percent over time,
- RAM usage, in gigabytes over time.



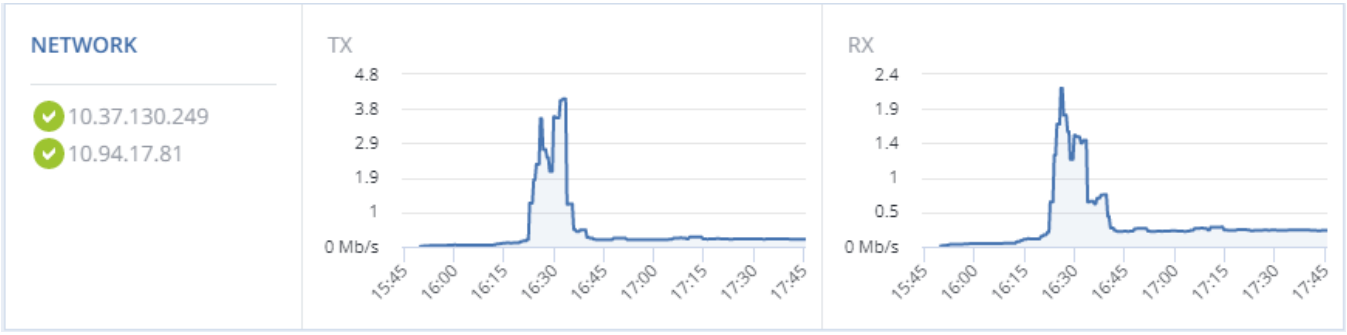
The **DISKS** section shows:

- the number of HDD and SSD drives and their statuses,
- node I/O activity over time on the read and write charts.



The **NETWORK** section shows:

- the list of network interfaces and their statuses,
- the amount of transmitted (TX) and received (RX) traffic over time.



The following sections provide more information on disk and network usage.

3.2.3 Monitoring Node Disks

To monitor the usage and status of node disks, click the **DISKS** link on the node overview screen. You will see a list of all disks on the node and their status icons.

A disk status icon shows the combined status of S.M.A.R.T. and the service corresponding to the disk role. It can be one of the following:

OK The disk and service are healthy.

Failed The service has failed or S.M.A.R.T. reported an error.

Releasing The service is being released. When the process finishes, the disk status will change to **OK**.

To monitor performance of a particular disk, select it and click **Performance**. The **Drive performance** panel will display the I/O activity of the disk.

To view information about the disk, including its S.M.A.R.T. status, click **Details**.

To have the disk blink its activity LED, select the disk, and click **Blink**. To have the disk stop blinking, click **Unblink**.

3.2.3.1 Monitoring the S.M.A.R.T. Status of Node Disks

The S.M.A.R.T. status of all disks is monitored by a tool installed along with Acronis Software-Defined Infrastructure. Run every 10 minutes, the tool polls all disks attached to nodes, including journaling SSDs and system disks, and reports the results to the management node.

For the tool to work, make sure the S.M.A.R.T. functionality is enabled in node's BIOS.

If a S.M.A.R.T. warning message is shown in the node status, one of that node's disks is in pre-failure condition and should be replaced. If you continue using the disk, keep in mind that it may fail or cause performance issues.

Pre-failure condition means that at least one of these S.M.A.R.T. counters is not zero:

- Reallocated Sector Count
- Reallocated Event Count
- Current Pending Sector Count
- Offline Uncorrectable

3.2.4 Monitoring Node Network

To monitor the node's network usage, click **NETWORK** on the node overview screen.

To display the performance charts of a specific network interface, select it in the list and click **Performance**. When monitoring network performance, keep in mind that if the **Receive and transmit errors** chart is not empty, the network is experiencing issues and requires attention.

To display the details of a network interface, click **Details**. The **Network details** panel shows the interface state, bandwidth, MTU, MAC address, and all IP addresses.

3.3 Monitoring Storage Cluster Objects via SNMP

You can monitor cluster objects via the Simple Network Management Protocol (SNMP). The implementation conforms to the same Structure of Management Information (SMI) rules as the data in the standard SNMP context: all objects are organized in a tree; each object identifier (OID) is a series of integers corresponding to tree nodes and separated by dots.

General information:

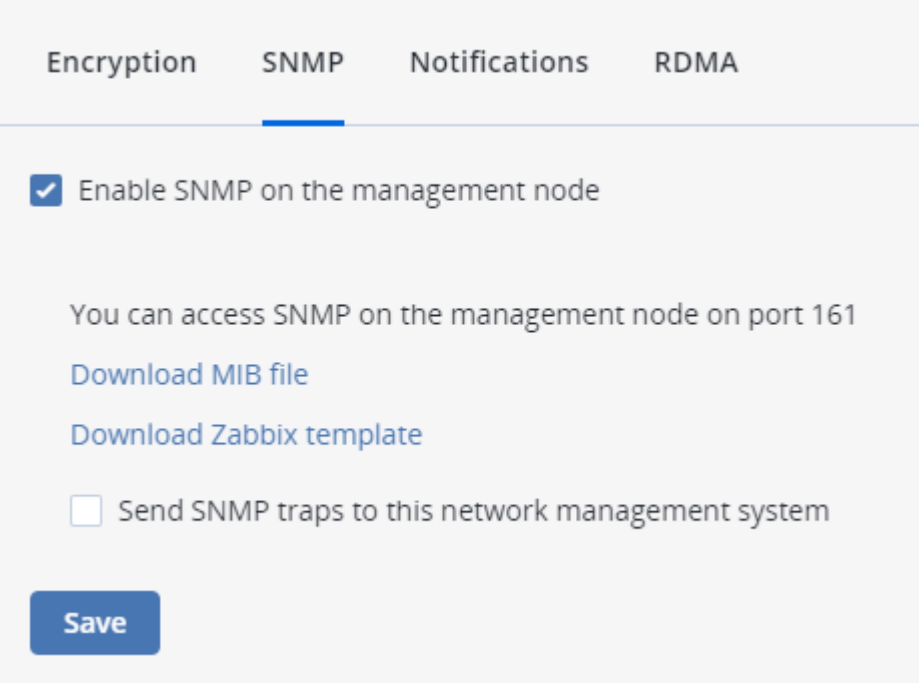
- The OID of the root subtree with all the objects you can monitor is 1.3.6.1.4.1.8072.161.1.
- The `VSTORAGE-MIB.txt` information base file is required to monitor the objects. You can download the file at `https://<admin_panel_IP>:8888/api/v2/snmp/mibs/`.

The following subsections describe ways to enable and use SNMP to monitor cluster objects.

3.3.1 Enabling SNMP Access

To monitor cluster objects, enable the SNMP access on the node. Do the following in the admin panel:

1. On the **SETTINGS** > **Advanced settings** > **SNMP** tab, check **Enable SNMP on management node**. Doing so lets your network management system (SNMP monitor) access the cluster via the SNMP protocol on the management node's port 161.



2. Click the corresponding link to download the MIB file and set it up in your SNMP monitor.
3. If required, have Acronis Software-Defined Infrastructure send SNMP traps to your SNMP monitor. Do the following:
    1. Check **Send SNMP traps to Network Management System**.
    2. Specify the **IP** of the system, and, if required, change the default **Port** and **Community**.
    3. If required, click **SEND TEST TRAP** to test the service.
4. Click **SAVE** to apply changes.

3.3.2 Accessing Storage Cluster Information Objects via SNMP

You can access storage cluster information objects with SNMP tools of your choice, e.g., the free Net-SNMP suite for Linux.

To obtain storage cluster information on a node with the admin panel, place the MIB file to `/usr/share/snmp/mibs` and run the `snmpwalk` command. For example:

```
# snmpwalk  -M /usr/share/snmp/mibs -m VSTORAGE-MIB -v 2c -c public \
localhost:161 VSTORAGE-MIB:cluster
```

Typical output may be the following:

```
VSTORAGE-MIB::clusterName.0 = STRING: "cluster1"
VSTORAGE-MIB::healthStatus.0 = STRING: "healthy"
VSTORAGE-MIB::usedSpace.0 = Counter64: 173732322
VSTORAGE-MIB::totalSpace.0 = Counter64: 1337665179648
VSTORAGE-MIB::freeSpace.0 = Counter64: 1318963253248
VSTORAGE-MIB::licenseStatus.0 = STRING: "unknown"
VSTORAGE-MIB::licenseCapacity.0 = Counter64: 1099511627776
VSTORAGE-MIB::licenseExpirationStatus.0 = STRING: "None"
VSTORAGE-MIB::ioReadOpS.0 = Counter64: 0
VSTORAGE-MIB::ioWriteOpS.0 = Counter64: 0
VSTORAGE-MIB::ioReads.0 = Counter64: 0
VSTORAGE-MIB::ioWrites.0 = Counter64: 0
VSTORAGE-MIB::csActive.0 = Counter64: 11
VSTORAGE-MIB::csTotal.0 = Counter64: 11
VSTORAGE-MIB::mdsAvail.0 = Counter64: 4
VSTORAGE-MIB::mdsTotal.0 = Counter64: 4
<...>
```

3.3.2.1 Listening to SNMP Traps

To start listening to SNMP traps, do the following:

1. Configure the `snmptrapd` daemon to log SNMP traps, allow them to trigger executable actions, and resend data to the network. To do this, add the following `public` community string to the `/etc/snmp/snmptrapd.conf` file:

   ```
   authCommunity log,execute,net public
   ```

2. Start the daemon and specify the MIB file:

   ```
   # snmptrapd -M /usr/share/snmp/mibs -m VSTORAGE-MIB -n -f -Lf /tmp/traps.log
   ```

3. Send a test trap from the **SETTINGS** > **Advanced settings** > **SNMP** tab in the admin panel.

4. View the log file:

   ```
   # tail -f /tmp/traps.log
   2017-04-23 02:48:18 UDP: [127.0.0.1]:58266->[127.0.0.1]:162 [UDP: \
   [127.0.0.1]:58266->[127.0.0.1]:162]:
   SNMPv2-SMI::mib-2.1.3.0 = Timeticks: (1687405) 4:41:14.05       \
   SNMPv2-SMI::snmpModules.1.1.4.1.0 = OID: VSTORAGE-MIB::generalAlert     \
   VSTORAGE-MIB::trapType = STRING: Test Case      VSTORAGE-MIB::trapMsg = \
   STRING: This Is Text Message to end-user    \
   VSTORAGE-MIB::trapPriority = Counter64: 1
   ```

   The test trap is considered a `generalAlert`.

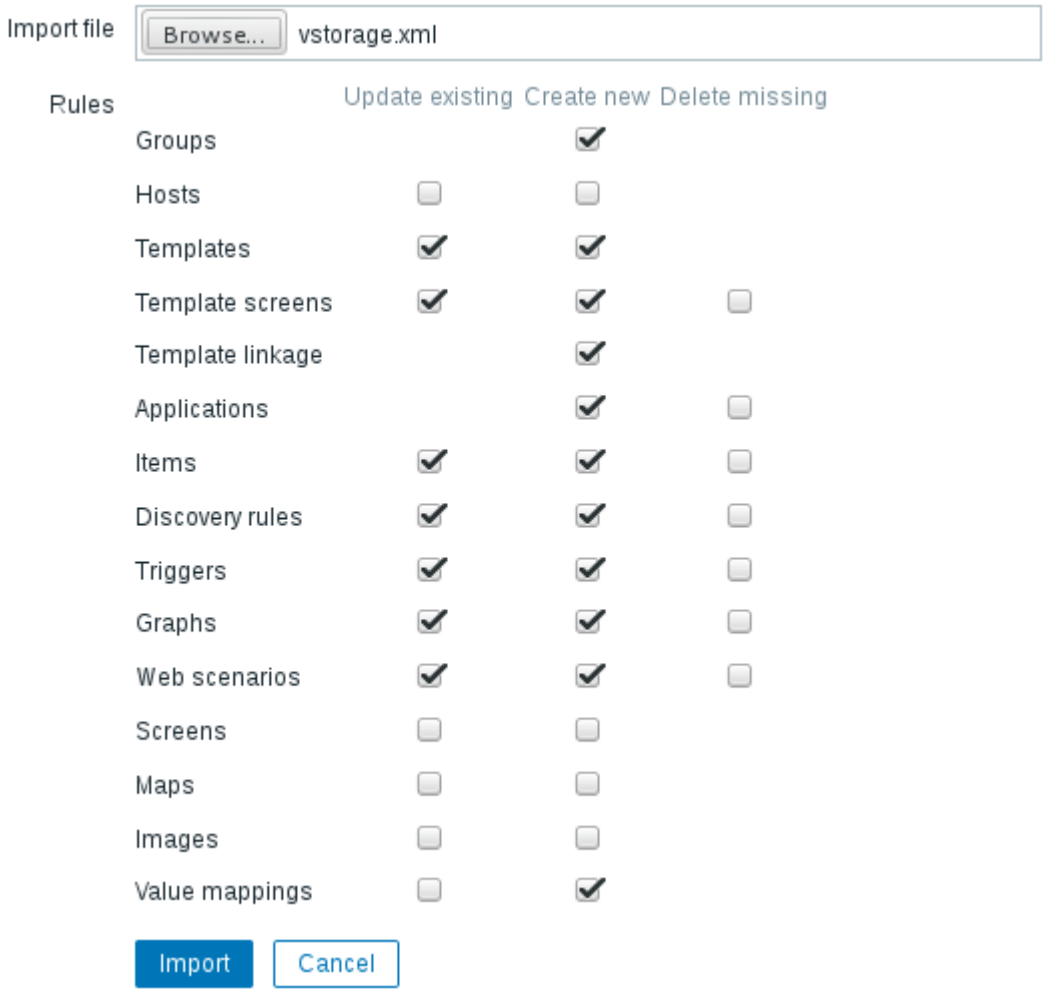
3.3.3 Monitoring the Storage Cluster with Zabbix

To configure cluster monitoring in Zabbix, do the following:

1. On the **SETTINGS** > **Advanced settings** > **SNMP** tab, click the corresponding link to download a template for Zabbix.

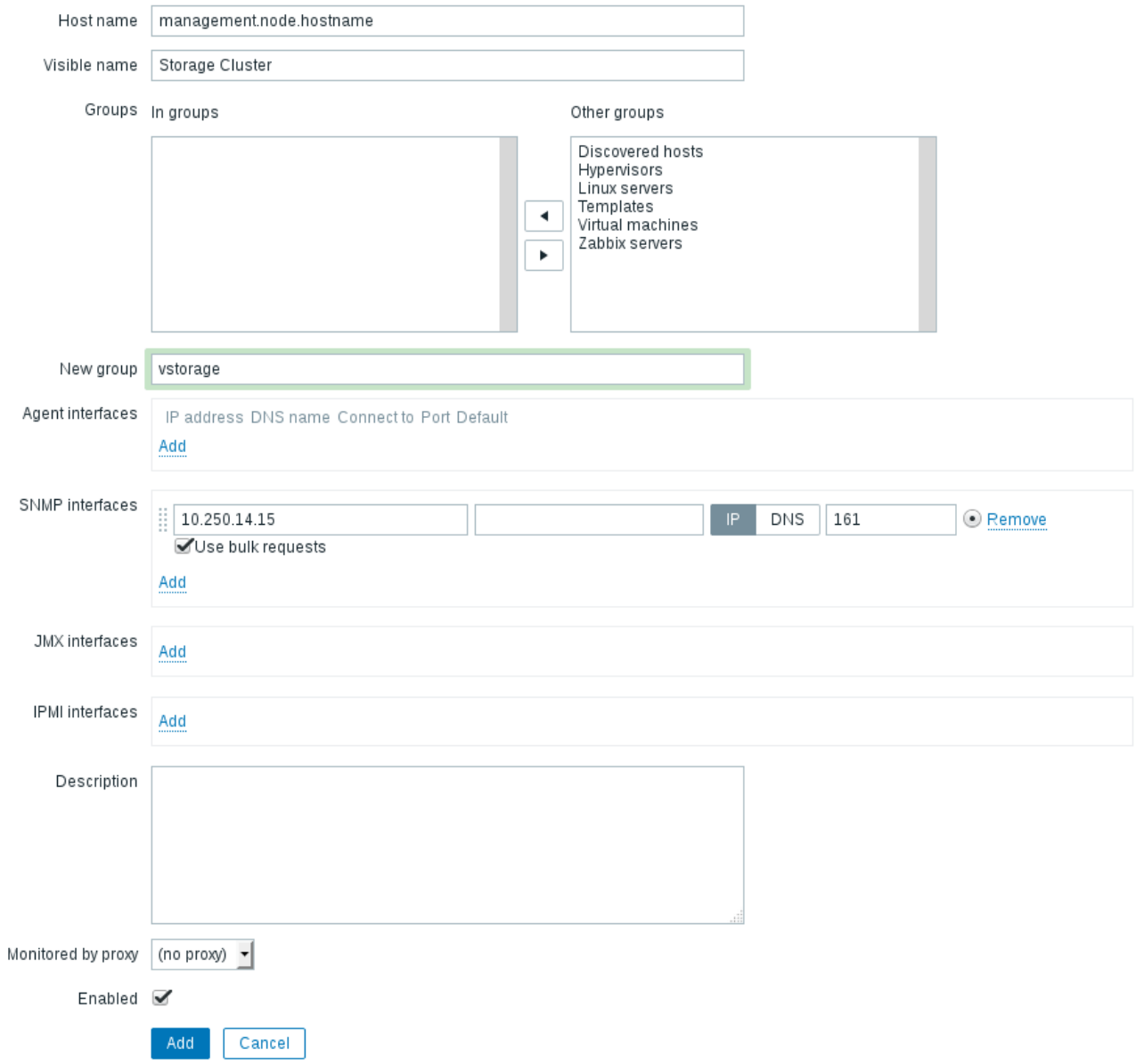
   Note: The template is compatible with Zabbix 3.x.

2. In Zabbix, click **Configuration** > **Templates** > **Import** and **Browse**.



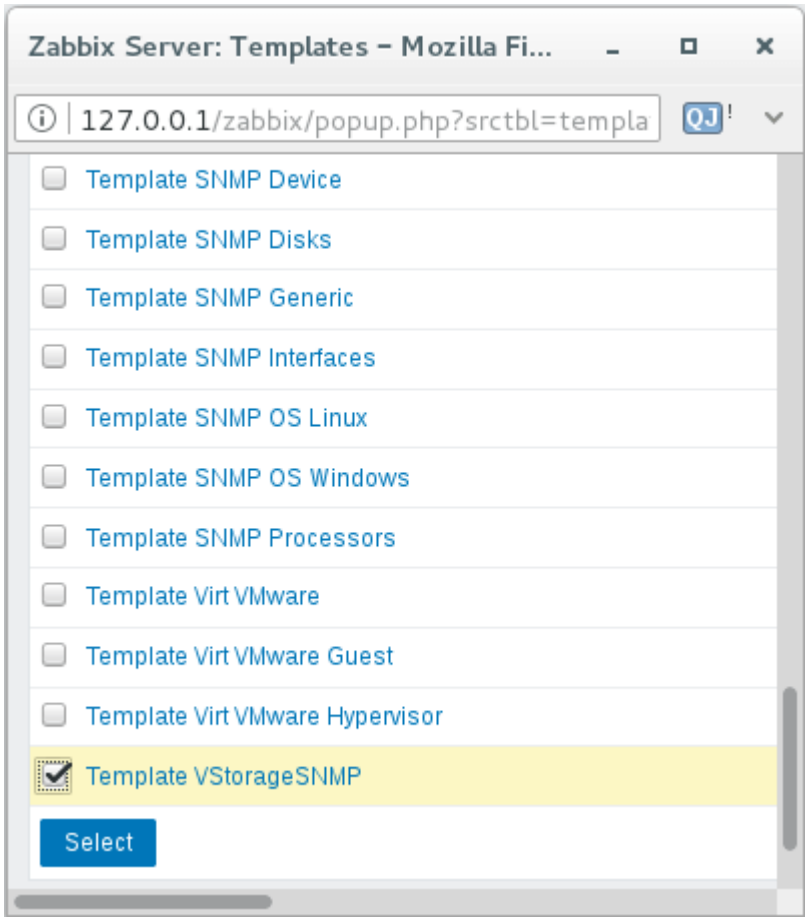
3. Navigate to the template, select it, and click **Import**.

4. Click **Configuration** > **Hosts** > **Create host**.

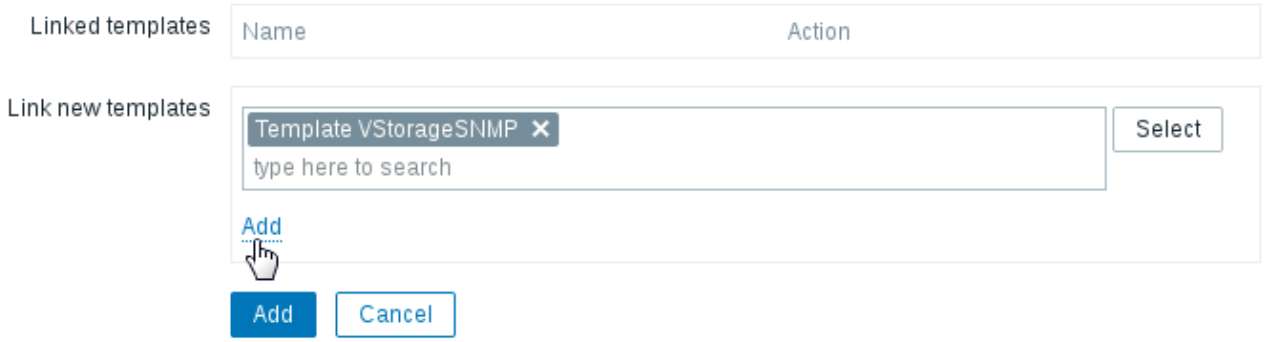


5. On the **Host** tab, do the following:
    1. Specify the **Host name** of the management node and its **Visible name** in Zabbix.
    2. Specify `vstorage` in the **New group** field.
    3. **Remove** the **Agent Interfaces** section.
    4. **Add** an **SNMP interfaces** section and specify the IP of the management node in the corresponding field.
6. On the **Templates** tab, click **Select** next to the **Link new templates** field.

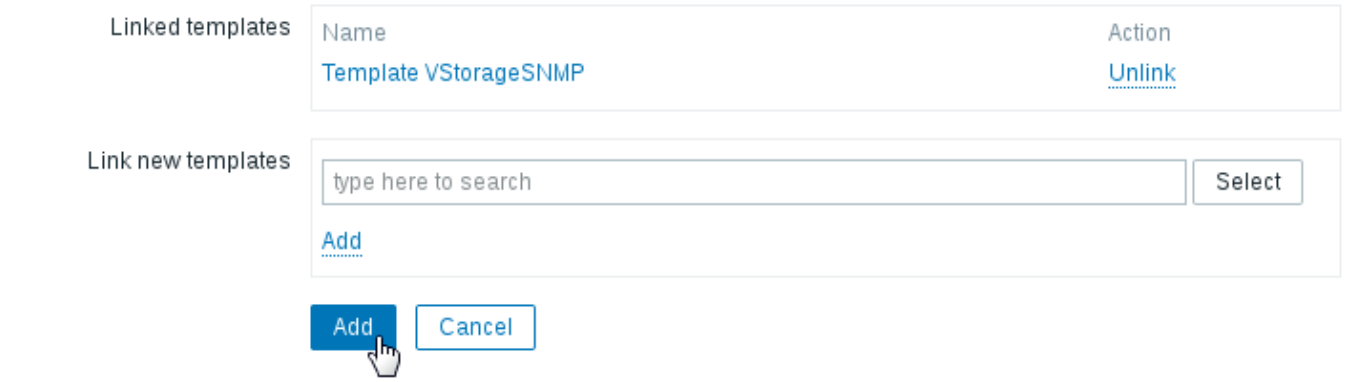
7. In the **Zabbix Server: Templates** window, check the `Template VStorageSNMP` template and click **Select**.



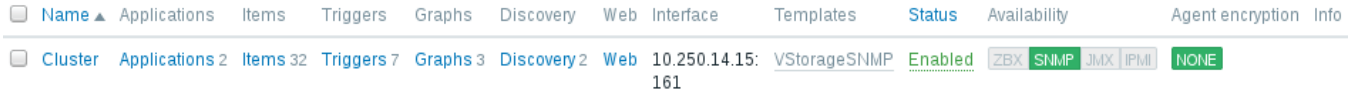
8. Back on the **Templates** tab, click the **Add** link in the **Link new templates** section. The `VStorageSNMP` template will appear in the **Linked templates** group.



9. Having configured the host and added its template, click the **Add** button.



In a few minutes, the cluster's SNMP label in the **Availability** column on the **Configuration** > **Hosts** screen will turn green.



To monitor cluster's parameters, open the **Monitoring** > **Latest data** screen, set the filter's **Host groups** to `vstorage` and click **Apply**.

You can create performance charts on the **Configuration** > **Hosts** > **<cluster>** > **Graphs** tab and a workplace for them on the **Monitoring** > **Screens** tab.

3.3.4 Storage Cluster Objects and Traps

Cluster-related objects that you can monitor:

VSTORAGE-MIB:cluster	General cluster information.
VSTORAGE-MIB:csStatTable	Chunk server statistics table.
VSTORAGE-MIB:mdsStatTable	Metadata server statistics table.
VSTORAGE-MIB::clusterName	Cluster name.
VSTORAGE-MIB::healthStatus	Cluster health status.
VSTORAGE-MIB::usedSpace	The space occupied by all data chunks and their replicas plus the space occupied by any other data stored on cluster nodes' disks.
VSTORAGE-MIB::totalSpace	The total space on all cluster nodes' disks.
VSTORAGE-MIB::freeSpace	The unused space on all cluster nodes' disks.

VSTORAGE-MIB::licenseStatus License status.

VSTORAGE-MIB::licenseCapacity The maximum disk space available as defined by license.

VSTORAGE-MIB::licenseExpirationStatus License expiration status.

VSTORAGE-MIB::ioReadOpS Current read speed in operations per second.

VSTORAGE-MIB::ioWriteOpS Current write speed in operations per second.

VSTORAGE-MIB::ioReads Current read speed in bytes per second.

VSTORAGE-MIB::ioWrites Current read write in bytes per second.

VSTORAGE-MIB::csActive The number of active chunk servers.

VSTORAGE-MIB::csTotal The total number of chunk servers.

VSTORAGE-MIB::mdsAvail The number of running metadata servers.

VSTORAGE-MIB::mdsTotal The total number of metadata servers.

VSTORAGE-MIB::s3OsAvail The number of running S3 object servers.

VSTORAGE-MIB::s3OsTotal The total number of S3 object servers.

VSTORAGE-MIB::s3NsAvail The number of running S3 name servers.

VSTORAGE-MIB::s3NsTotal The total number of S3 name servers.

VSTORAGE-MIB::s3GwAvail The number of running S3 gateways.

VSTORAGE-MIB::s3GwTotal The total number of S3 gateways.

CS-related objects that you can monitor:

VSTORAGE-MIB::csId Chunk server identifier.

VSTORAGE-MIB::csStatus Current chunk server status.

VSTORAGE-MIB::csIoReadOpS Current read speed of a chunk server in operations per second.

VSTORAGE-MIB::csIoWriteOpS Current write speed of a chunk server in operations per second.

VSTORAGE-MIB::csIoWait The percentage of time spent waiting for I/O operations. Includes time spent waiting for synchronization.

VSTORAGE-MIB::csIoReadS Current read speed of a chunk server in bytes per second.

VSTORAGE-MIB::csIoWriteS Current write speed of a chunk server in bytes per second.

MDS-related objects you can monitor:

VSTORAGE-MIB::mdsId Metadata server identifier.

VSTORAGE-MIB::mdsStatus Current metadata server status.

VSTORAGE-MIB::mdsMemUsage The amount of memory used by a metadata server.

VSTORAGE-MIB::mdsCpuUsage The percentage of the CPU's capacity used by a metadata server.

VSTORAGE-MIB::mdsUpTime Time since the startup of a metadata server.

SNMP traps triggered by the specified alerts:

licenseExpired The license has expired.

tooFewClusterFreeLogicalSpace Too few free space is left.

tooFewClusterFreePhysicalSpace Too few physical space is left.

tooFewNodes Too few nodes are left.

tooFewMdses Too few MDSs are left.

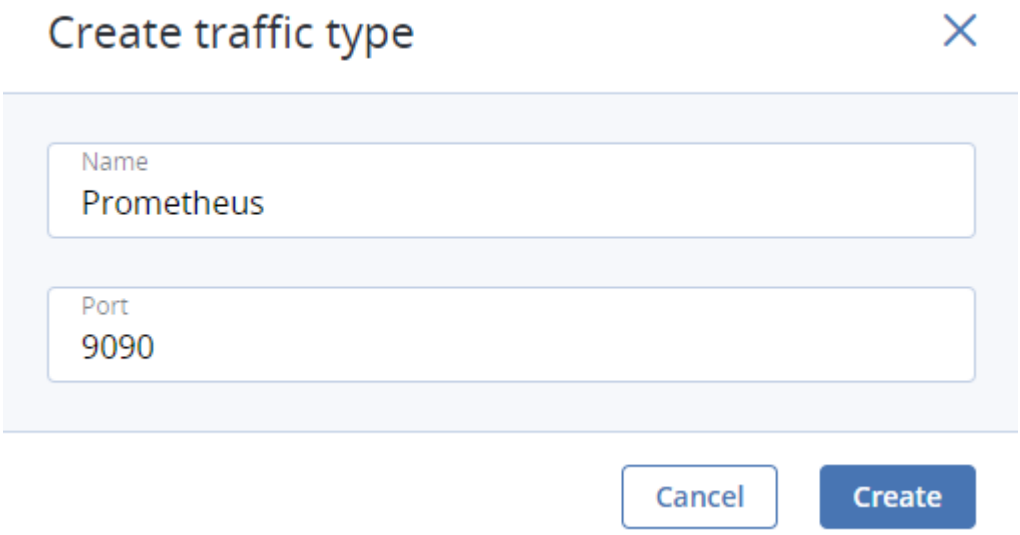
generalAlert Other.

3.4 Monitoring Storage Cluster Remotely

You can monitor your storage cluster via Prometheus remotely. To do this, you need to open a TCP port for Prometheus API to be accessible from the outside.

To open a port, do the following:

1. On the **INFRASTRUCTURE** > **Networks** screen, click **Edit** and then **Create traffic type**.
2. In the **Create traffic type** window, specify a custom name in the **Name** field and `9090` in the **Port** field.



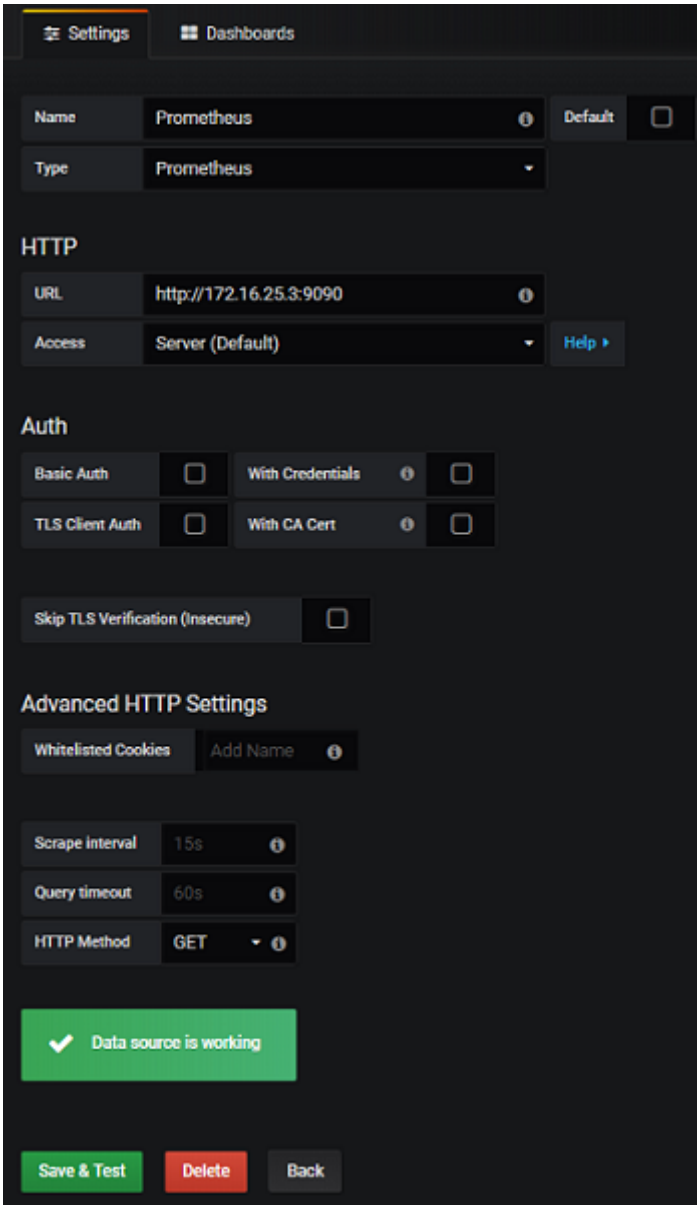
3. Click **Create**.
4. Add the newly created traffic type to your public network by ticking the corresponding checkbox.
5. Click **Save** to apply the changes.

You can now access the built-in Prometheus web-based user interface at http://<admin_panel_IP_address>:9090. For more information on using Prometheus, refer to its documentation.

If you have an external Grafana account and want to use it for monitoring Acronis Software-Defined Infrastructure, you can add Prometheus as a data source as follows:

1. Log in into your Grafana user interface.
2. Click the cogwheel icon in the left menu and select **Data Sources**.
3. On the **Data Sources** tab, click **Add data source**.
4. On the **Data Sources / New** screen, specify the following parameters:
    1. Enter a custom data source name in the **Name** field.
    2. Set **Type** to `Prometheus`.
    3. Enter `http://<admin_panel_IP_address>:9090` in the **URL** field.
5. Click **Save & Test**.

If the specified parameters are correct, the `Data source is working` message will appear.



Using the newly added Prometheus data source, you can import the default Grafana dashboards from Acronis Software-Defined Infrastructure or create new ones.

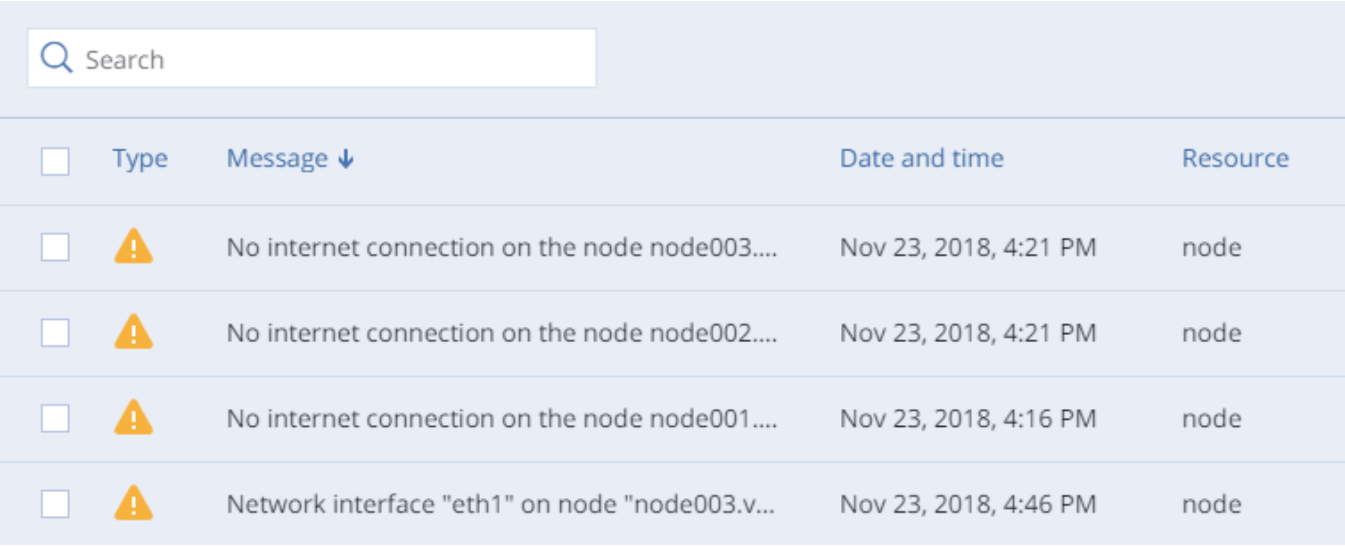
3.5 Viewing Alerts and Audit Log and Sending E-mail Notifications

This section describes Acronis Software-Defined Infrastructure alerts and audit log and how to send out e-mail notifications about alerts, warnings, and errors.

3.5.1 Viewing Alerts

The **ALERTS** tab lists all the alerts logged by Acronis Software-Defined Infrastructure. An alert is generated and logged each time one of the following conditions is met or events happen:

- a critical issue has happened with a cluster, its components (CS, MDS), disks, nodes, or services;
- cluster requires configuration or more resources to build or restore its health;
- network requires configuration or is experiencing issues that may affect performance;
- license is about to expire or has expired;
- cluster is about to or has run out of available space.



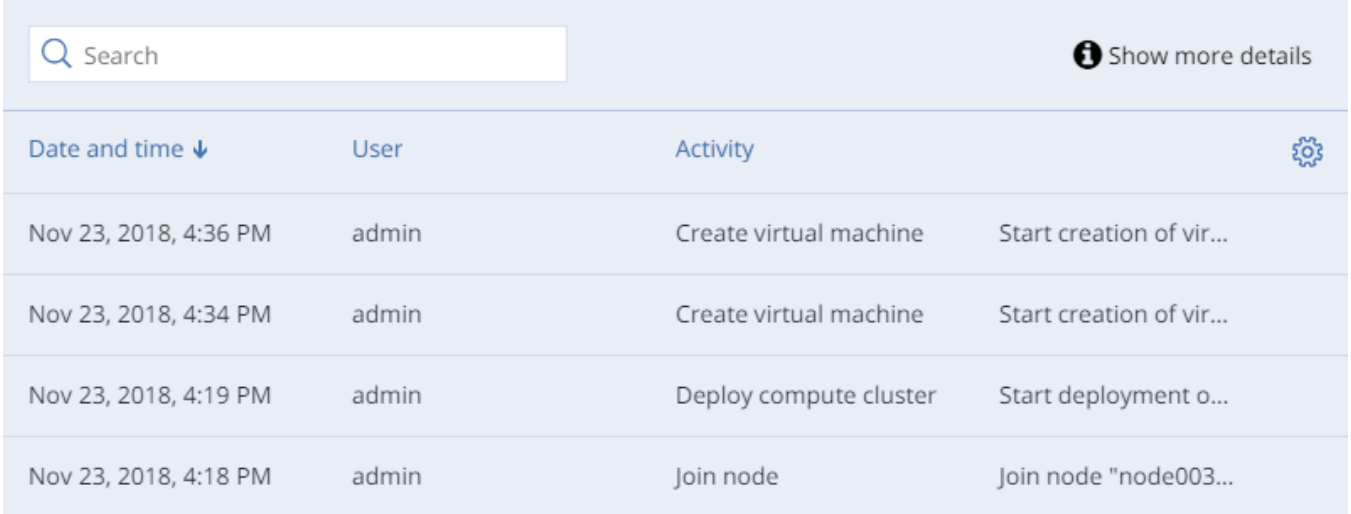
To view the details of an alert, select it on the **MONITORING** > **Alerts** screen and click **Details** in the menu on the right.

Alerts can be ignored (deleted from the alerts list) or postponed for several hours. Postponed alerts reappear in the list after some time.

To ignore or postpone an alert, select it and click the corresponding button.

3.5.2 Viewing Audit Log

The **MONITORING** > **Audit log** screen lists all management operations performed by users and their activity events.



To view detailed information on a log entry, select it and click **Show more details**.

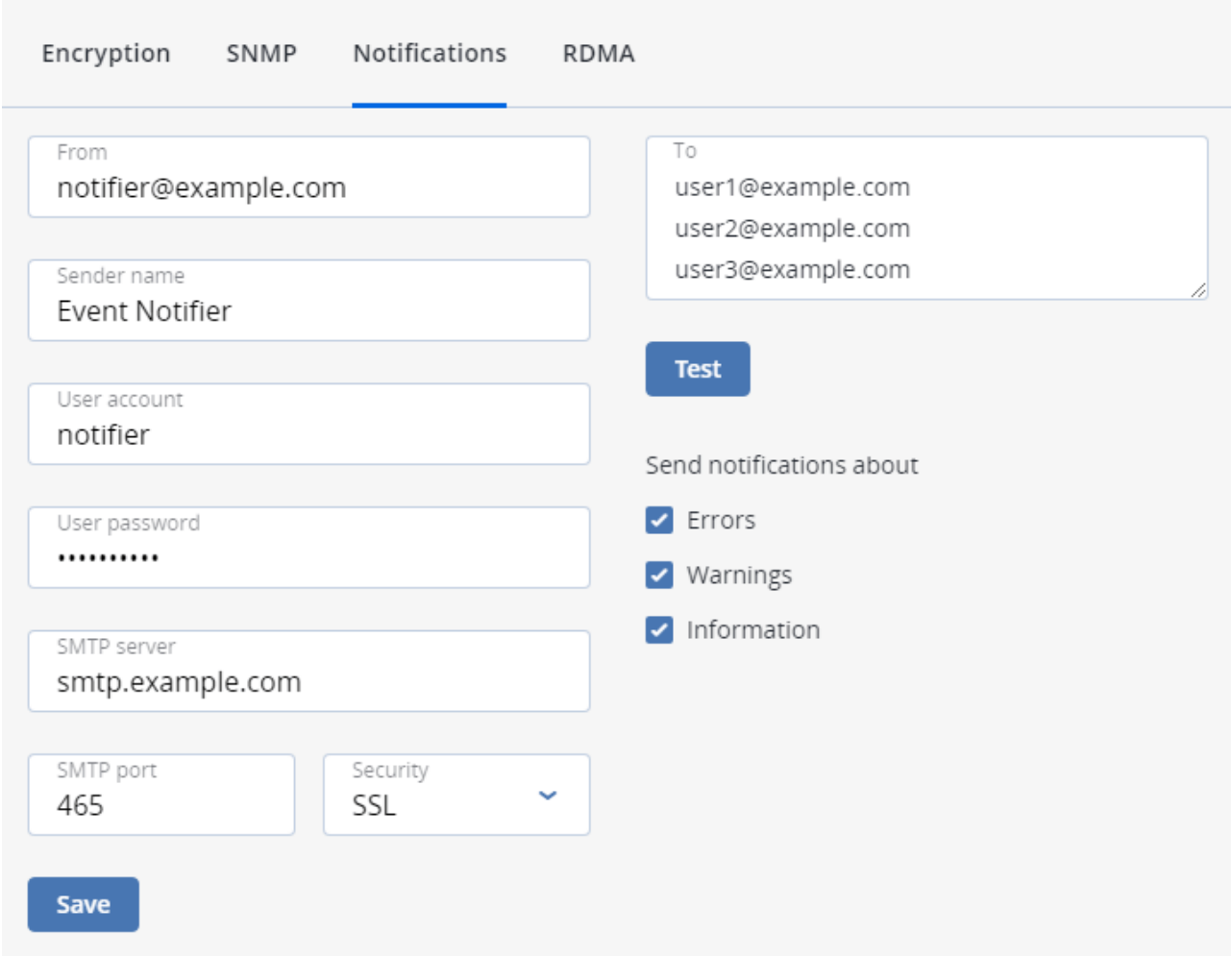
3.5.3 Sending E-mail Notifications

Acronis Software-Defined Infrastructure can send automatic e-mail notifications about errors, warnings, and alerts.

To set up e-mail notifications, do the following:

1. On the **SETTINGS** > **Advanced settings** > **Notifications** tab, specify the following information:
    1. In the **From** and **Sender name** fields, the notification sender's e-mail and name.
    2. In the **To** field, one or more notification recipient e-mails, one per line.
    3. In the **User account** and **User password** fields, the credentials of the notification sender registered on the SMTP server.
    4. In the **SMTP server** field, the DNS name of the SMTP server, either public (e.g., `smtp.gmail.com`) or the one in your organization.

       The management node must be able to access the SMTP server.
    5. If required, a custom **SMTP port** the server uses.
    6. In the **Security** field, the security protocol of the SMTP server.



2. Tick the checkboxes for alerts you want to be notified about.
3. Click **Save**.

To send a test e-mail, specify your e-mail registered on the SMTP server in both the **From** and **To** fields and click **Test**.

CHAPTER 4

Managing the Compute Cluster

4.1 Creating the Compute Cluster

Before creating a compute cluster, make sure the following requirements are met:

1. Network is set up according to recommendations in *Managing Networks and Traffic Types* (page 2). The basic requirement is that the traffic types **VM private**, **VM public**, and **Compute API** are assigned to networks; and that the nodes to be added to the compute cluster are connected to these networks.
2. All nodes to be added to the compute cluster are connected to the same network with the **VM public** traffic type.

It is also recommended to enable high availability for the management node (see *Enabling High Availability* (page 152)).

Also take note of the following:

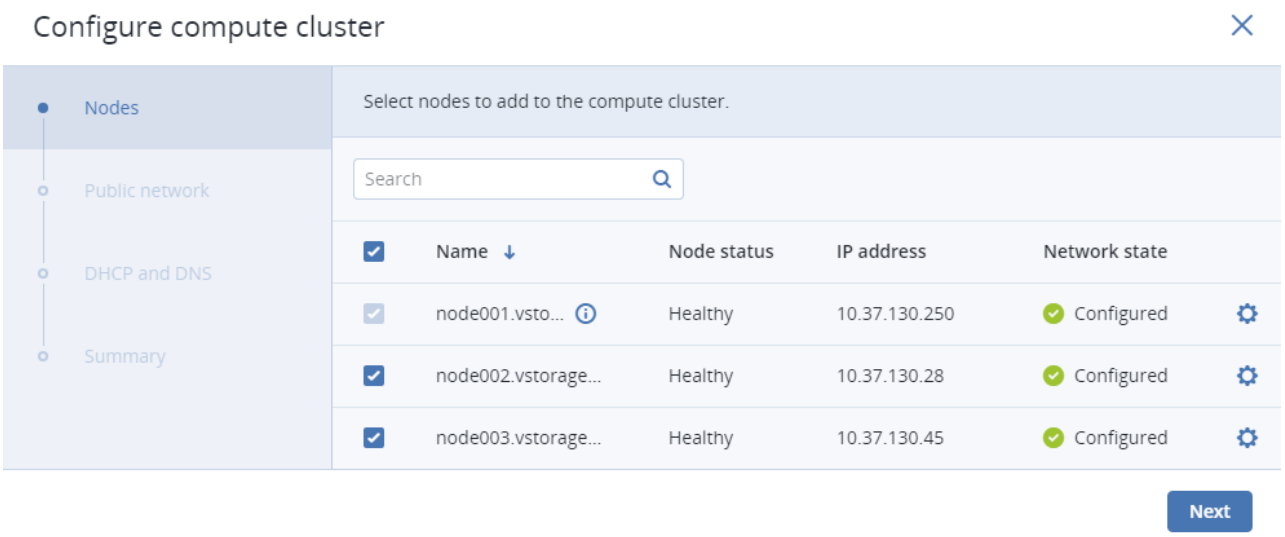
1. Creating the compute cluster prevents (and replaces) the use of the management node backup and restore feature.
2. If nodes to be added to the compute cluster have different CPU models, consult the section "Setting Virtual Machines CPU Model" in the *Administrator's Command Line Guide*.

To create the compute cluster, open the **COMPUTE** screen, click **Configure** and do the following in the **Configure compute cluster** window:

1. In the **Nodes** section, select nodes to add to the compute cluster, make sure the network state of each selected node is **Configured**, and click **Next**.

   Nodes in the management node high availability cluster are automatically selected to join the compute

cluster.



If node network interfaces are not configured, click the cogwheel icon, select networks as required, and click **Apply**.

2. In the **Public network** section, enable IP address management if needed and provide the required details for the public network.

   With IP address management enabled, Acronis Software-Defined Infrastructure will handle virtual machine IP addresses and provide the following features:

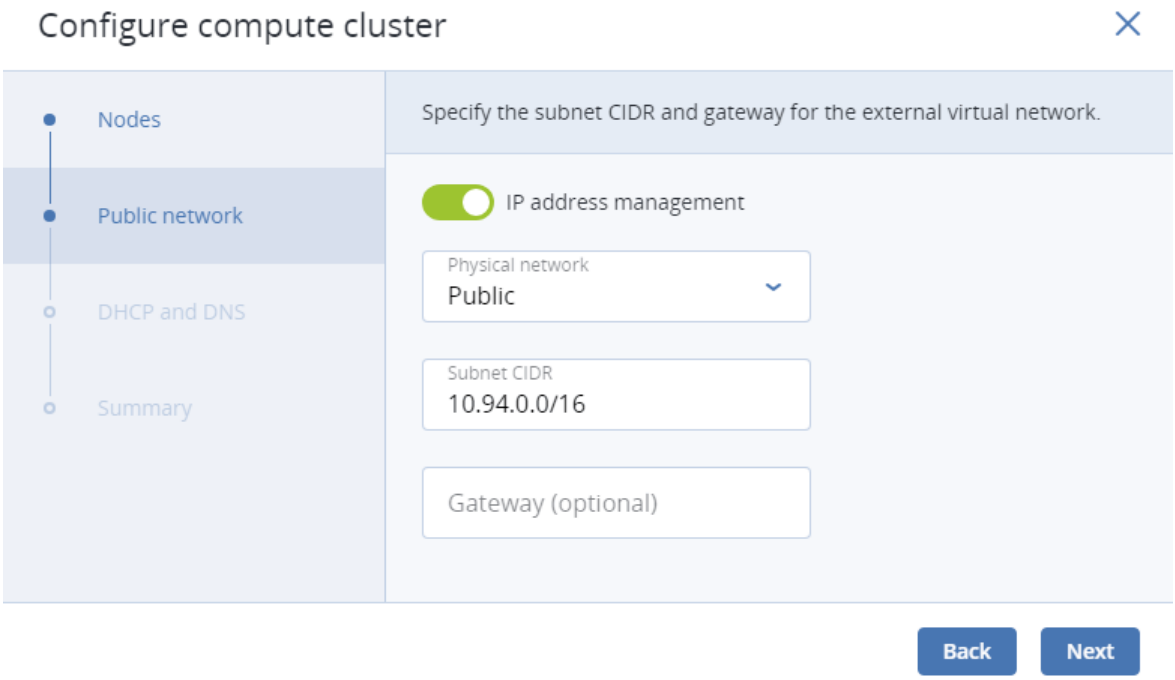
   - Allocation pools. You can specify ranges of IP addresses that will be automatically assigned to VMs.
   - Built-in DHCP server. Assigns IP addresses from allocation pools to virtual machines. With the DHCP server enabled, VM network interfaces will be automatically assigned IP addresses from allocation pools or, if no pools are specified, network's entire IP range. With the DHCP server disabled, VM network interfaces will be allocated IP addresses, but you will have to manually assign them inside VMs.
   - Custom DNS servers. You can specify DNS servers that will be used by VMs. These servers will be delivered to virtual machines via the built-in DHCP server.

   With IP address management disabled:

   - VMs connected to a network will be able to obtain IP addresses from DHCP servers in that network.
   - Spoofing protection will be disabled for all VM network ports. Each VM network interface will accept all traffic, even frames addressed to other network interfaces.

In any case, you will be able to manually assign static IP addresses from inside VMs.

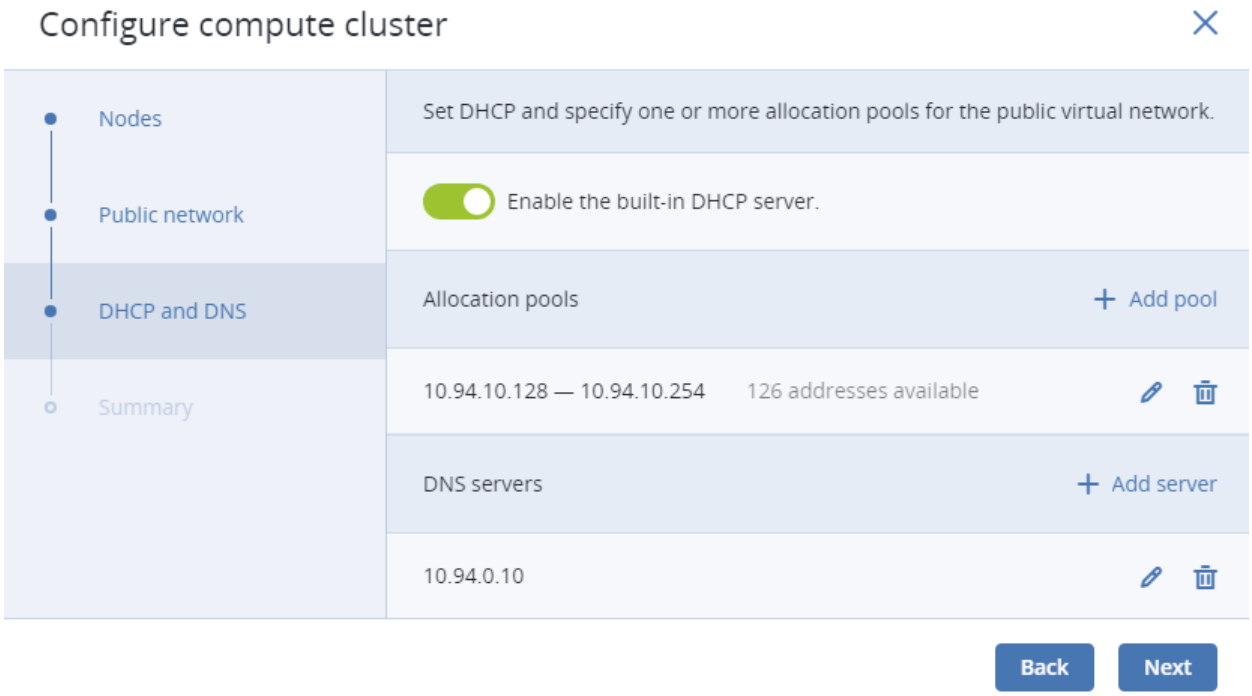
If you choose to enable IP address management, select a physical network to connect the public virtual network to and optionally specify its gateway. The subnet IP range in the CIDR format will be filled in automatically. If you choose to leave IP address management disabled, select a physical network to connect the public virtual network to.



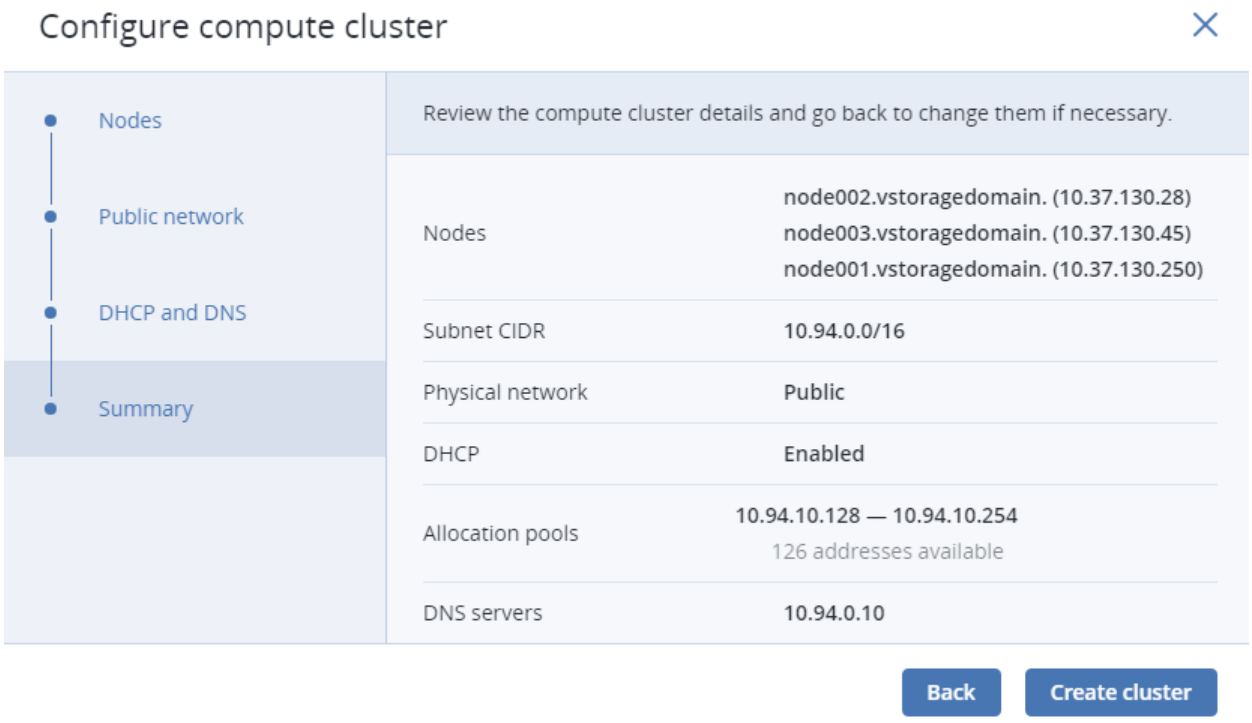
The selected public network will appear in the list of virtual networks on compute cluster's **VIRTUAL NETWORKS** tab.

Click **Next**.

3. If you enabled IP address management on the previous step, you will move on to the **DHCP and DNS** section. In it, enable or disable the built-in DHCP server and specify one or more allocation pools and DNS servers. Click **Next**.



4. In the **Summary** section, review the configuration and click **Create cluster**.



You can monitor the compute cluster deployment progress on the **Compute** screen.

4.2 Managing Compute Nodes

Management node HA and compute cluster are tightly coupled, so changing nodes in one usually affects the other. Take note of the following:

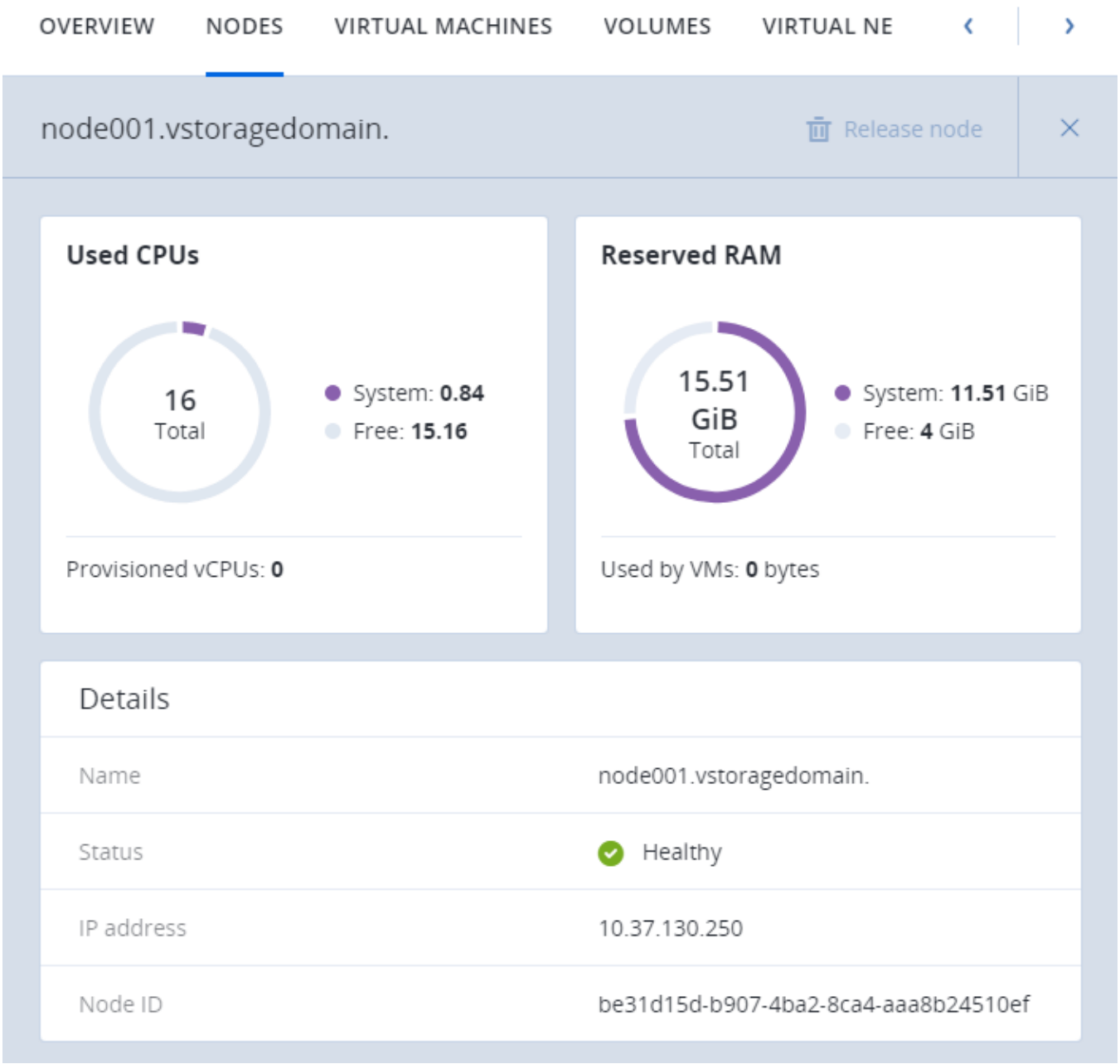
1. Each node in the HA configuration must meet the requirements to the management node listed in the *Installation Guide*. If the compute cluster is to be created, its hardware requirements must be added as well.
2. The HA configuration must include at least three nodes at all times. Because of this, removing nodes from the HA configuration (whether or not the compute cluster exists) is only possible if the required minimum remains after removal. For example, to remove one of the minimum three nodes from the HA configuration, a fourth node must be added to it first.
3. If the HA configuration has been created before the compute cluster, all nodes in it will be added to the compute cluster.
4. If the compute cluster has been created before HA configuration, only nodes in the compute cluster can be added to the HA configuration. For this reason, to add a node to HA configuration, add it to the compute cluster first.
5. If both the HA configuration and compute cluster include the same four or more nodes, a node must first be removed from the HA configuration to be removed from the compute cluster.

   If both the HA configuration and compute cluster include the same three nodes (the required minimum), single nodes cannot be removed from the compute cluster. In such a case, the compute cluster can be destroyed completely, but the HA configuration will remain; this is also true vice versa, the HA configuration can be deleted, but the compute cluster will continue working.

Nodes in the compute cluster are shown on the **NODES** tab.

Clicking a node, you can see the following information about it:

- node CPU and RAM usage,
- node name, status, and IP address,
- hosted virtual machines and their resource consumption.



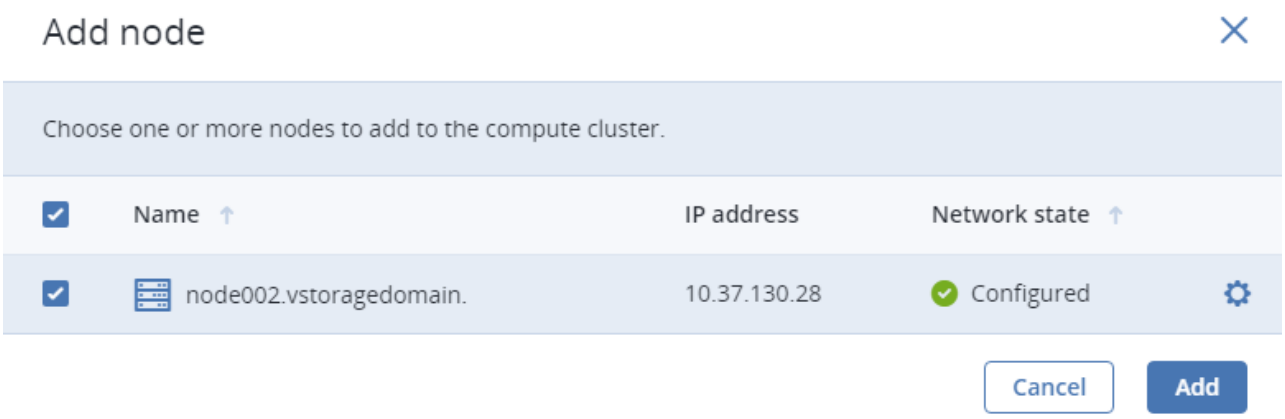
The next subsections describe how to add nodes to and remove nodes from the compute cluster.

4.2.1 Adding Nodes to Compute Cluster

Note: Before changing nodes in the compute cluster, see limitations in *Managing Compute Nodes* (page 50).

To add one or more nodes to your compute cluster, do the following:

1. Click **Add node** on the **NODES** tab. The **Add node** window will open.
2. If required, configure network on each node not marked green: click the cogwheel icon, assign networks with the compute-related traffic types to node NICs, and click **Apply**.
3. Select nodes and click **Add**.



The added nodes will appear on the **NODES** tab.

If several nodes are in the management node HA group, they all must be added to the compute cluster.

4.2.2 Releasing Nodes from Compute Cluster

Note: Before changing nodes in the compute cluster, see limitations in *Managing Compute Nodes* (page 50).

To release one or more nodes from the compute cluster, do the following:

1. On the **NODES** tab, either
   - select the nodes and click **Release nodes** above the list, or
   - click the ellipsis icon next to a node and select **Release**, or
   - click a node to open its details, then click **Release node** on the top toolbar.
2. In the **Release node** window, confirm the action by clicking **Release**.

The selected nodes will disappear from the **NODES** tab.

If the node to be released has VMs on it, they must be migrated to other nodes first.

4.3 Managing Virtual Networks

In the compute cluster, you can create and manage two types of virtual networks:

Private VXLAN-based overlay virtual networks that can be used for intercommunication between VMs. Each private network is isolated from other private networks as well as public networks.

Public Virtual networks that use IP address ranges of public physical networks. Such networks can be used to provide Internet access to VMs.

Each public virtual network can use IP addresses of only one physical network.

Both private and public virtual networks are listed on the **VIRTUAL NETWORKS** tab.

The next subsections describe how to add, view, edit, and delete virtual networks.

4.3.1 Creating Virtual Networks

To add a new virtual network, do the following:

1. On the **COMPUTE** > **VIRTUAL NETWORKS** tab, click **Add virtual network**.
2. In the **Network configuration** section, configure the network parameters:
    1. Enable or disable IP address management.

        With IP address management enabled, Acronis Software-Defined Infrastructure will handle virtual machine IP addresses and provide the following features:

        - Allocation pools. You can specify ranges of IP addresses that will be automatically assigned to VMs.
        - Built-in DHCP server. Assigns IP addresses from allocation pools to virtual machines. With the DHCP server enabled, VM network interfaces will be automatically assigned IP addresses from allocation pools or, if no pools are specified, network's entire IP range. With the DHCP server disabled, VM network interfaces will be allocated IP addresses, but you will have to manually assign them inside VMs.
        - Custom DNS servers. You can specify DNS servers that will be used by VMs. These servers will

be delivered to virtual machines via the built-in DHCP server.

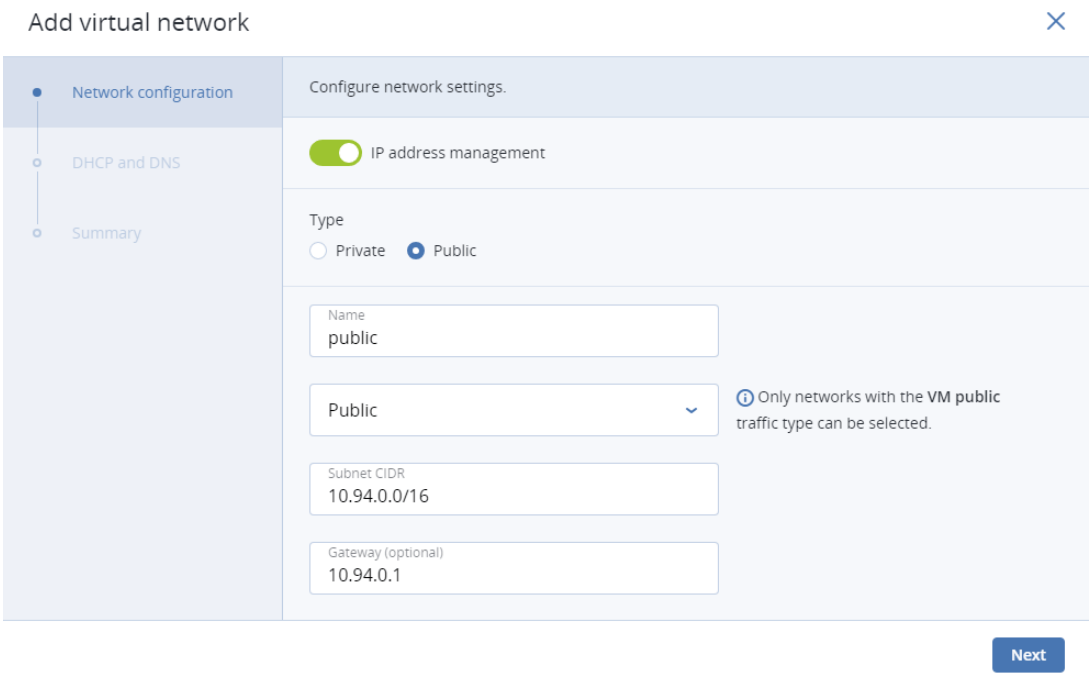
With IP address management disabled:

- VMs connected to a network will be able to obtain IP addresses from DHCP servers in that network.
- Spoofing protection will be disabled for all VM network ports. Each VM network interface will accept all traffic, even frames addressed to other network interfaces.

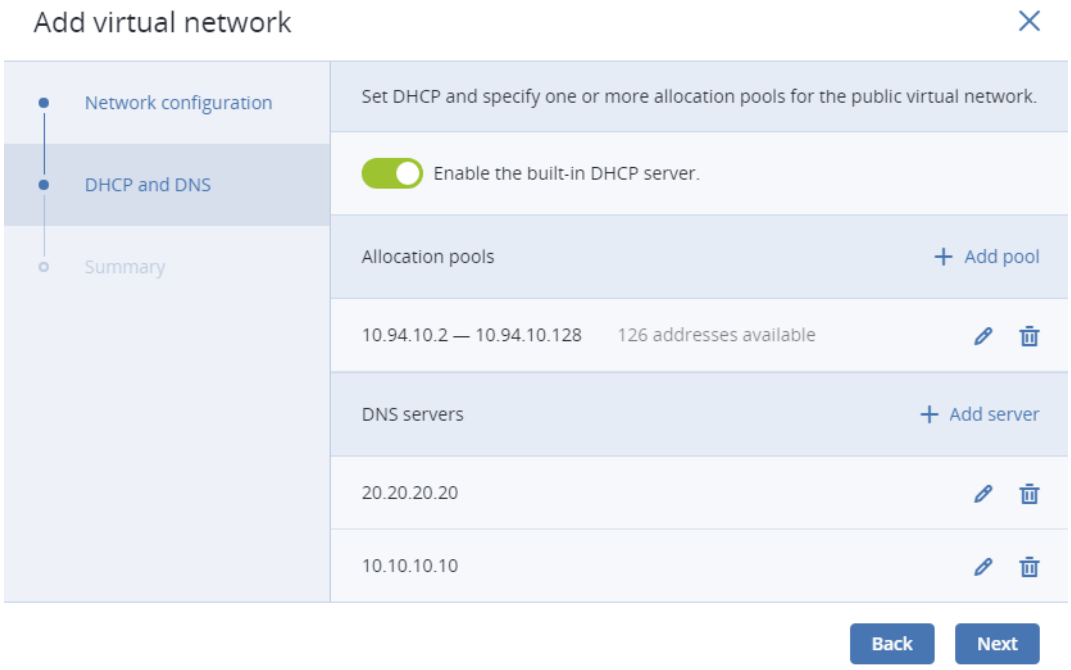
In any case, you will be able to manually assign static IP addresses from inside VMs.

2. Choose network type.
3. Provide network details depending on type:
   - For a private network, specify a name. If IP address management is enabled, specify network's IPv4 address range in **Subnet CIDR**. Optionally specify a gateway. If you leave the **Gateway** field blank, the gateway will be omitted from network settings.
   - For a public network, specify a name and choose a physical network with the **VM public** traffic type (that is not already used by a public network). If IP address management is enabled, optionally specify a gateway. If you leave the **Gateway** field blank, the gateway will be omitted from network settings. The **Subnet CIDR** field will be filled in automatically.

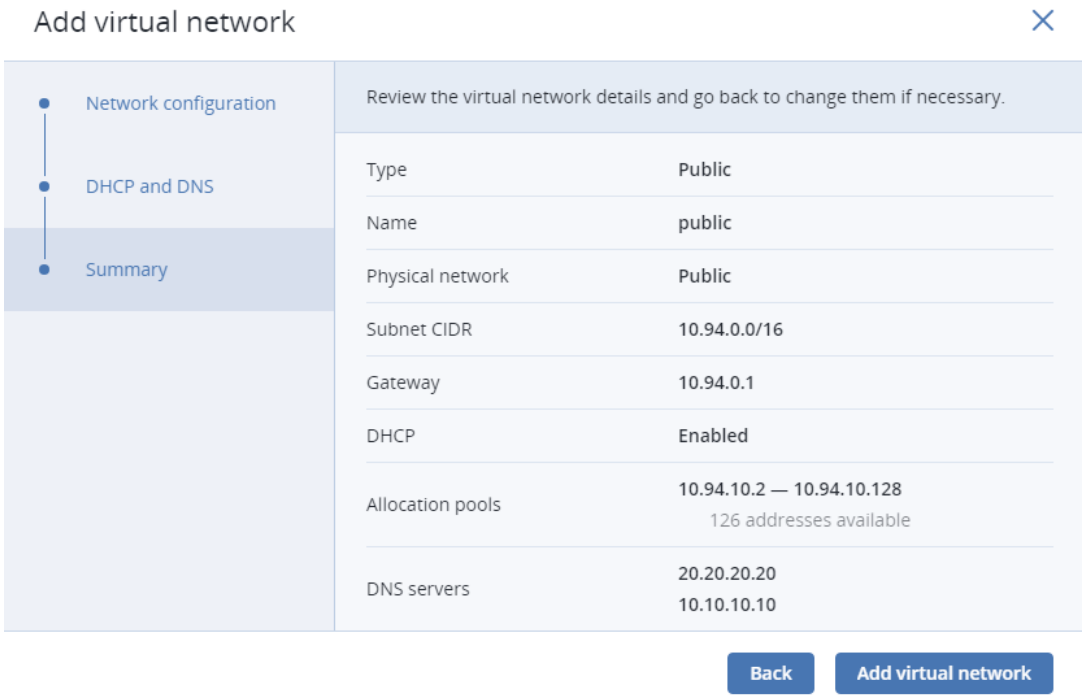
Click **Next**.



3. If you enabled IP address management on the previous step, you will move on to the **DHCP and DNS** section. In it, enable or disable the built-in DHCP server and specify one or more allocation pools and DNS servers. Click **Next**.

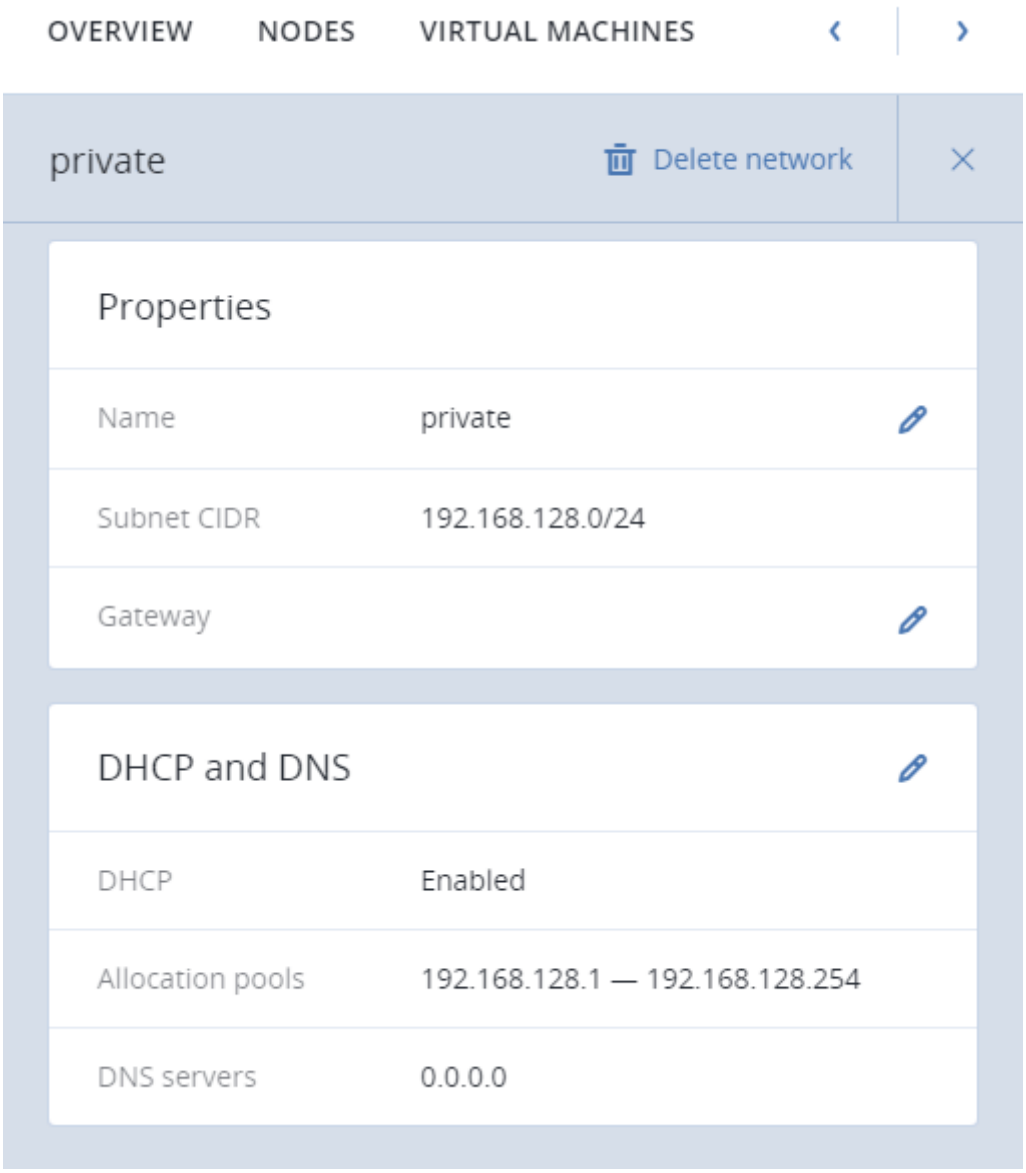


4. In the **Summary** section, review the configuration and click **Add virtual network**.



4.3.2 Editing Virtual Networks Parameters

To view and edit parameters of a virtual network, click it on the **VIRTUAL NETWORKS** tab. A panel with the virtual network details will open.



On this panel, you can change the virtual network name, gateway, DHCP settings, allocation pools, and DNS servers. To do this, click the pencil icon, enter a new value, and click the check mark icon to confirm.

4.3.3 Deleting Virtual Networks

Important: Before deleting a virtual network, make sure no VMs are connected to it.

To delete one or more virtual networks, do the following:

1. On the **VIRTUAL NETWORKS** tab, either:
   - select networks and click **Delete** above the list, or
   - click the ellipsis icon next to the network and select **Delete**, or
   - click a network to open its details and click **Delete** on the top toolbar.
2. In the **Delete networks** window, confirm the action by clicking **Delete**.

4.4 Managing Storage Policies

A storage policy in Acronis Software-Defined Infrastructure is a group of parameters that define how to store VM volumes: how redundant they must be and on what storage tier they need to be located.

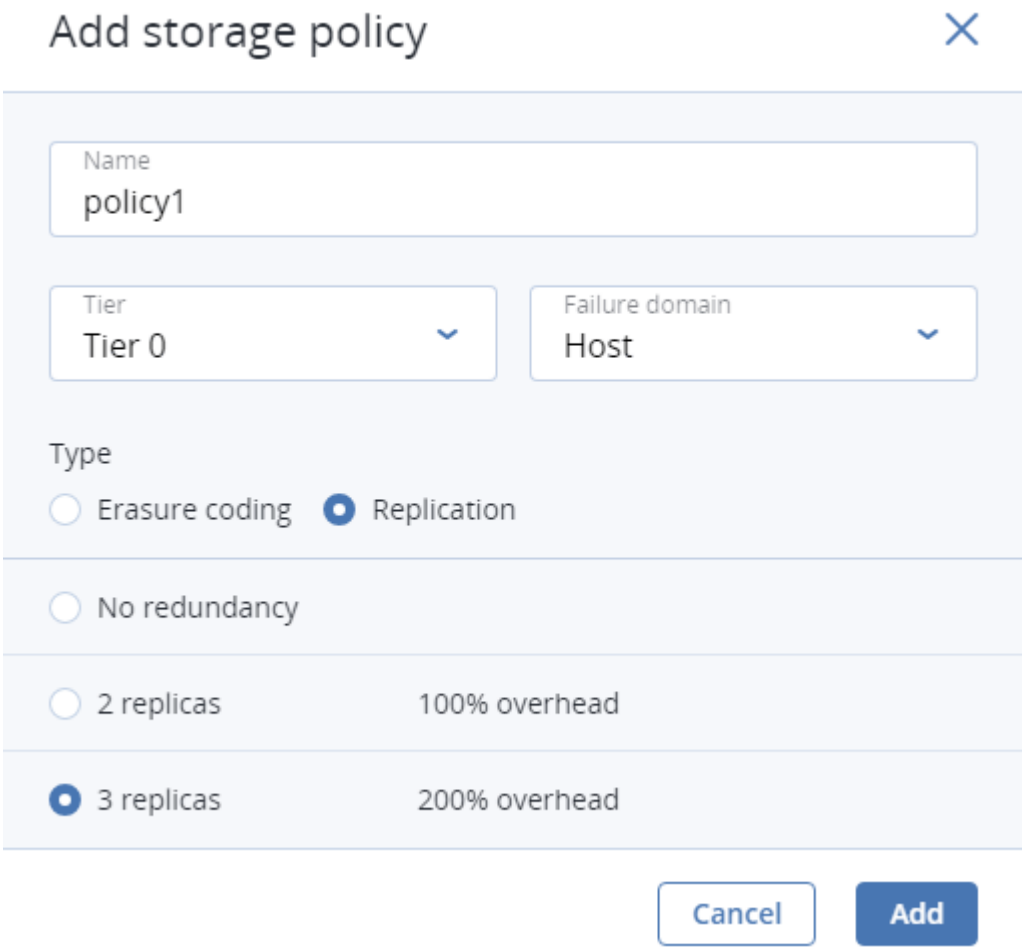
When you deploy the compute cluster, a default storage policy is created that enforces the best replication scheme allowed by the number of nodes in the storage cluster. The default policy cannot be deleted or renamed and is always applied to uploaded images and base volumes created from these images.

Note: A base volume is created from a source image when you deploy a VM. It is not used directly by a VM, but all volumes that a VM actually uses (which are listed on the **VOLUMES** tab) are in fact deltas (differences) from the base volume. It is important to keep base volumes available as VM volumes depend on them. For that, you need the default storage policy to enforce multiple replicas.

If the storage cluster does not have enough nodes to enable multiple replicas (not recommended), you can adjust the default storage policy once you add more nodes to the storage cluster. It will be applied to images and base volumes that already exist in the compute cluster.

To apply custom redundancy schemes to VM volumes, you can create custom storage policies in addition to the default one. To create a custom storage policy, do the following:

1. On the **COMPUTE** > **STORAGE POLICIES** tab, click **Add storage policy**.
2. In the **Add storage policy** window, specify a name and select the following:



    1. In **Tier**, a tier to store volumes on.
    2. In **Failure domain**, a placement policy for data pieces or replicas.
    3. In **Type**, a data redundancy type and mode.
3. Click **Add**.

To edit a policy, select it and click the pencil icon next to a parameter you need to change. To change the redundancy mode of the policy, click the ellipsis button next to it and click **Edit redundancy**.

Note: You cannot change redundancy type of policies used by volumes. You can create new policies instead.

After a policy is modified, the changes are applied to every volume governed by it.

To remove a policy, select it and click **Delete policy**. A policy cannot be removed if it governs existing volumes.

4.5 Managing Images

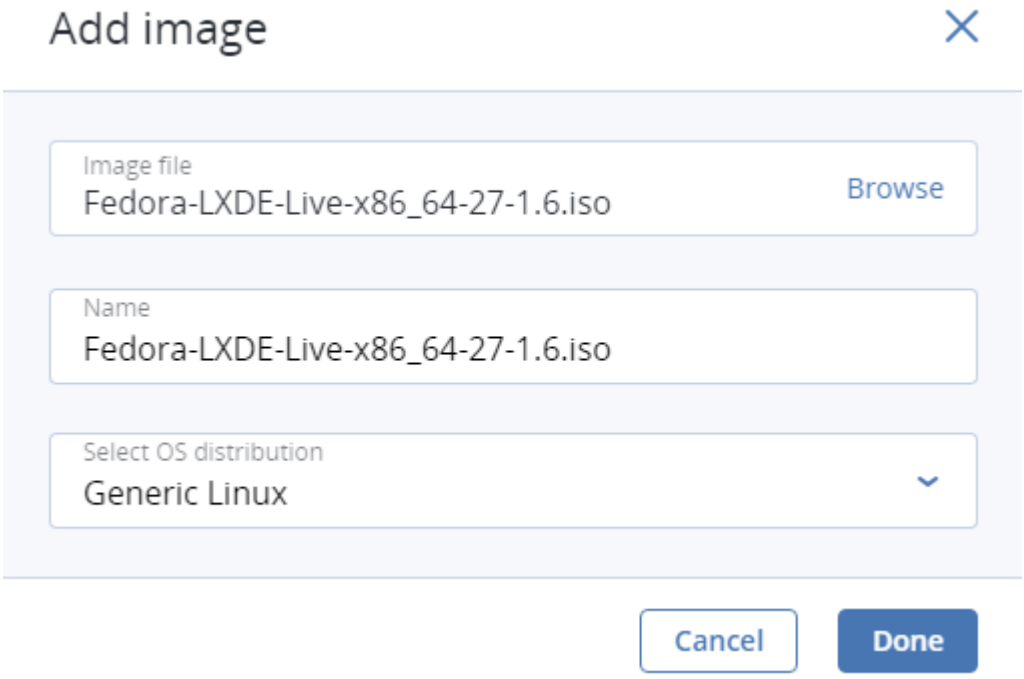
Acronis Software-Defined Infrastructure allows you to upload ISO images and templates that can be used to create VM volumes. An ISO image is a typical OS distribution that needs to be installed on disk. In turn, a template is a ready volume in the QCOW2 format with an installed operating system and applications and a set minimum size. Many OS vendors offer templates of their operating systems under the name “cloud images”. For a list of guest OSes supported in virtual machines, see *Supported Guest Operating Systems* (page 61).

Note: Images are stored according to the default storage policy.

To add an image, do the following:

1. On the **COMPUTE** > **IMAGES** tab, click **Add image**.
2. In the **Add image** window, do the following:
    1. Click **Browse** and select a template or ISO file.
    2. Specify an image name to be shown in the admin panel.
    3. Select a correct OS type from the drop-down list.

    Important: OS type affects VM parameters like hypervisor settings. VMs created from an image with a wrong OS type may not work correctly, e.g., crash.



3. Click **Done** to upload the image.

The admin panel will show the upload progress.

To edit an image, select it and click the pencil icon next to a parameter you need to change.

To remove an image, click the ellipsis button next to it and **Delete**.

For information on how to create Linux templates, see the *Administrator's Command Line Guide*.

4.6 Managing Virtual Machines

Each virtual machine (VM) is an independent system with an independent set of virtual hardware. Its main features are the following:

- A virtual machine resembles and works like a regular computer. It has its own virtual hardware. Software applications can run in virtual machines without any modifications or adjustment.
- Virtual machine configuration can be changed easily, e.g., by adding new virtual disks or memory.
- Although virtual machines share physical hardware resources, they are fully isolated from each other (file system, processes, sysctl variables) and the compute node.

- A virtual machine can run any supported guest operating system.

The following table lists the current virtual machine configuration limits:

Table 4.6.1: Virtual machine hardware

Resource	Limit
RAM	1 TiB
CPU	48 logical CPUs
Storage	15 volumes, 512 TiB each
Network	15 NICs

A logical CPU is a core (thread) in a multicore (multithreading) processor.

4.6.1 Supported Guest Operating Systems

The following guest operating systems have been tested and are supported in virtual machines:

Table 4.6.1.1: Windows guest operating systems

Operating System	Edition	Architecture
Windows Server 2016	Essentials, Standard, Datacenter	x64
Windows Server 2012 R2	Essentials, Standard, Datacenter	x64
Windows Server 2012	Standard, Datacenter	x64
Windows Server 2008 R2	Standard, Datacenter	x64
Windows 10	Home, Professional, Enterprise, Enterprise 2016 LTSB	x86, x64
Windows 8.1	Home, Professional, Enterprise	x86, x64
Windows 7	Home, Professional, Enterprise	x86, x64

Table 4.6.1.2: Linux guest operating systems

Operating System	Architecture
CentOS 7.x	x64
CentOS 6.6	x64
RHEL 7.3	x64
Debian 9.x	x64

Continued on next page

Table 4.6.1.2 – continued from previous page

Operating System	Architecture
Ubuntu 16.04.x	x64

4.6.2 Creating and Deleting Virtual Machines

Before you proceed to creating VMs, check that you have these:

- A guest OS source (see *Managing Images* (page 59)):
  - a distribution ISO image of a guest OS to install in the VM, or
  - a boot volume template, or
  - a boot volume.

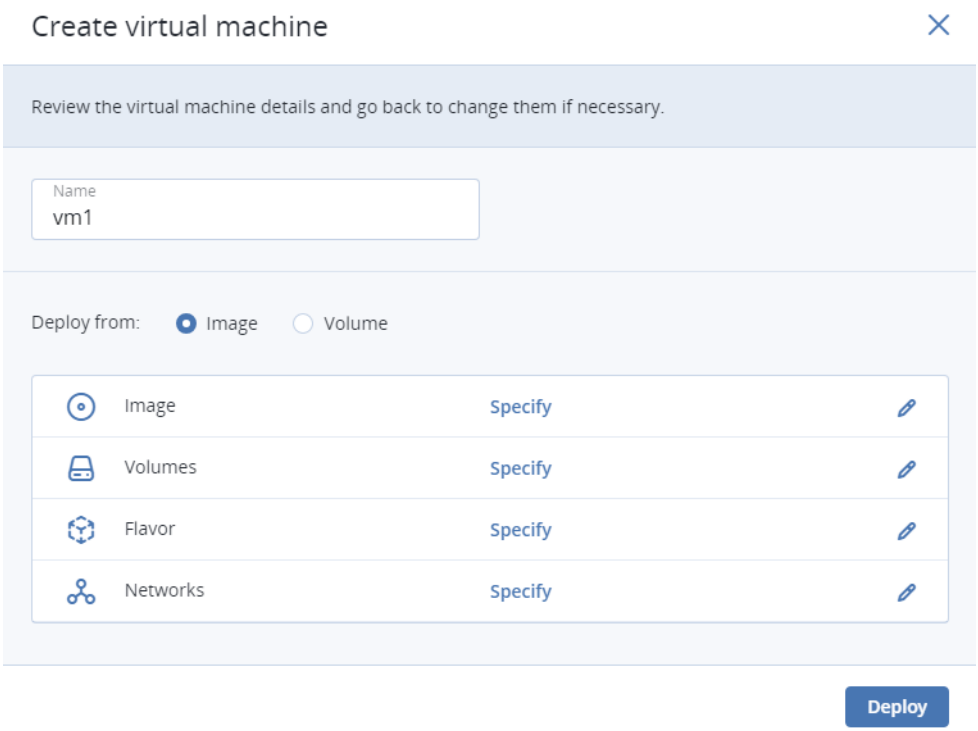
  Note: To obtain a boot volume, create a volume as described in *Managing Volumes* (page 70), attach it to a VM, install an operating system in it, then detach it from the VM.

- A storage policy for volumes (see *Managing Storage Policies* (page 57)).
- A flavor (see *Managing Flavors* (page 73)).
- One or more virtual networks (see *Managing Virtual Networks* (page 53)).

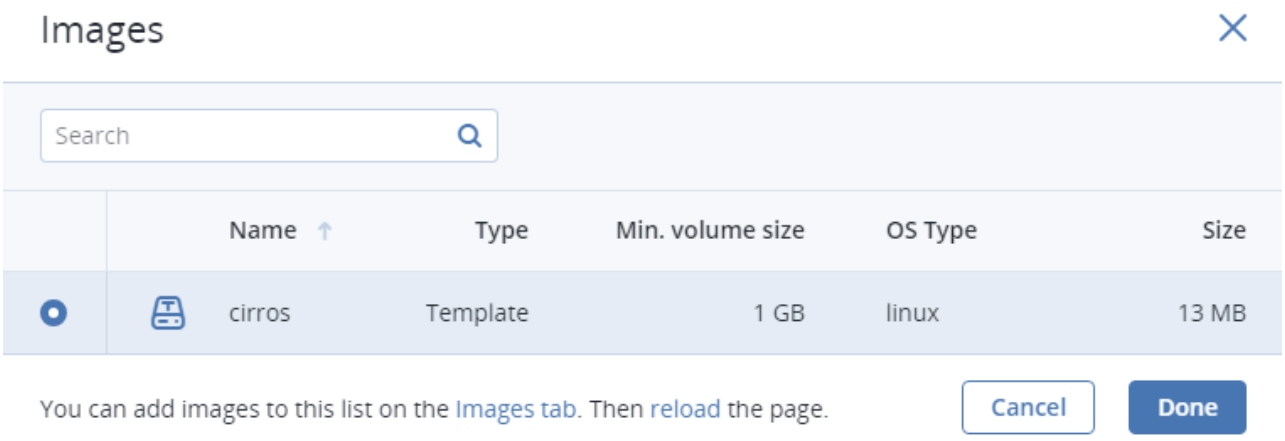
Note: Virtual machines are created with the host CPU model by default. Having compute nodes with different CPUs may lead to live migration issues. To avoid them, you can manually set CPU model for all new VMs as described in the *Administrator's Command Line Guide*.

To create a VM, do the following:

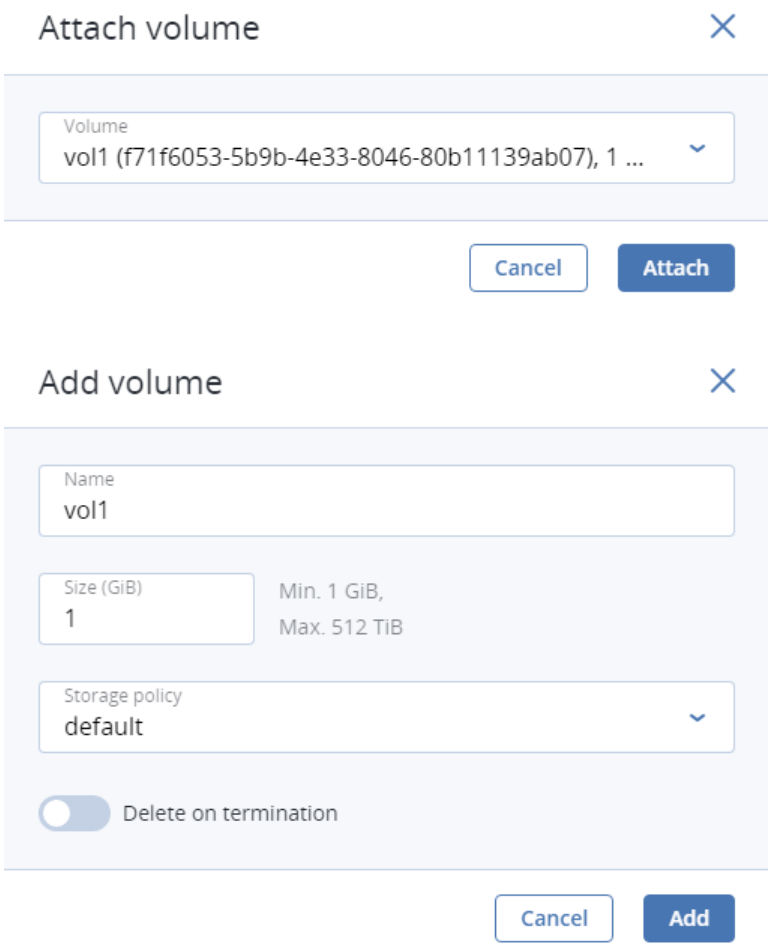
1. On the **COMPUTE** > **VIRTUAL MACHINES** tab, click **Create VM**. A window will open where you will need to specify VM parameters.



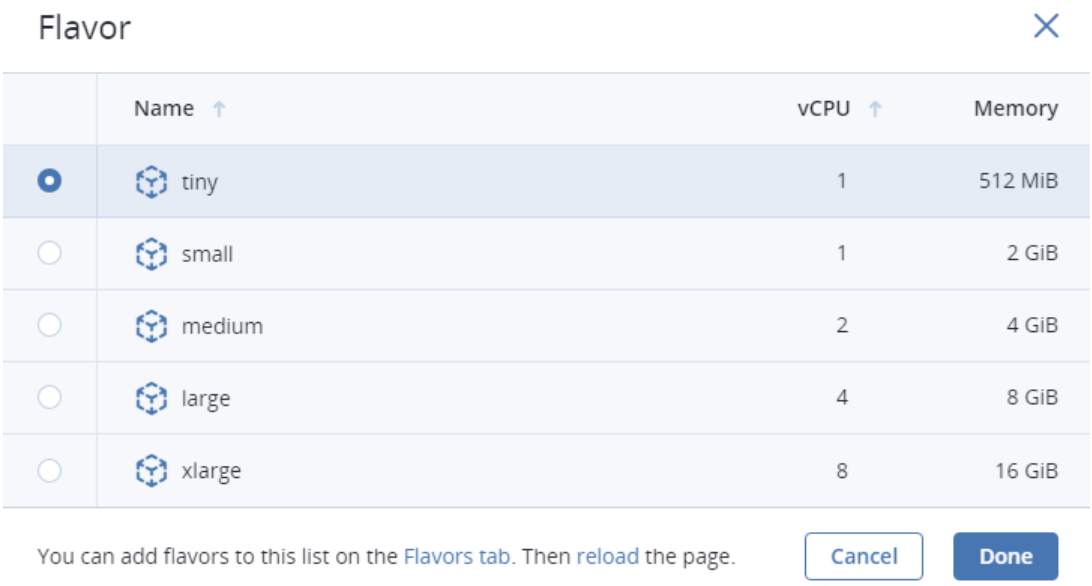
2. Specify a name for the new VM.
3. In **Deploy from**, choose **Volume** if you have a boot volume or want to create one. Otherwise, choose **Image**.
4. Depending on your choice, click the pencil icon in the **Volumes** or **Image** section and do one of the following:
   - In the **Images** window, select the ISO image or template and click **Done**.



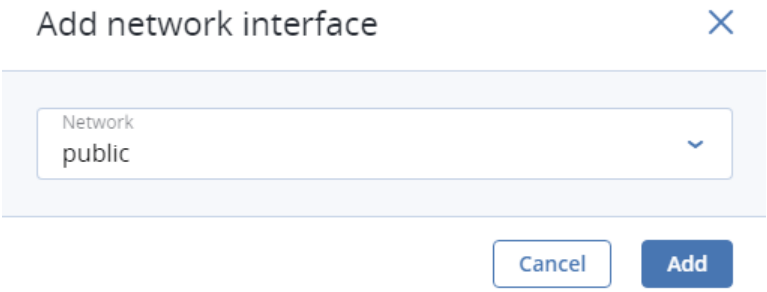
- In the **Volumes** window, do one of the following:
  - If you have prepared a volume with an installed guest OS, click **Attach**, find and select the volume, and click **Done**.



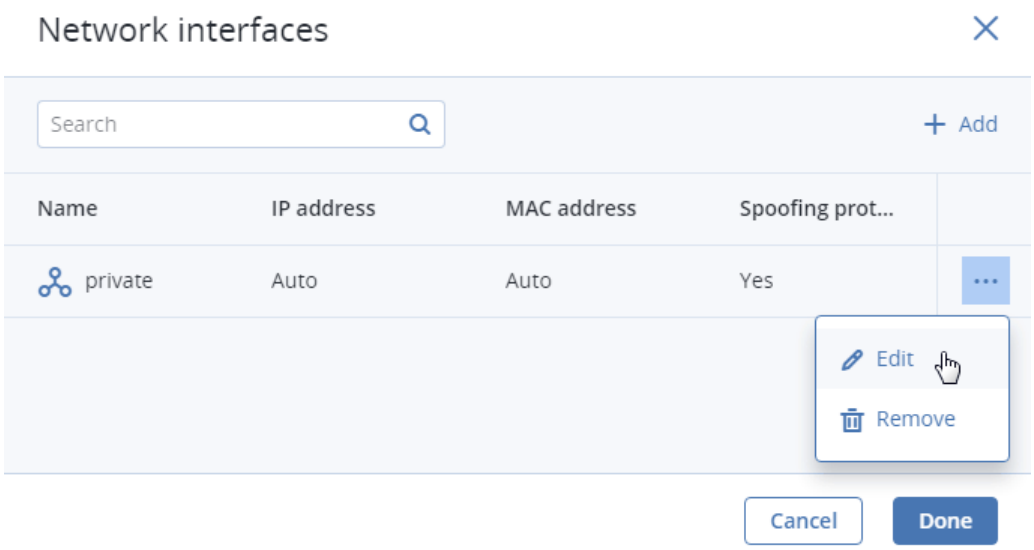
5. Optionally, in the **Volumes** window, click **Add new** or **Attach new** to create or attach any other volumes you need. To select a volume as bootable, place it first in the list by clicking the up arrow button next to it.
6. In the **Flavor** window, choose a flavor and click **Done**.



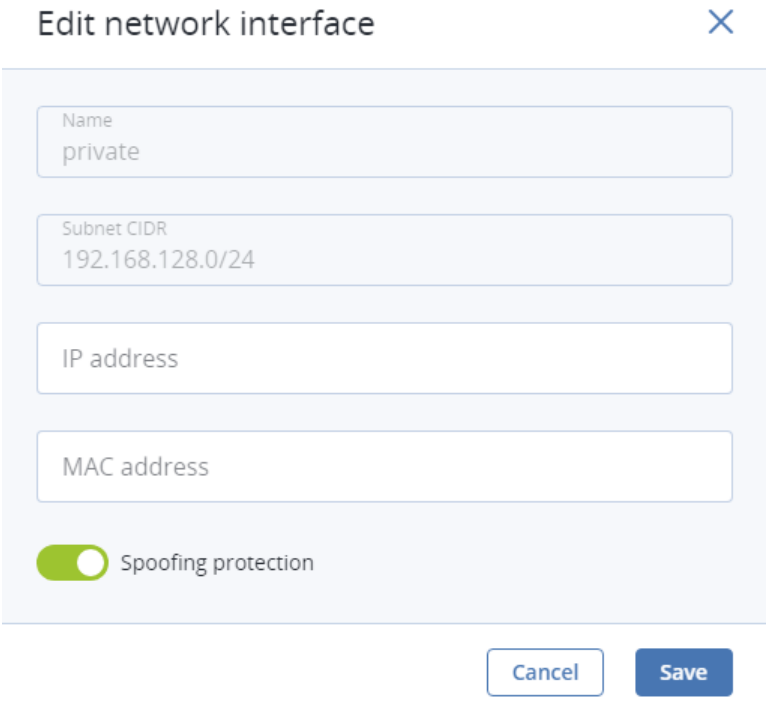
7. In the network window, click **Add**, select a virtual network interface and click **Add**. It will appear in the **Network interfaces** list.



To edit additional parameters of network interfaces that you have just added (IP and MAC addresses and spoofing protection), click interface's ellipsis icon, click **Edit**, and specify needed details in the **Edit network interface** window. Click **Save**.



You will not be able to edit these parameters later. Instead, you will be able to delete old network interface and replace it with a new one.



Click **Done**.

8. Back in the **Create virtual machine** window, click **Deploy** to create and boot the VM.
9. If you are deploying the VM from an ISO image (not a boot volume template or volume with a

pre-installed guest OS), select the VM, click **Console**, and install the guest OS using the built-in VNC console.

To remove a VM, select it, click the ellipsis button next to it, **Delete**, and **Remove**. You cannot delete running VMs.

4.6.3 Running, Shutting Down, and Rebooting Virtual Machines

To start, shut down, reboot, or hard reboot a VM, click the ellipsis button next to it and click the desired action.

The start, shutdown, and reboot operations are equivalent to powering up, shutting down, and soft-rebooting a computer, respectively. The hard reboot operation is equivalent to cutting off and restoring power, then starting a computer.

4.6.4 Suspending and Resuming Virtual Machines

Acronis Software-Defined Infrastructure allows you to suspend a running VM by saving its current state to a special file. Later on, you can restore VM's state by resuming it. Suspending VMs may prove useful, for example, if you need to restart the host but do not want to quit the applications currently running in the VM or spend time on restarting the guest OS.

To suspend or resume a VM, click the ellipsis button next to it and click **Suspend** or **Resume**, respectively.

4.6.5 Reconfiguring and Monitoring Virtual Machines

To monitor virtual machine's CPU, storage, and network usage, select the VM and open the **Monitoring** tab. To download the VM's console log (if such logging is enabled inside the VM), click the ellipsis button next to it and **Download console log**.

To reconfigure a VM, select it and, on the **Overview** tab, click the pencil icon next to a parameter you need to change. You cannot do the following:

- change, detach, or delete the boot volume;
- manage other volumes except attaching and detaching;
- modify previously added network interfaces;

- change the flavor while the VM is running.

4.6.6 Migrating Virtual Machines

VM migration helps facilitate cluster upgrades and workload balancing between compute nodes. Acronis Software-Defined Infrastructure allows you to perform two types of migration:

- **Cold migration** for stopped and suspended virtual machines.
- **Hot migration** for running virtual machines. This migration type is useful when VM downtime is not desirable.

For both migration types, a virtual machine is migrated between compute nodes using shared storage, so no block device migration takes place.

Hot migration consists of the following steps:

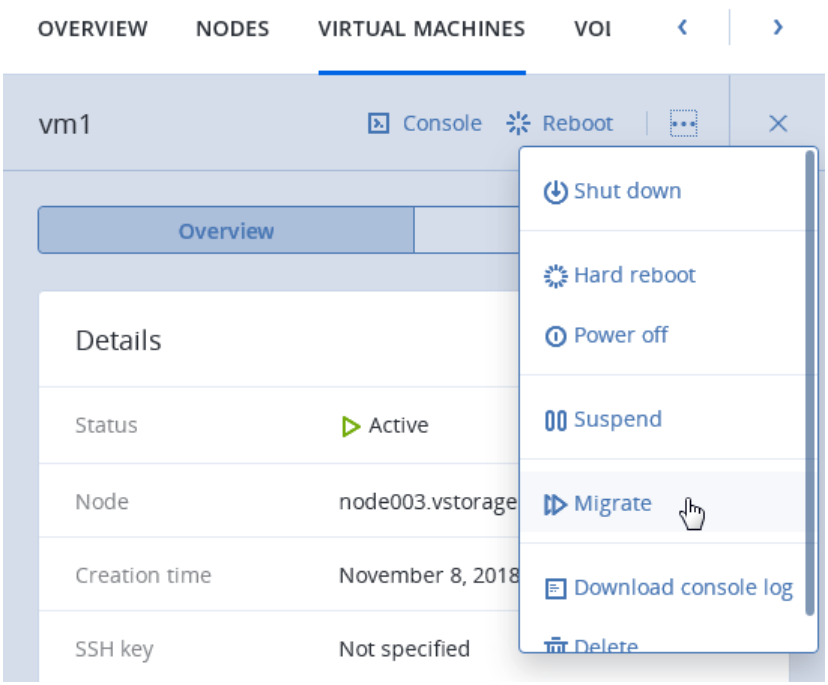
1. All VM memory is copied to the destination node while the virtual machine keeps running on the source node. If a VM memory page changes, it is copied again.
2. When only a few memory pages are left to copy, the VM is stopped on the source node, the remaining pages are transferred, and the VM is restarted on the destination node.

Large virtual machines with write-intensive workloads write to memory faster than memory changes can be transferred to the destination node, thus preventing migration from converging. For such VMs, the auto-converge mechanism is used. When a lack of convergence is detected during live migration, VM's vCPU execution speed is throttled down, which also slows down writing to VM memory. Initially, virtual machine's vCPU is throttled by 20% and then by 10% during each iteration. This process continues until writing to VM memory slows down enough for migration to complete or the VM vCPU is throttled by 99%.

Note: Virtual machines are created with the host CPU model by default. Having compute nodes with different CPUs may lead to live migration issues. To avoid them, you can manually set CPU model for all new VMs as described in the *Administrator's Command Line Guide*.

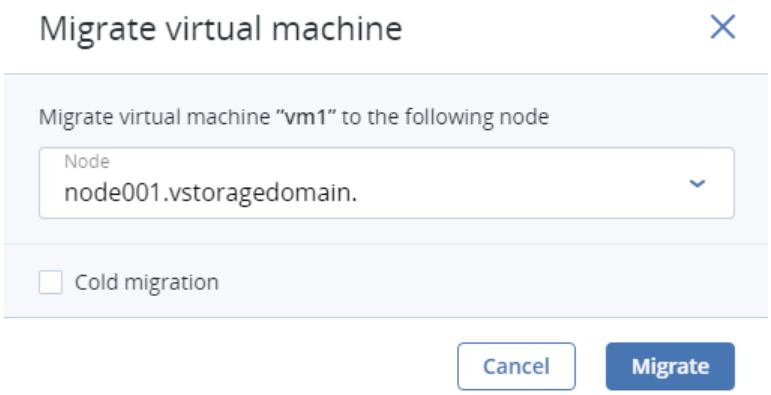
To migrate a VM, do the following:

1. On the **COMPUTE** > **VIRTUAL MACHINES** tab, click a VM to migrate, click the ellipsis button and choose **Migrate**.



2. In the new window, specify the destination node:

   - **Auto**. Automatically select the optimal destination among cluster nodes based on available CPU and RAM resources.
   - Select the destination node manually from the drop-down list.



3. By default, running VMs are migrated live. You can change the migration mode to offline by ticking the **Cold migration** checkbox. A VM will be stopped and restarted on the destination node after migration.
4. Click **Migrate** to reserve resources on the destination node and start migration.

The admin panel will show the migration progress.

4.7 Managing Volumes

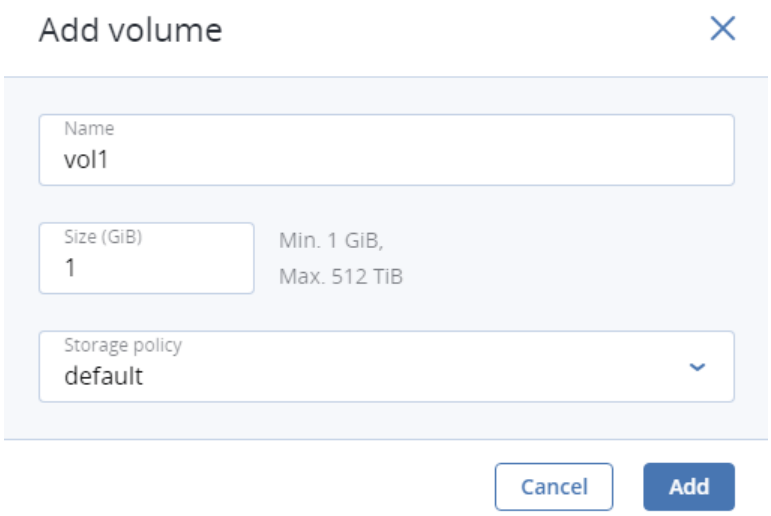
A volume in Acronis Software-Defined Infrastructure is a virtual disk drive that can be attached to a VM. The integrity of data in volumes is protected by a redundancy mode specified in a storage policy.

Note: Additional virtual disks attached to VMs need to be initialized inside the guest OS by standard means before they can be used.

4.7.1 Creating, Editing, and Removing Volumes

To create a volume, do the following:

1. On the **COMPUTE** > **VOLUMES** tab, click **Add volume**.



2. In the **Add volume** window, specify volume name and size in gigabytes; select a storage policy from the corresponding drop-down list; click **Add**.

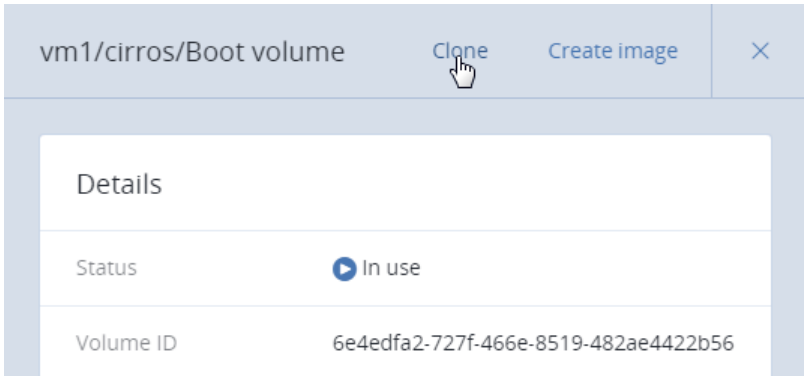
To edit a volume, select it and click the pencil icon next to a parameter you need to change. You cannot shrink volumes. To extend volumes that are in use, stop the VM first.

To remove a volume, click the corresponding ellipsis button then click **Delete**. To remove multiple volumes at once, select them and click **Delete**. To remove a volume that is in use, detach it first.

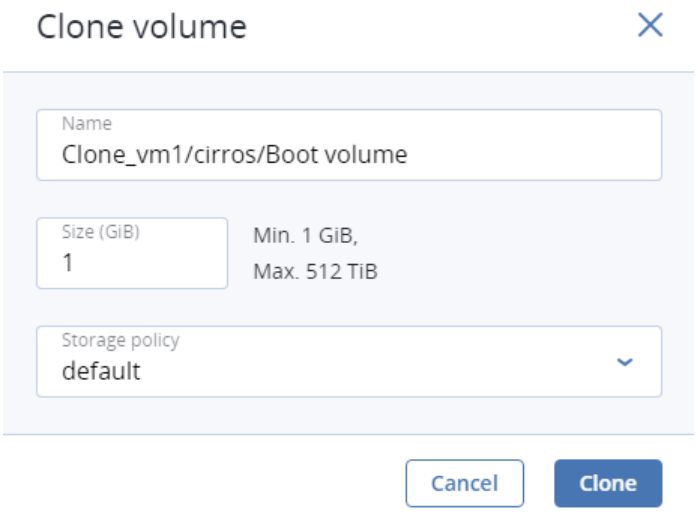
4.7.2 Cloning Volumes

You can clone volumes that are not attached to VMs or attached to stopped VMs. To clone a volume, do the following:

1. On the **COMPUTE** > **VOLUMES** tab, click a volume.
2. In volume details that open, click **Clone**.



3. In the **Clone volume** window that opens, specify a volume name, size, and storage policy. Click **Clone**.

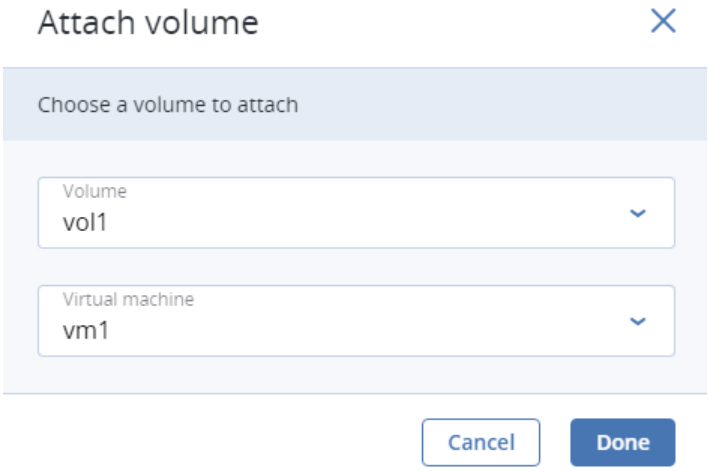


4.7.3 Attaching and Detaching Volumes

To add a writable virtual disk drive to a VM, attach a volume to it. To do this:

1. On the **COMPUTE** > **VOLUMES** tab, click the ellipsis button next to an unused volume and click **Attach** in the context menu.

2. In the **Attach volume** window, select the VM from the drop-down list and click **Done**.



To detach a volume, do the following:

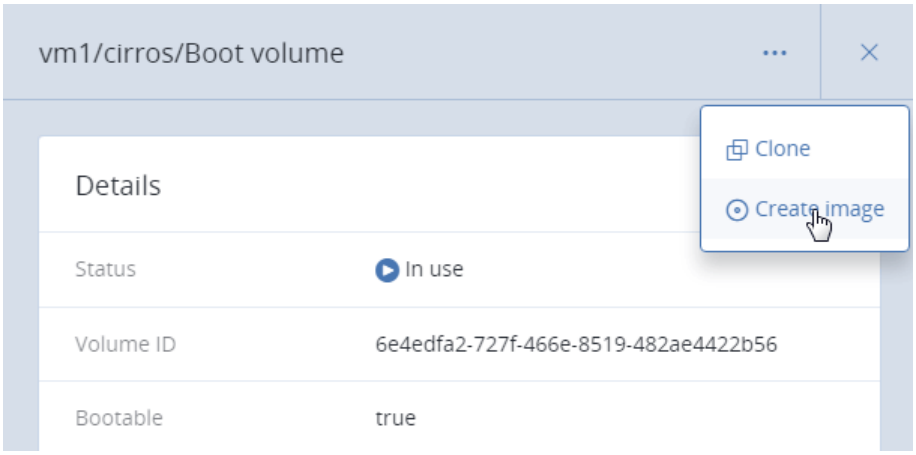
1. Click the ellipsis button next to the volume that is in use.
2. Click **Detach** to gracefully stop all operations and detach the volume; or click **Force detach** to immediately detach it with a risk of data loss.

4.7.4 Creating Images from Volumes

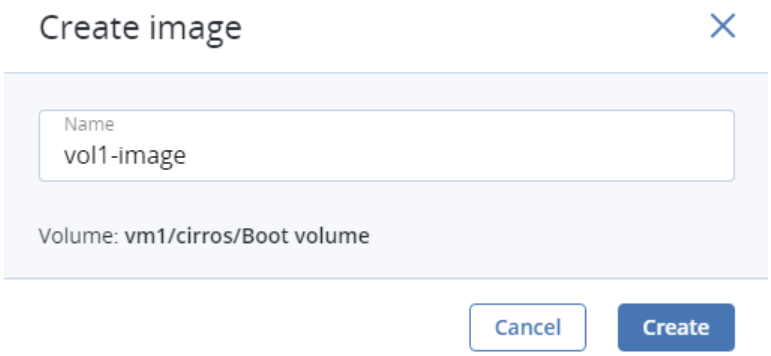
To create multiple VMs with the same boot volume, you can create an image from an existing boot volume and deploy VMs from it. Make sure to install cloud-init in the volume before creating the image.

Do the following:

1. Power off the VM that the original volume is attached to.
2. Switch to **VOLUMES**, click the volume, then click volume's ellipsis button and **Create image**.



3. In the **Create image** window, enter an image name and click **Create**.



The new image will appear on the **IMAGES** tab.

4.8 Managing Flavors

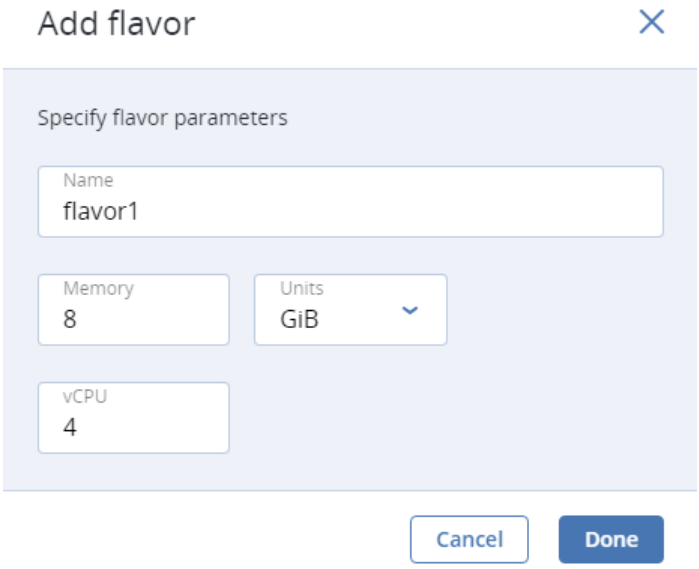
A flavor in Acronis Software-Defined Infrastructure is a configuration template that simplifies VM deployment. It allows you to set the number of virtual CPU cores and the amount of RAM a virtual machine will use.

Important: When choosing a flavor for a VM, make sure it satisfies the hardware requirements of the guest OS. For more information on VM hardware, see *Managing Virtual Machines* (page 60).

To create a flavor, do the following:

1. On the **Compute** > **FLAVORS** tab, click **Add flavor**.
2. In the **Add flavor** window, specify a flavor name, a number of virtual CPU cores, an amount of RAM and

click **Done**.



To delete one or more flavors, select them and click **Delete flavors**.

4.9 Monitoring the Compute Cluster

After you create the compute cluster, you can monitor it on the **COMPUTE** > **OVERVIEW** screen.

The charts show the information on CPU, RAM, and storage usage; the number of virtual machines grouped by status and resource consumption; and compute-related alerts.

4.9.1 Used CPUs Chart

This chart displays CPU utilization of the compute cluster. The following statistics are available:

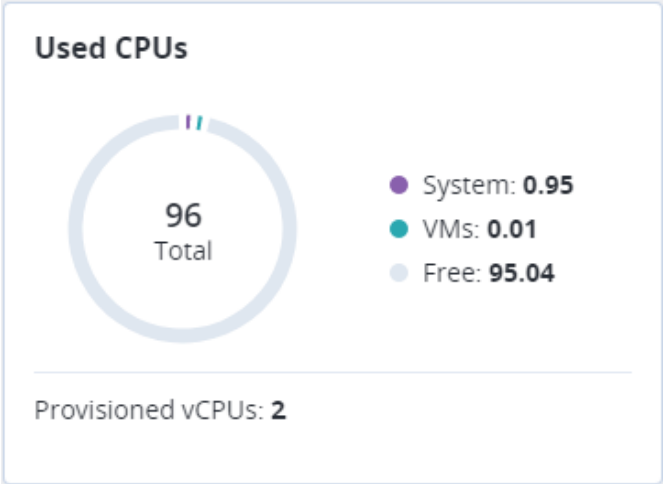
System The number of logical cores used by system and storage services on all nodes in the compute cluster.

VMs The number of logical cores used by virtual machines on all nodes in the compute cluster.

Free The number of unused logical cores on all nodes in the compute cluster.

Total The total number of logical cores on all nodes in the compute cluster.

Provisioned vCPUs The number of vCPUs provisioned for all VMs in the compute cluster.



A similar chart is available for each individual node in the compute cluster.

4.9.2 Reserved RAM Chart

This chart displays RAM utilization of the compute cluster. The following statistics are available:

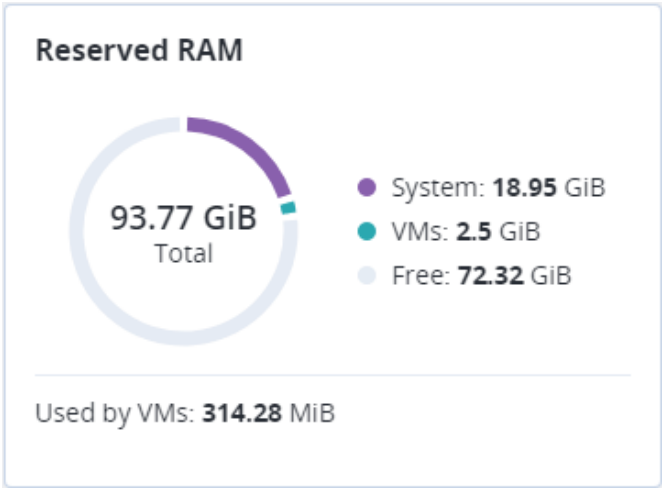
System The amount of RAM reserved for system and storage services on all nodes in the compute cluster.

VMs The amount of RAM provisioned for all VMs in the compute cluster.

Free The amount of free RAM on all nodes in the compute cluster.

Total The total amount of RAM on all nodes in the compute cluster.

Used by VMs The amount of RAM actually used by all VMs in the compute cluster.



A similar chart is available for each individual node in the compute cluster.

4.9.3 Provisioned Storage Chart

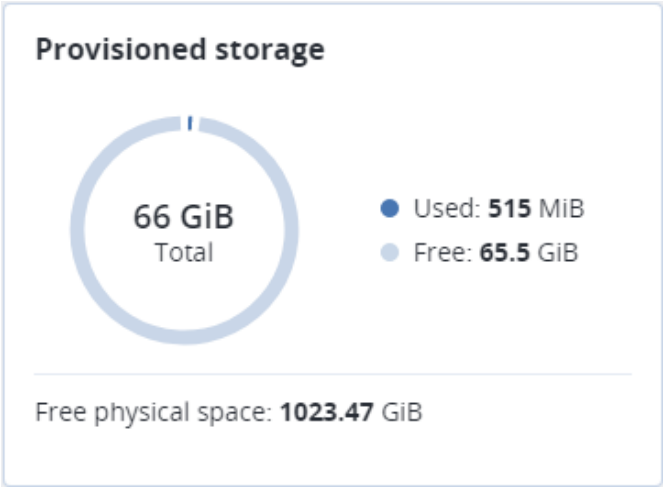
This chart shows usage of storage space by the compute cluster. The following statistics are available:

Used The amount of storage space actually occupied by data in all volumes provisioned in the compute cluster.

Free The amount of unused space in all volumes provisioned in the compute cluster.

Total The total size of volumes provisioned in the compute cluster.

Free physical space The amount of physical space available in the storage cluster.



4.9.4 VM Status Chart

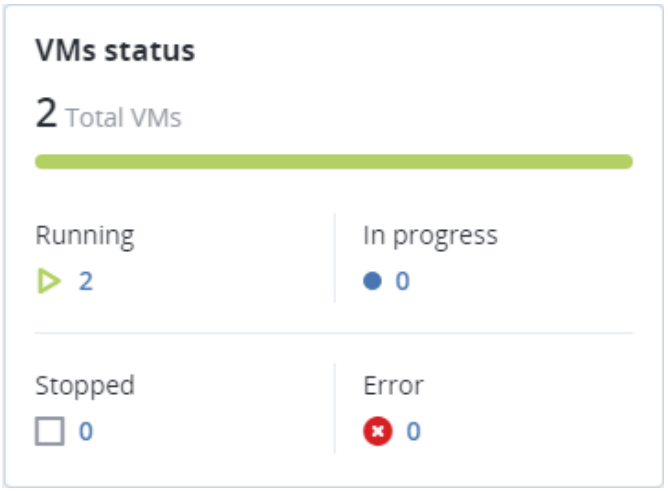
The **VMs status** chart shows the total number of virtual machines in the compute cluster and groups them by status, which can be the following:

Running The number of virtual machines that are up and running.

In progress The number of virtual machines that are in a transitional state: building, restarting, migrating, etc.

Stopped The number of virtual machines that are suspended or powered off.

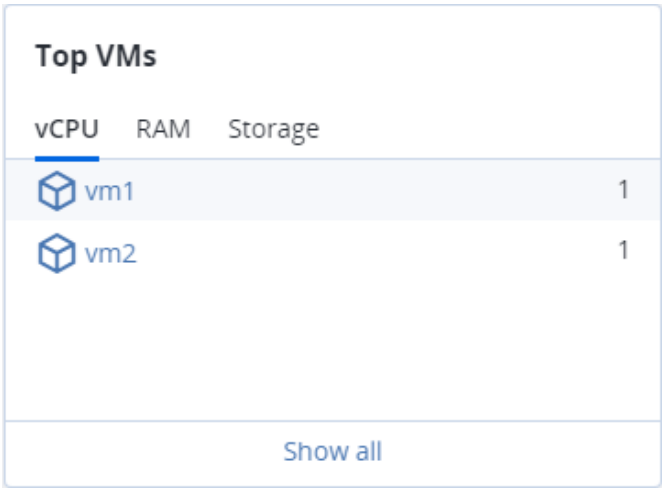
Error The number of virtual machines that have failed. Try troubleshooting such VMs via the console or rebuild them.



To see a full list of virtual machines filtered by the chosen status, click the number next to the status icon.

4.9.5 Top VMs Chart

The **Top VMs** chart lists virtual machines with the highest resource consumption sorted by **CPU**, **RAM**, or **Storage** in descending order. To switch between lists, click the desired resource.



To see a full list of virtual machines in the compute cluster, click **Show all**.

4.9.6 Alerts Chart

The **Alerts** chart lists all the alerts related to the compute cluster sorted by severity. Alerts include the following:

Critical The compute cluster has encountered a critical problem. For example, one or more of its components have been unavailable for more than 10 seconds or some resource has exceeded its soft limit.

Warning The compute cluster is experiencing issues that may affect its performance. For example, one or more of its components operate slowly or some resource is approaching its soft limit.

Other Some other issue has happened with the compute cluster. For example, its license is about to expire or has expired.

To see a full list of compute-related alerts, click **Show all**.

4.9.7 Per-VM Charts

You can monitor performance individual VMs on the **COMPUTE** > **VIRTUAL MACHINES** > VM > **Monitoring** tab.

The default time interval for the charts is 12 hours. To zoom into a particular time interval, select the internal with the mouse; to reset zoom, double click any chart.

The following performance charts are available:

CPU / RAM CPU and RAM usage by the VM.

Network Incoming and outgoing network traffic.

Storage read/write Amount of data read and written by the VM.

Read/write latency Read and write latency. Hovering the mouse cursor over a point on the chart, you can also see the average and maximum latency for that moment as well as the 95 and 99 percentiles.

4.10 Destroying the Compute Cluster

To destroy the compute cluster, do the following:

1. Delete all virtual machines from all nodes.
2. Release the compute nodes. To do this, select all nodes on the **COMPUTE** > **NODES** screen and click **Release nodes**. Regular (non-management) nodes will be released first. Management nodes will follow. Releasing the management nodes will destroy the compute cluster.

CHAPTER 5

Exporting Storage Cluster Data

Acronis Software-Defined Infrastructure allows you to export storage space as:

- Block storage via iSCSI for virtualization, databases and other needs.
- Object storage for storing unlimited number of files via an Amazon S3 compatible protocol. You can store data like media files, backups, Open Xchange files and access the storage using Dropbox-like applications. You can build your own Amazon S3 compatible object storage services as a part of your cloud offering or for internal needs.
- A back-end for Acronis Backup Cloud and Acronis Backup Advanced backups.
- NFS exports.

5.1 Exporting Storage via iSCSI

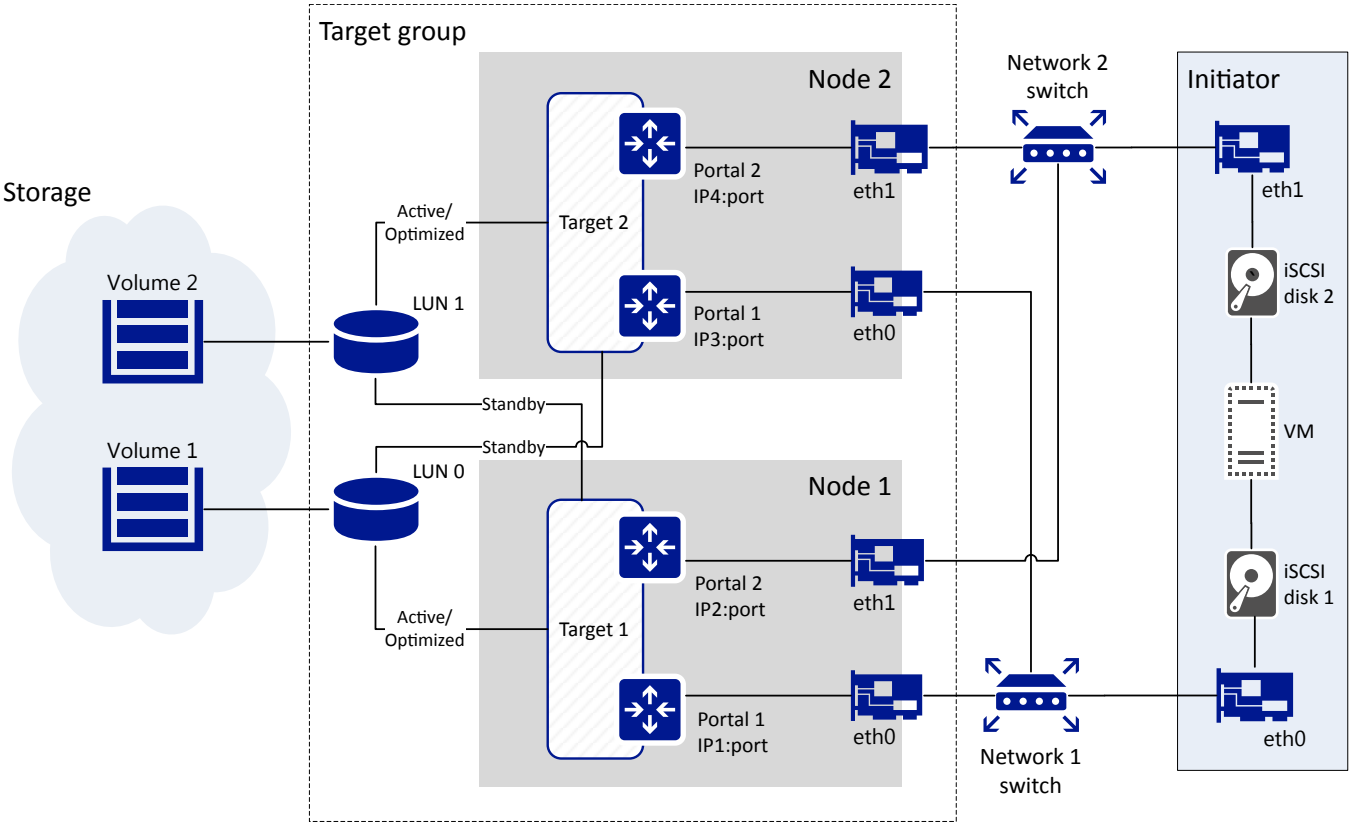
Acronis Software-Defined Infrastructure allows you to export cluster disk space to external operating systems and third-party virtualization solutions in the form of LUN block devices over iSCSI in a SAN-like manner.

In Acronis Software-Defined Infrastructure, you can create groups of redundant targets running on different storage nodes. To each target group you can attach multiple storage volumes with their own redundancy provided by the storage layer. These volumes are exported by targets as LUNs.

Each node in a target group can host a single target for that group if Ethernet is used or one target per FC port if Fibre Channel is used. If one of the nodes in a target group fails along with its target(s), healthy targets from the same group continue to provide access to the LUNs previously serviced by the failed target(s).

You can create multiple target groups on same nodes. A volume, however, may only be attached to one target group at any moment of time.

The figure below shows a typical setup for exporting Acronis Software-Defined Infrastructure disk space via iSCSI.



The figure shows two volumes located on redundant storage provided by Acronis Software-Defined Infrastructure. The volumes are attached as LUNs to a group of two targets running on Acronis Software-Defined Infrastructure nodes. Each target has two portals, one per network interface with the iSCSI traffic type, which makes a total of four discoverable endpoints with different IP addresses. Each target provides access to all LUNs attached to the group. Targets work in the ALUA mode, so one path to the volume is preferred and considered Active/Optimized while the other is Standby. Network interfaces `eth0` and `eth1` on each node are connected to different switches for redundancy. The initiator, e.g., VMware ESXi, is connected to both switches as well and provides volumes as iSCSI disks 1 and 2 to a VM via different network paths. If the Active/Optimized path becomes unavailable for some reason (e.g., the node with the target or network switch fails), the Standby path through the other target will be used instead to connect to the volume. When the Active/Optimized path is restored, it will be used again.

5.1.1 iSCSI Workflow Overview

The typical workflow of exporting volumes via iSCSI is as follows:

1. Assign the network with the traffic type **iSCSI** to a network interface on each node that you will add to a target group. See *Managing Networks and Traffic Types* (page 2).
2. Create a target group on chosen nodes. See *Creating Target Groups* (page 82).
3. Create volumes and attach them to the target group as LUNs. Typically you do this while creating the target group. However, you can also do this later as described in *Managing Volumes* (page 90).
4. Optionally, enable CHAP and ACL authorization for the target group: create CHAP accounts and assign them to the target group, populate group's access control list. Typically, you do this while creating the target group. However, you can also do this later as described in *Restricting Access to Target Groups* (page 96).
5. Connect initiators to targets using standard tools of your operating system or product. To view target IQNs, click the target group name.

5.1.2 Managing Target Groups

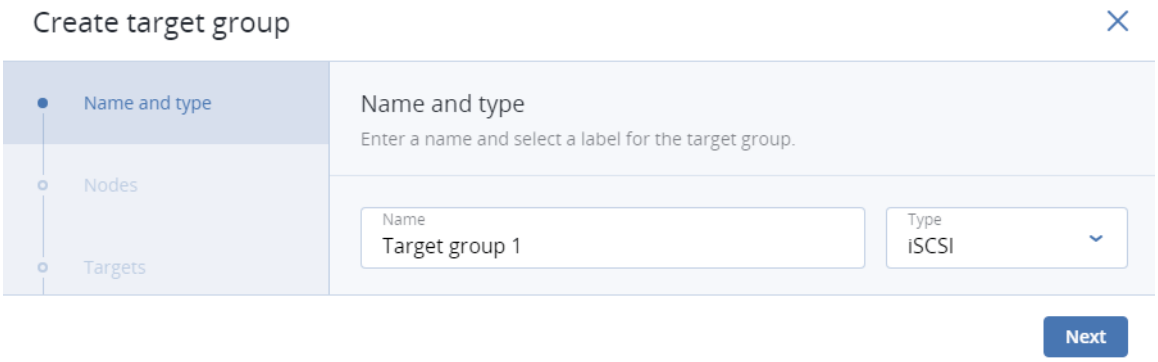
This section explains how to create and manage groups of iSCSI targets.

5.1.2.1 Creating Target Groups

Before you create any target groups, assign the network with the iSCSI traffic type to a network interface on each node that you will add to a target group.

To create a target group, open **STORAGE SERVICES** > **Block storage** > **Target groups** and click **Create target group**. A wizard will open where you need to do the following:

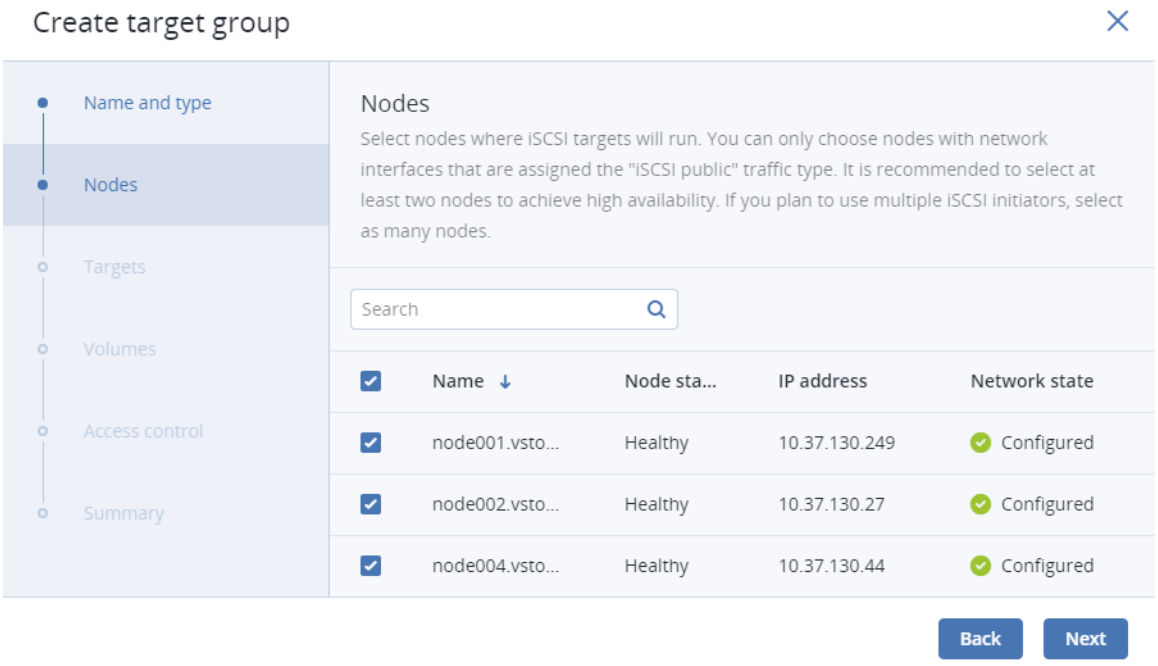
1. On **Name and type**, enter a target group name and select a type: iSCSI or Fibre Channel.



2. On **Nodes**, select nodes to add to the target group. On these nodes, iSCSI targets will run. You can only choose nodes with network interfaces that are assigned the **iSCSI** traffic type. It is recommended to have at least two nodes in the target group to achieve high availability. If you plan to use multiple iSCSI initiators, you should have as many nodes in the target group.

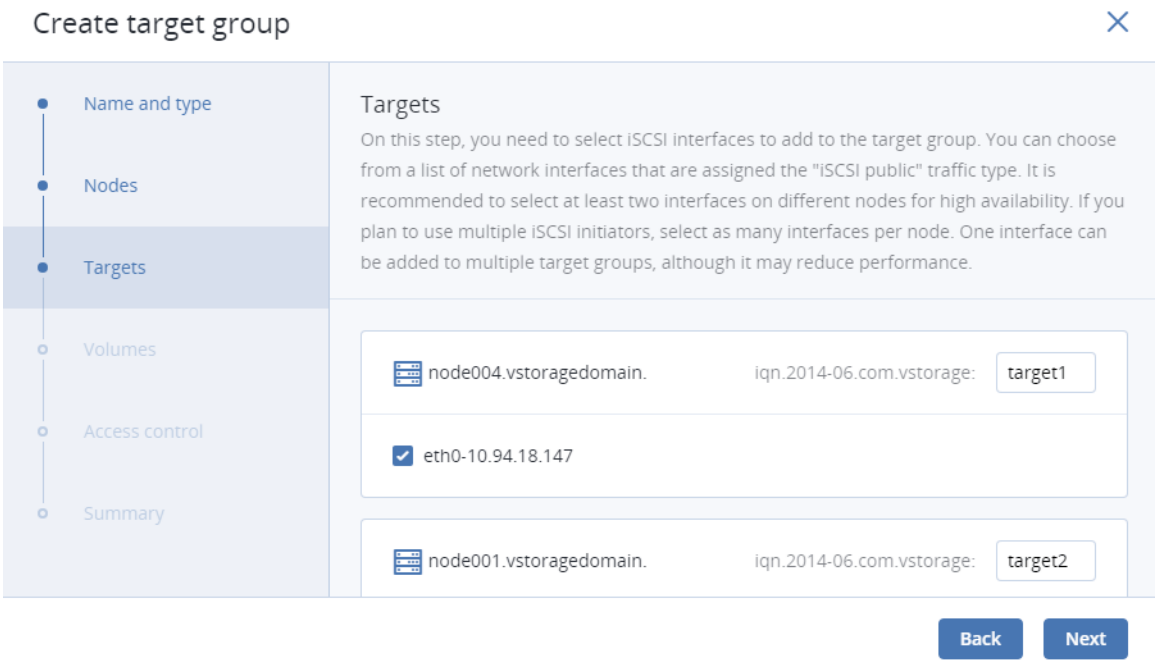
   The optimal way is to create a single target per node if you use the iSCSI protocol and one target per FC port if you use the FC protocol.

   If node network interfaces are not configured, click the cogwheel icon, select networks as required, and click **Apply**.

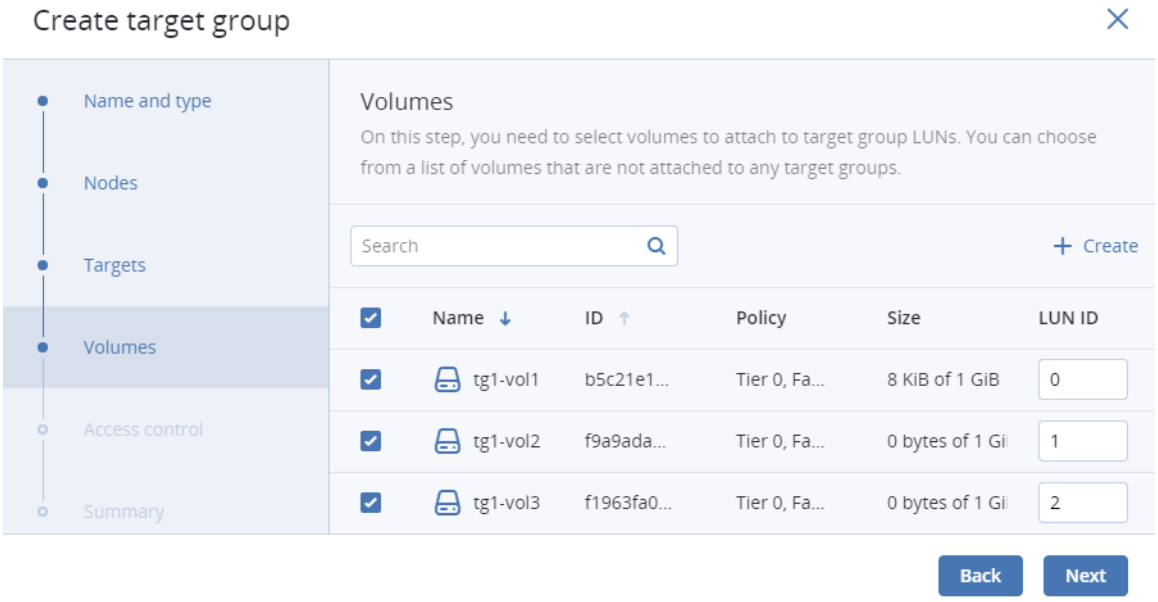


3. On **Targets**, select iSCSI interfaces to add to the target group. You can choose from a list of network interfaces that are assigned the **iSCSI** traffic type. If you plan to use multiple iSCSI initiators, you should

select as many interfaces per node. One interface can be added to multiple target groups, although it may reduce performance.

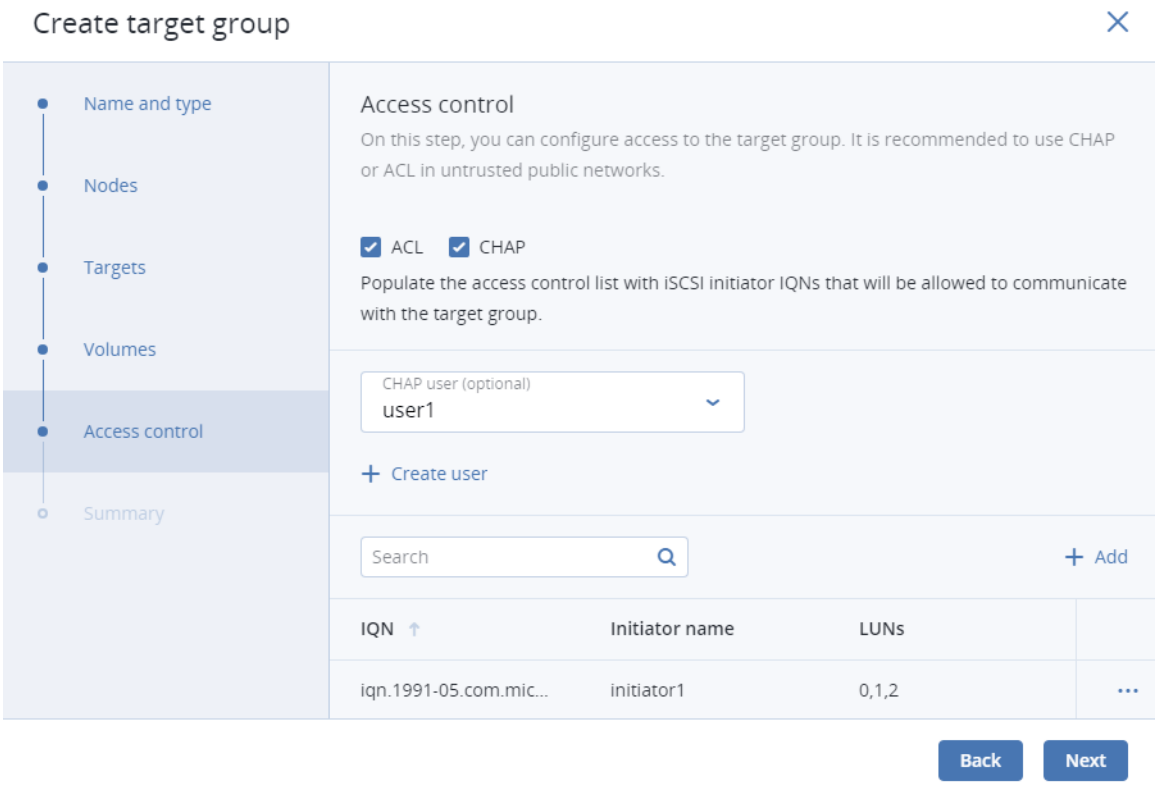


4. On **Volumes**, select volumes to attach to target group LUNs. You can choose from a list of volumes that are not attached to any target groups. If no volumes are available, you can create them on this step so they are attached to the target group automatically or later and attach them manually.



5. On **Access control**, configure access to the target group. It is recommended to use CHAP or ACL in

untrusted public networks. Without access control, any connections to the target group are allowed. For more information, see *Restricting Access to Target Groups* (page 96).



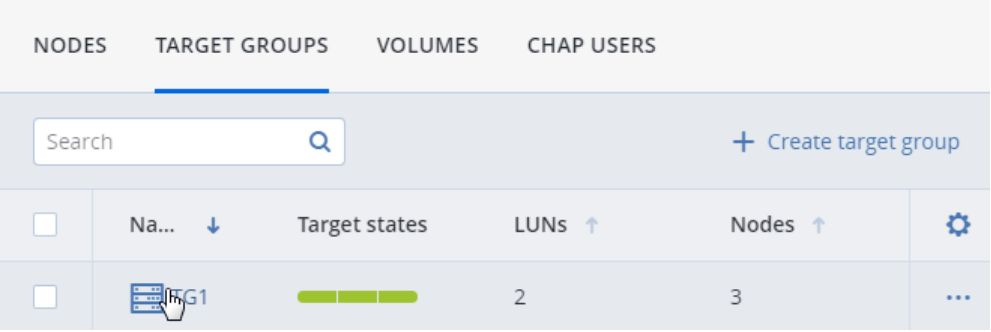
6. On **Summary**, review the target group details. You can go back to change them if necessary. Click **Create**.

The created target group will appear on the **TARGET GROUPS** tab. Its targets will start automatically.

5.1.2.2 Adding Targets

To add a target to a target group, do the following:

1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the name of the desired target group to open it.

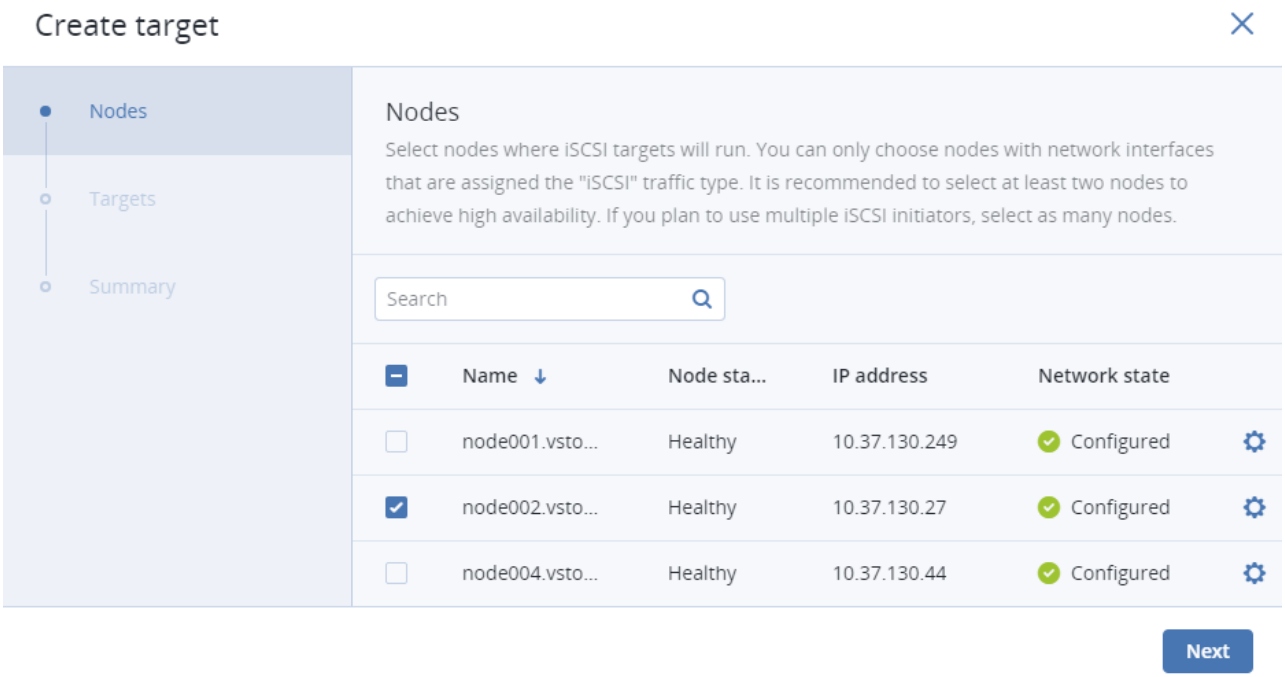


2. On the **Targets** tab, click **Add target**. The **Create target** wizard will open.

3. On **Nodes**, select nodes to add to the target group. On these nodes, iSCSI targets will run. You can only choose nodes with network interfaces that are assigned the **iSCSI** traffic type. It is recommended to have at least two nodes in the target group to achieve high availability. If you plan to use multiple iSCSI initiators, you should have as many nodes in the target group.

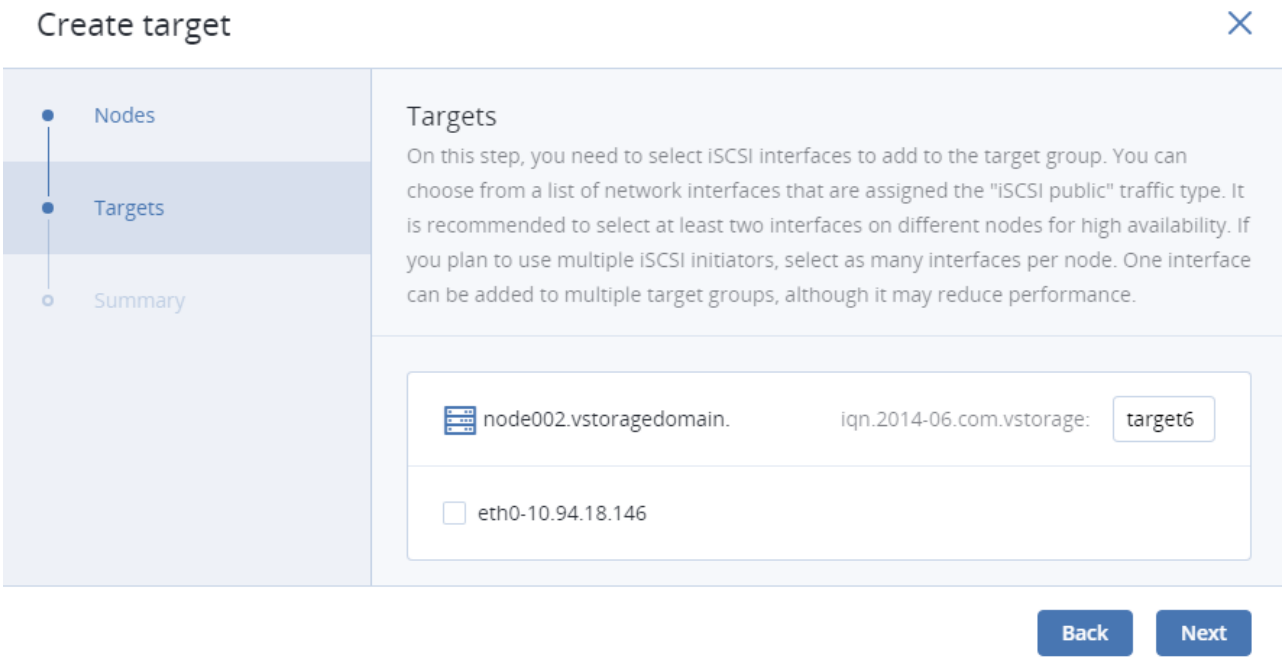
   The optimal way is to create a single target per node if you use the iSCSI protocol and one target per FC port if you use the FC protocol.

   If node network interfaces are not configured, click the cogwheel icon, select networks as required, and click **Apply**.



4. On **Targets**, select iSCSI interfaces to add to the target group. You can choose from a list of network interfaces that are assigned the **iSCSI** traffic type. If you plan to use multiple iSCSI initiators, you should

select as many interfaces per node. One interface can be added to multiple target groups, although it may reduce performance.

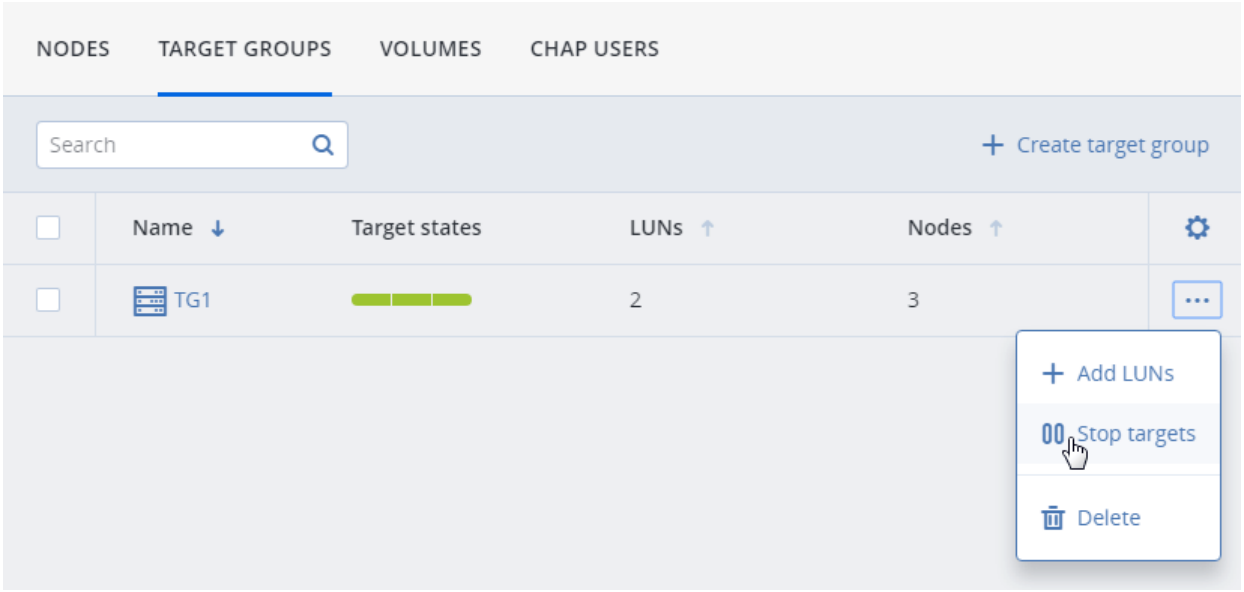


5. On **Summary**, review the target details. You can go back to change them if necessary. Click **Next**.

The created target will appear on the **Targets** tab.

5.1.2.3 Starting and Stopping Targets

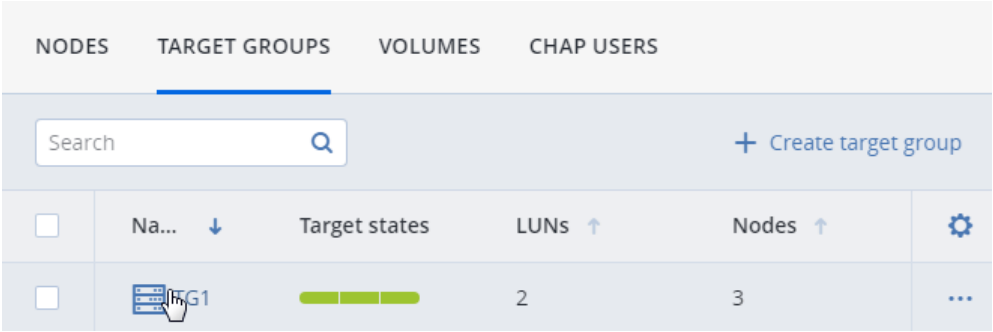
To start or stop all targets in a target group, open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the ellipsis icon of the desired target group, and click **Start targets** or **Stop targets**, respectively.



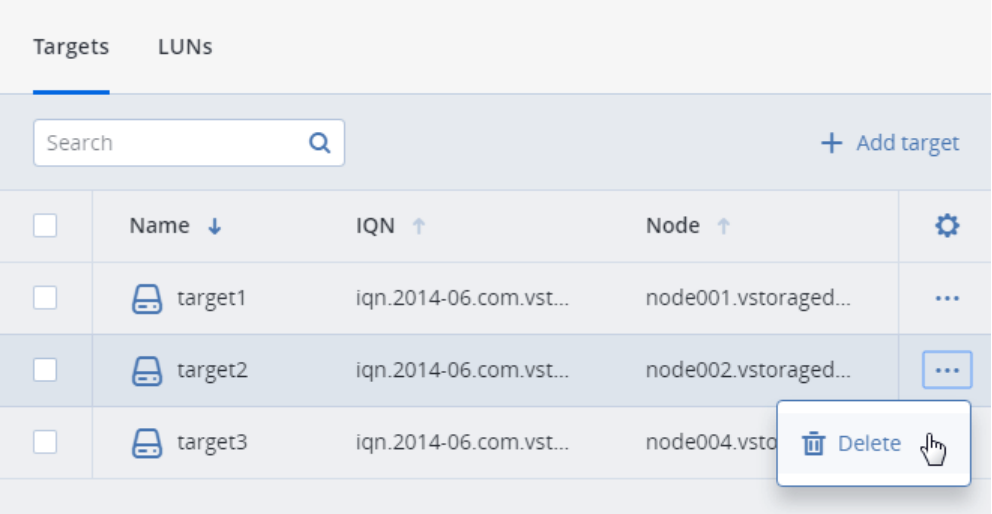
5.1.2.4 Deleting Targets

To delete a target from a target group, do the following:

1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the name of the desired target group to open it.



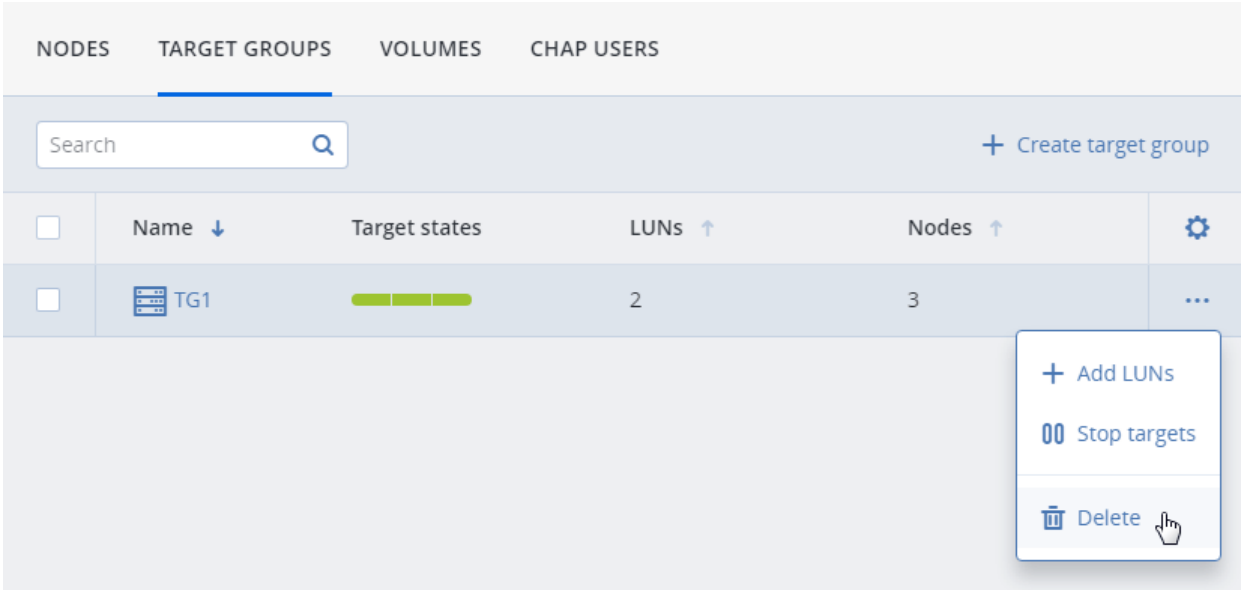
2. On the **Targets** tab, click the ellipsis button of the desired target then click **Delete**.



If you delete a target on the Active/Optimized path (indicated in LUN details), said path will switch to another target.

5.1.2.5 Deleting Target Groups

To delete a target group, open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the ellipsis icon of the desired target group, and click **Delete**.



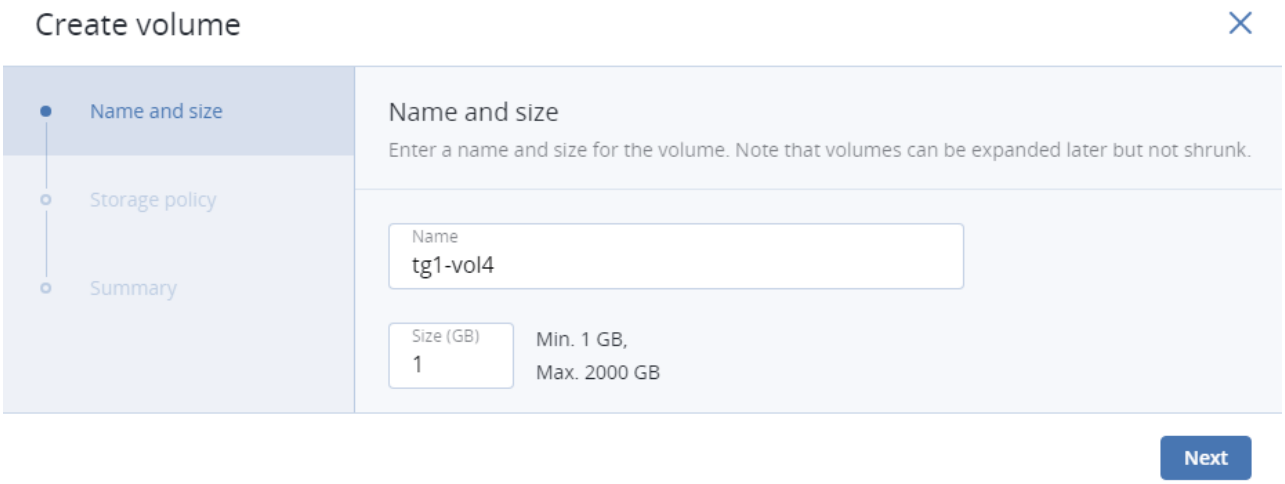
5.1.3 Managing Volumes

This section describes how to create and manage volumes to be exported via iSCSI.

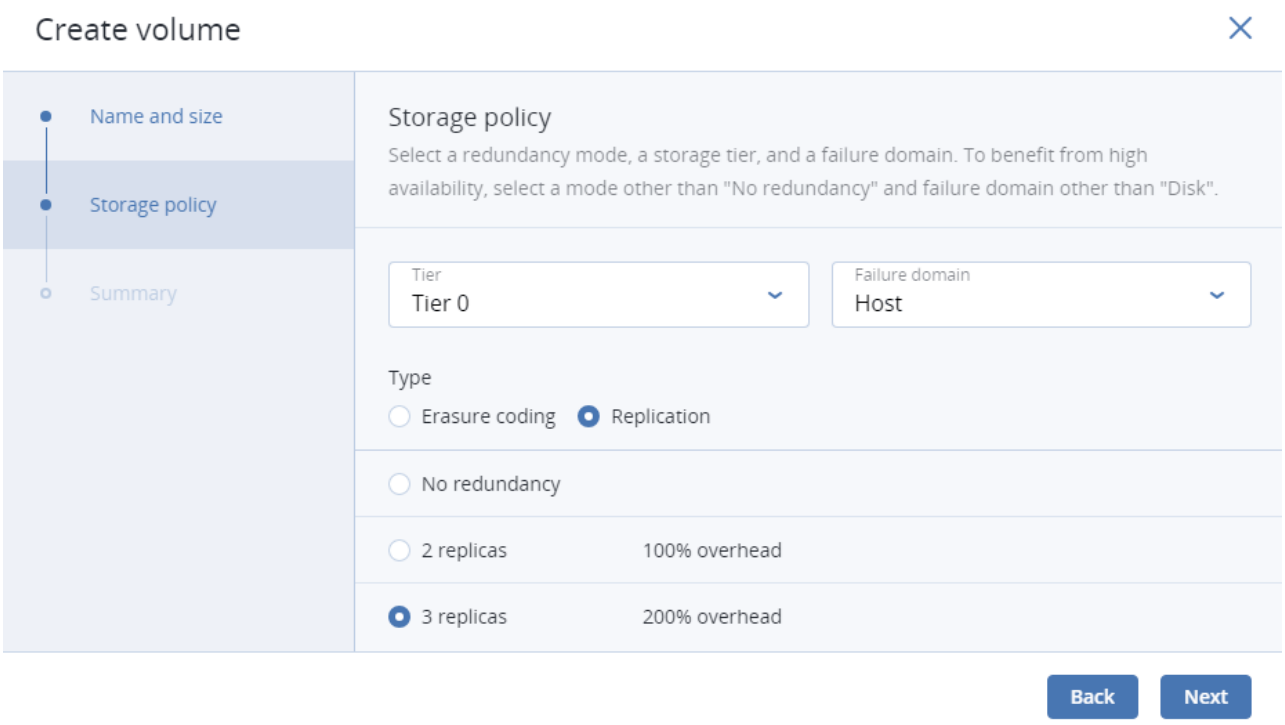
5.1.3.1 Creating Volumes

While it is convenient to create desired volumes while creating a target group, you can also do this at any time afterwards:

1. Open **STORAGE SERVICES** > **Block storage** > **VOLUMES** and click **Create volume**. A corresponding wizard will open.
2. On **Name and size**, enter a volume name and specify a size in gigabytes. Note that volumes can be extended later but not shrunk.



3. On **Storage policy**, select a redundancy mode, a storage tier, and a failure domain. To benefit from high availability, select a mode other than **No redundancy** and failure domain other than **Disk**.

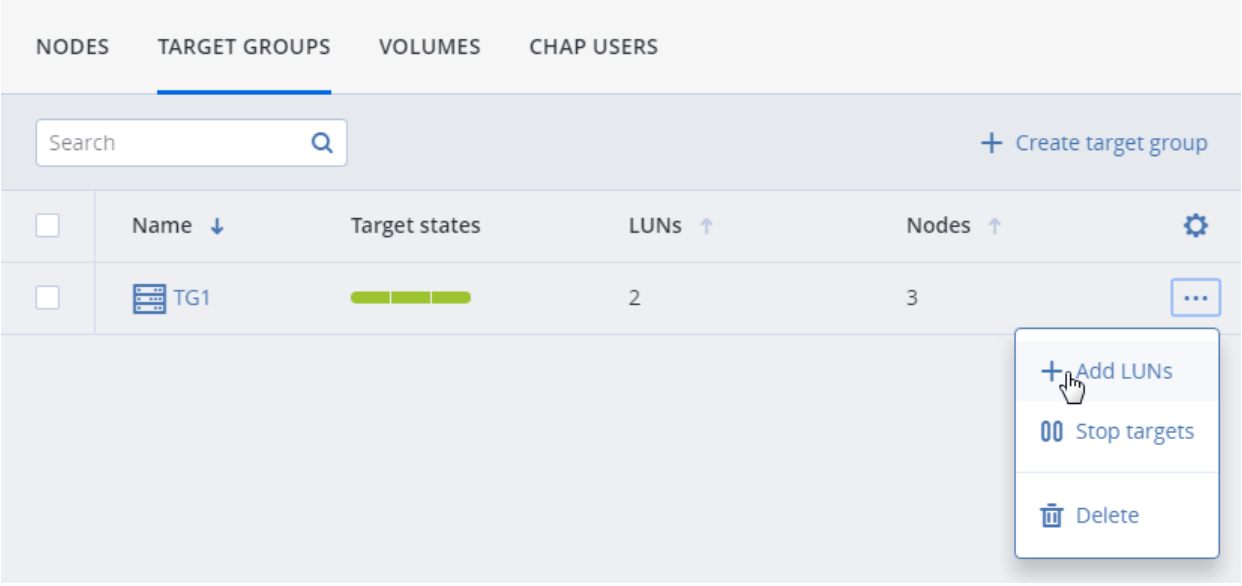


4. On **Summary**, review the volume details. You can go back to change them if necessary. Click **Create**.

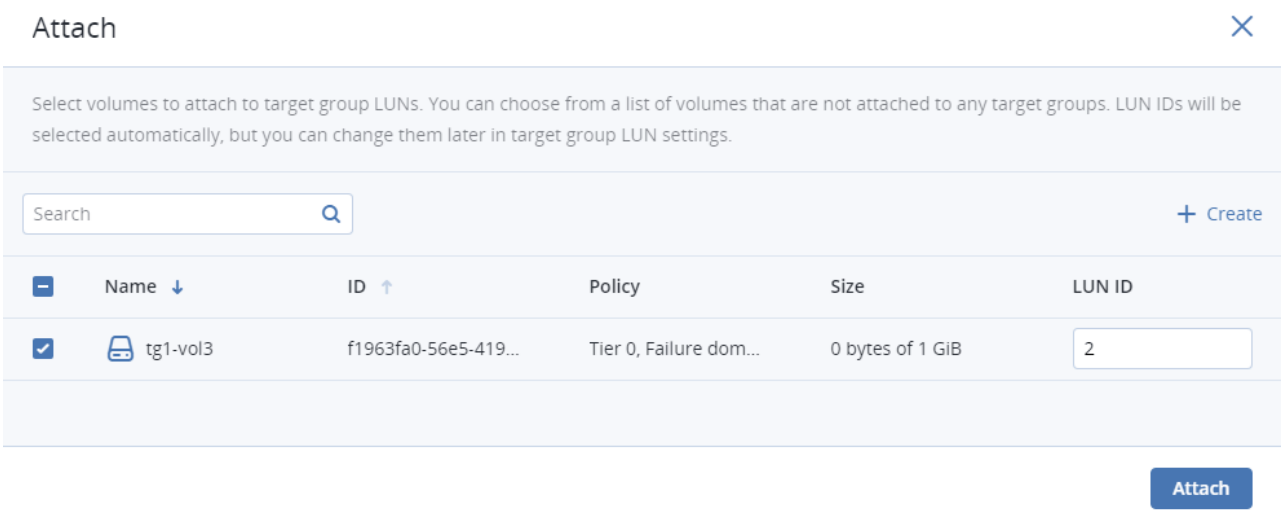
5.1.3.2 Attaching Volumes to Target Groups

To add a volume as a LUN to a target group, do the following:

1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the ellipsis icon of the desired target group, and click **Add LUNs**.

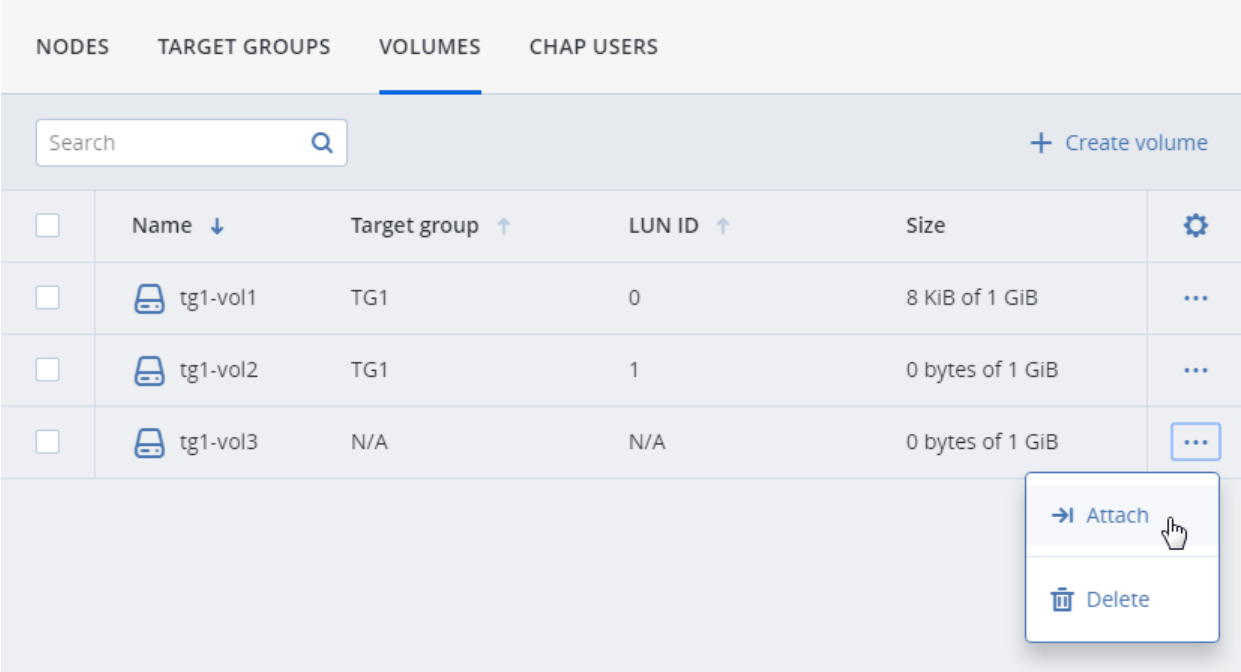


2. In the **Attach** window that opens, select volumes to attach to the target group (create them if needed) and click **Attach**.



Alternatively, you can do the same on the **VOLUMES** tab:

1. Click the ellipsis icon of the desired volume then click **Attach**.

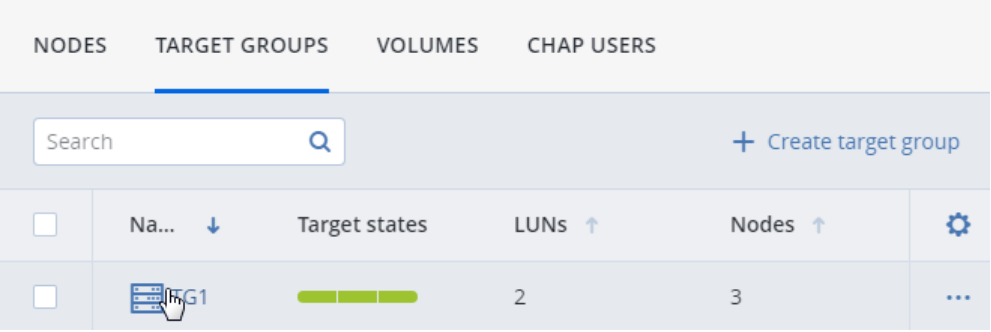


2. In the **Attach** window that opens, select a target group and click **Attach**.

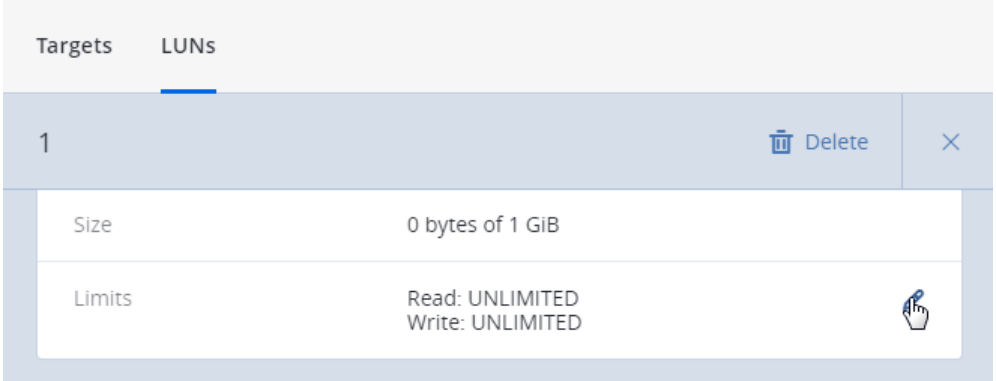
5.1.3.3 Setting LUN Limits

To set a read/write limit for a volume attached to a target group as a LUN, do the following:

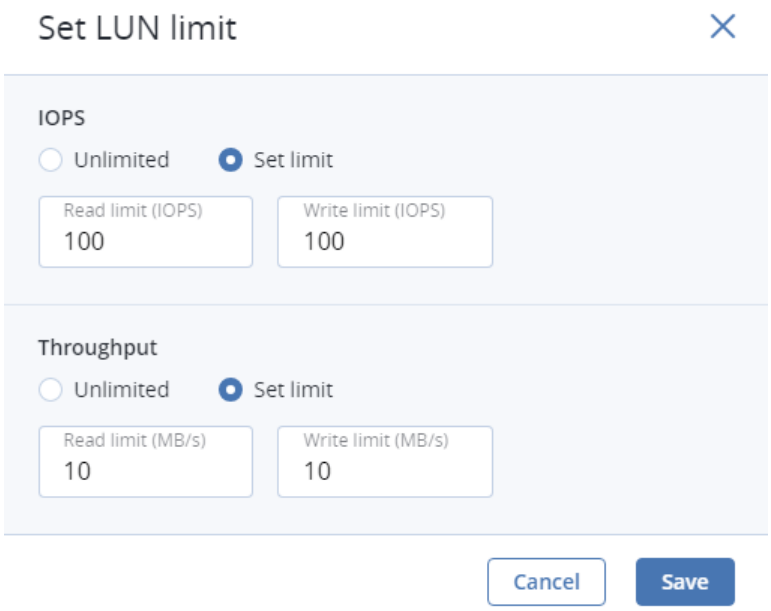
1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the name of the desired target group to open it, and switch to **LUNs**.



2. Click the desired LUN to open its details, then click the **Limits** pencil icon.



3. In the **Set LUN limit** window that opens, enter limit values and click **Save**.

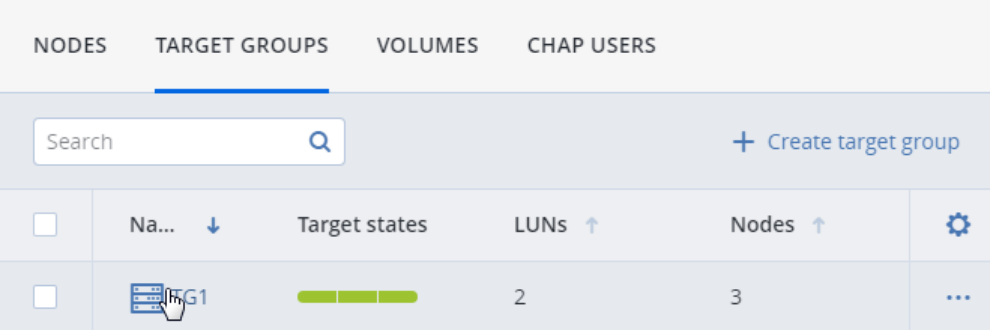


Set limits will be shown in LUN details.

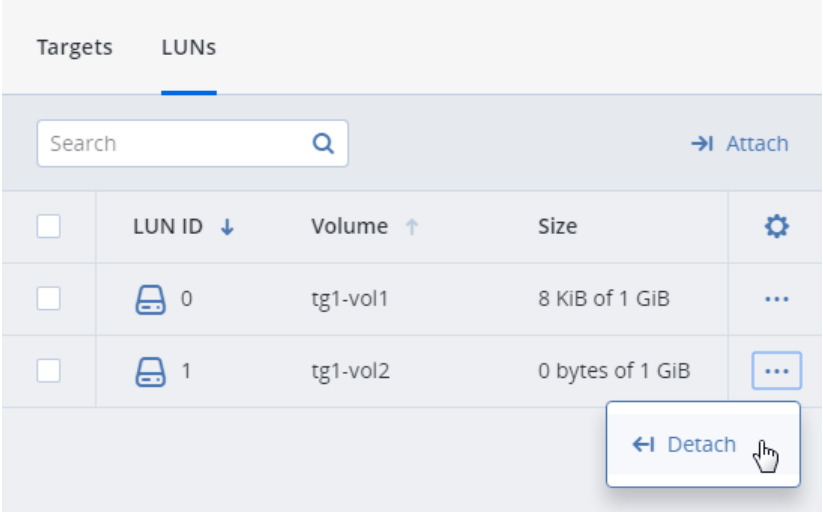
5.1.3.4 Detaching Volumes

To detach a volume from a target group, do the following:

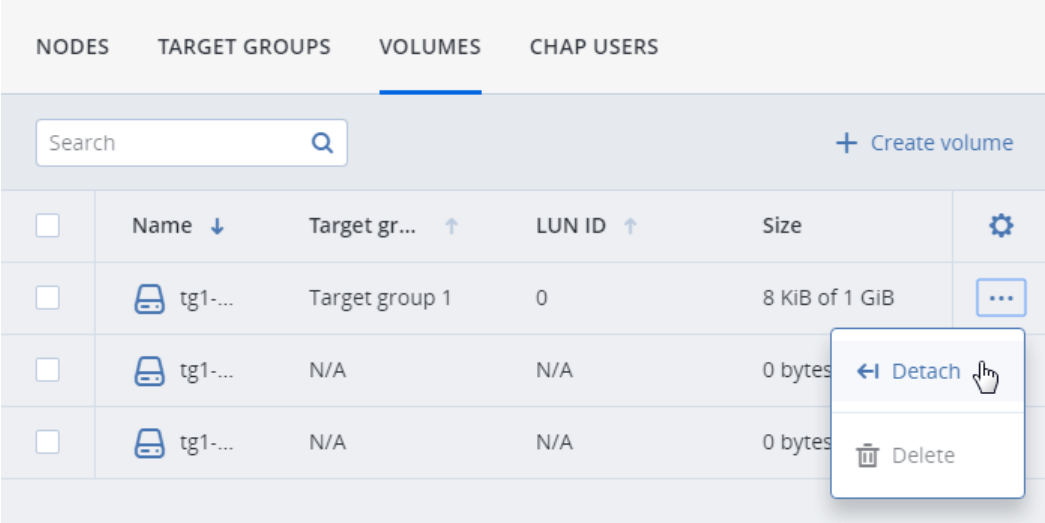
1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS**, click the name of the desired target group to open it, and switch to **LUNs**.



2. Click the ellipsis button of the desired LUN then click **Detach**.

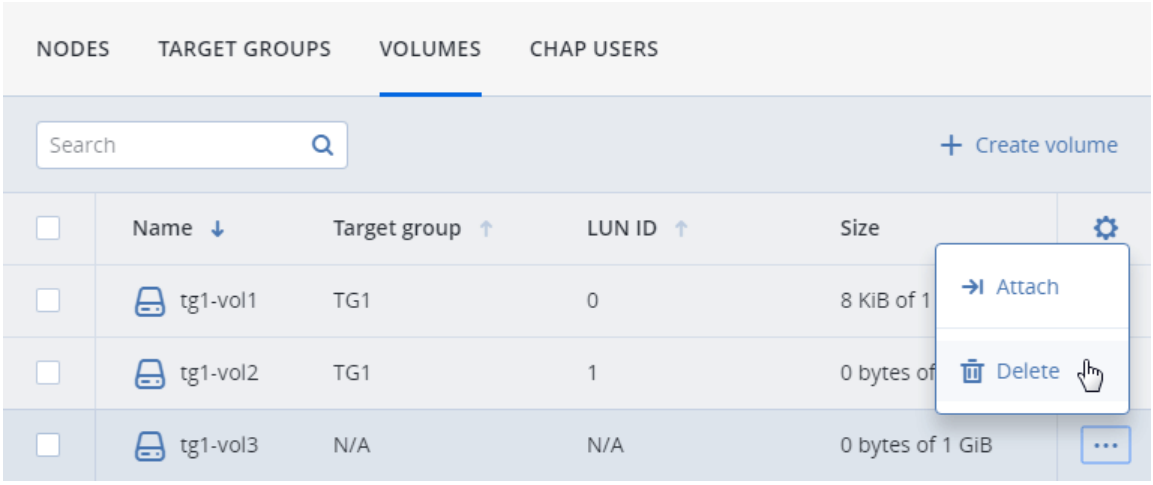


Alternatively, you can open **STORAGE SERVICES** > **Block storage** > **VOLUMES**, click the ellipsis icon of the desired volume, and click **Detach**.



5.1.3.5 Deleting Volumes

To delete a volume that is not attached to a target group, open **STORAGE SERVICES** > **Block storage** > **VOLUMES**, click the ellipsis icon of the desired volume, and click **Delete**.



5.1.4 Restricting Access to Target Groups

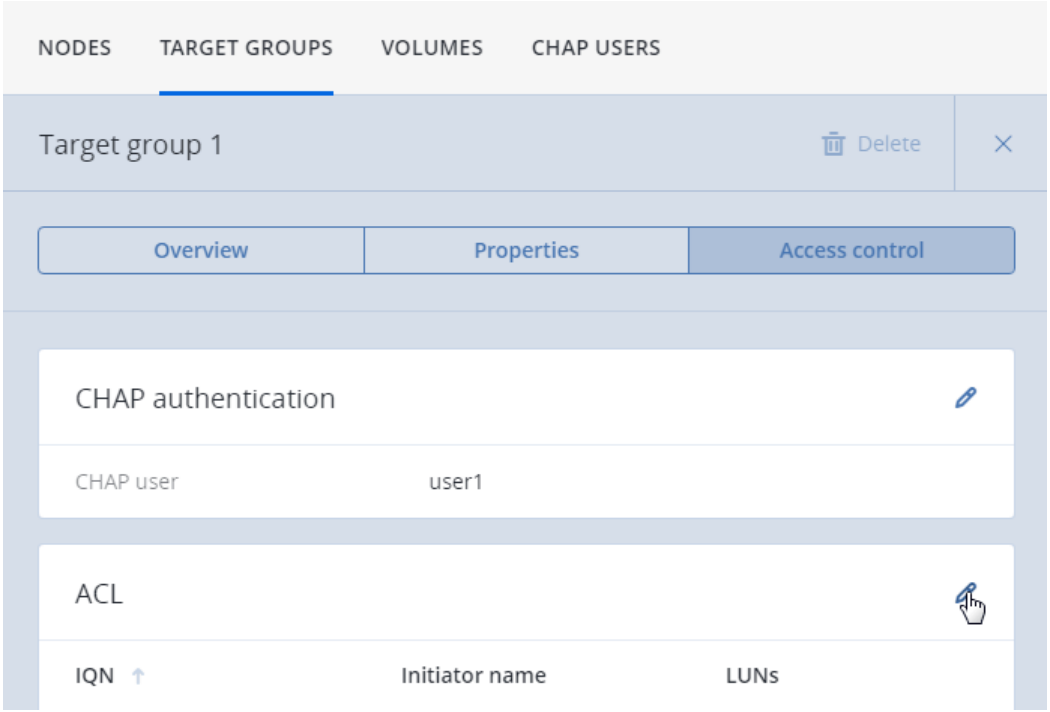
You can restrict access to entire target groups (and all volumes attached to them) by way of ACL-based authorization as well as password-based authentication (CHAP).

5.1.4.1 Managing Access Control Lists

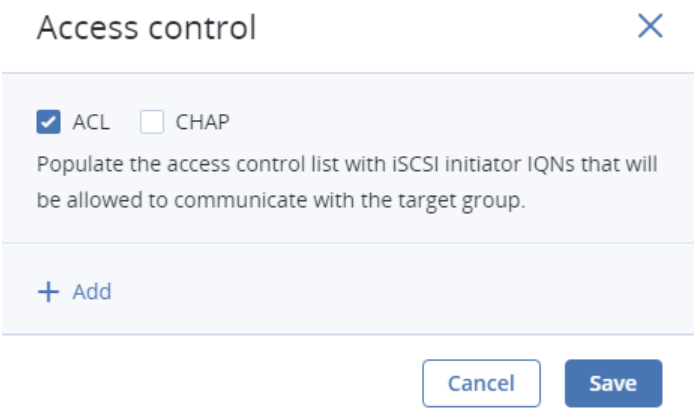
An access control list (ACL) limits access to chosen LUNs for specific initiators. Initiators not on the list have access to all LUNs in iSCSI target groups. Volumes exported via Fibre Channel target groups, however, can only be accessed by initiators that are added to group ACL.

To add an initiator to a target group's ACL, do the following:

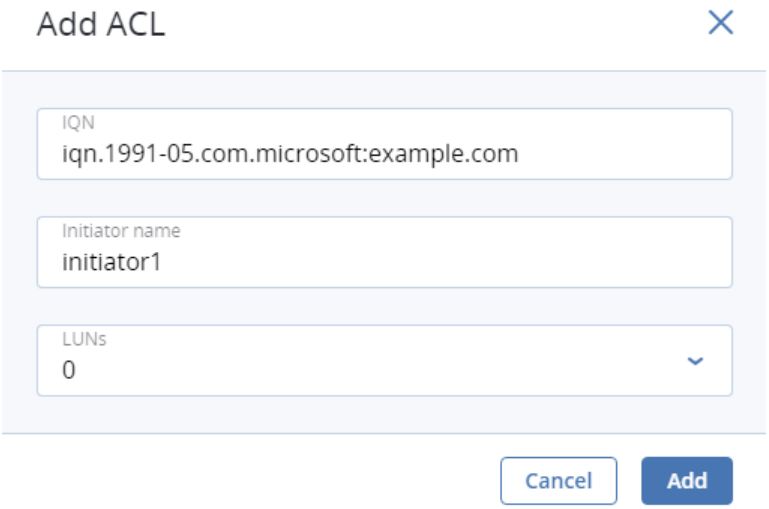
1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS** and click the desired target group in the list (anywhere except group's name).
2. In group details that open, click **Access control** and then click the pencil icon.



3. In the **Access control** window that opens, check the **ACL** box and click **Add**.



4. In the window that opens, specify initiator's IQN, enter an alias, select LUNs that it will be able to access. Click **Add**. The initiator will appear in the ACL.



5. Having populated the ACL with initiators, click **Save**.

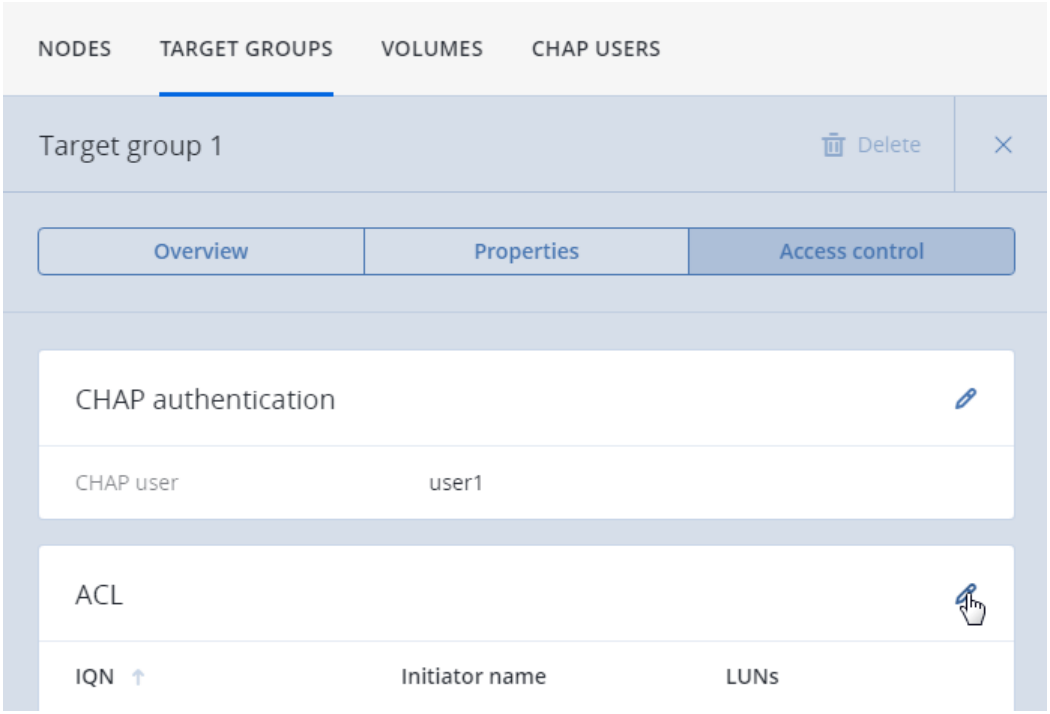
To edit or delete initiators in the ACL, click the pencil icon in target group details. In the **Access control** window that opens, click the pencil icon of the desired initiator then click **Edit** or **Delete**. Having changed the ACL, click **Save**.

5.1.4.2 Managing CHAP Users

The Challenge-Handshake Authentication Protocol (CHAP) provides a way to restrict access to targets and their LUNs by requiring a user name and a password from the initiator. CHAP accounts apply to entire target groups. Fibre Channel target groups do not use CHAP.

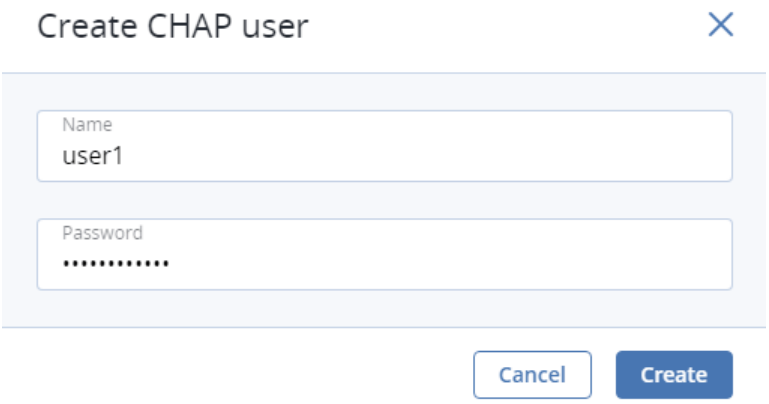
To restrict access to a target group to a specific CHAP user, do the following:

1. Open **STORAGE SERVICES** > **Block storage** > **TARGET GROUPS** and click the desired target group in the list (anywhere except group's name).
2. In group details that open, click **Access control** and then click the pencil icon.

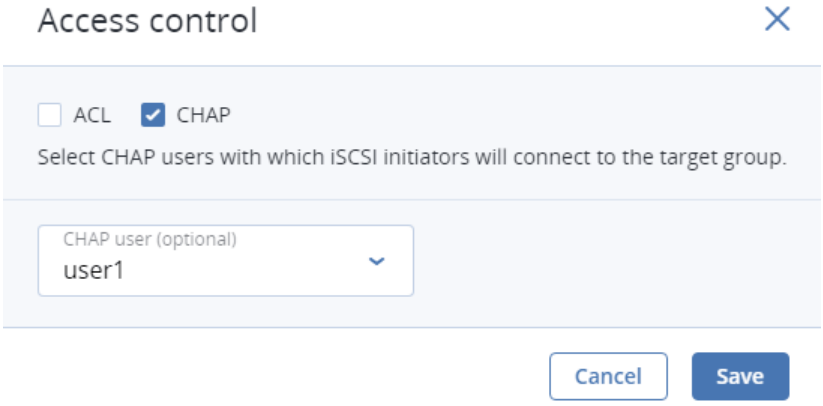


3. In the **Access control** window that opens, check the **CHAP** box and click **Create user**.

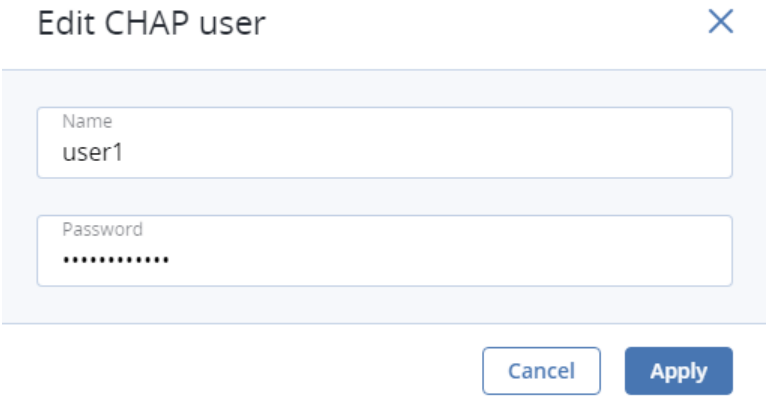
4. In the **Create CHAP user** window that opens, enter a user name and a password (12 to 16 characters long). Click **Create**.



5. Back on the **Access control** screen, select the desired CHAP user and click **Save**.

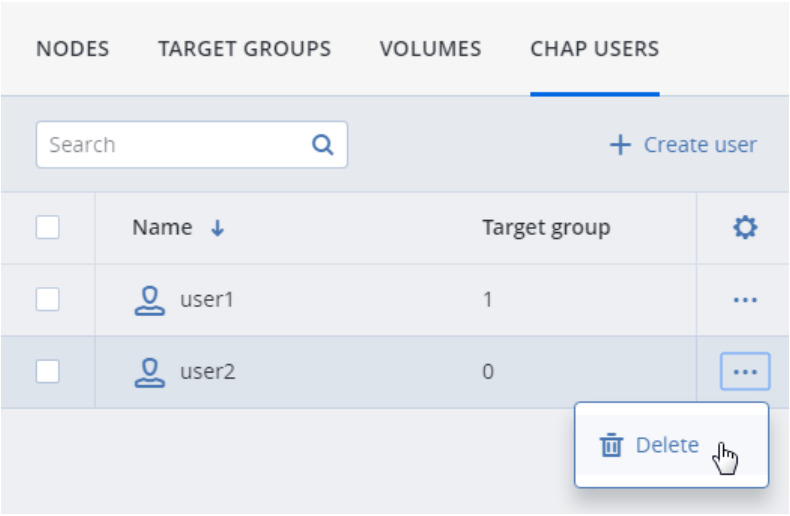


To change the password of a CHAP user, open **STORAGE SERVICES** > **Block storage** > **CHAP USERS**, click a user to open details, and click the pencil icon. In the **Edit CHAP user** window that opens, specify a new password and click **Apply**.



To delete a CHAP user that is not added to any ACLs, open **STORAGE SERVICES** > **Block storage** > **CHAP**

USERS, click the ellipsis icon of the user, and click **Delete**.



5.2 Exporting Data via S3

Acronis Software-Defined Infrastructure allows you to export cluster disk space to customers in the form of an S3-like object-based storage.

Acronis Software-Defined Infrastructure is implemented as an Amazon S3-like API, which is one of the most common object storage APIs. End users can work with Acronis Software-Defined Infrastructure as they work with Amazon S3. You can use the usual applications for S3 and continue working with it after the data migration from Amazon S3 to Acronis Software-Defined Infrastructure.

Object storage is a storage architecture that enables managing data as objects (like in a key-value storage) as opposed to files in file systems or blocks in a block storage. Except for the data, each object has metadata that describes it as well as a unique identifier that allows finding the object in the storage. Object storage is optimized for storing billions of objects, in particular for application storage, static web content hosting, online storage services, big data, and backups. All of these uses are enabled by object storage thanks to a combination of very high scalability and data availability and consistency.

Compared to other types of storage, the key difference of object storage is that parts of an object cannot be modified, so if the object changes a new version of it is spawned instead. This approach is extremely important for maintaining data availability and consistency. First of all, changing an object as a whole eliminates the issue of conflicts. That is, the object with the latest timestamp is considered to be the current version and that is it. As a result, objects are always consistent, i.e. their state is relevant and appropriate.

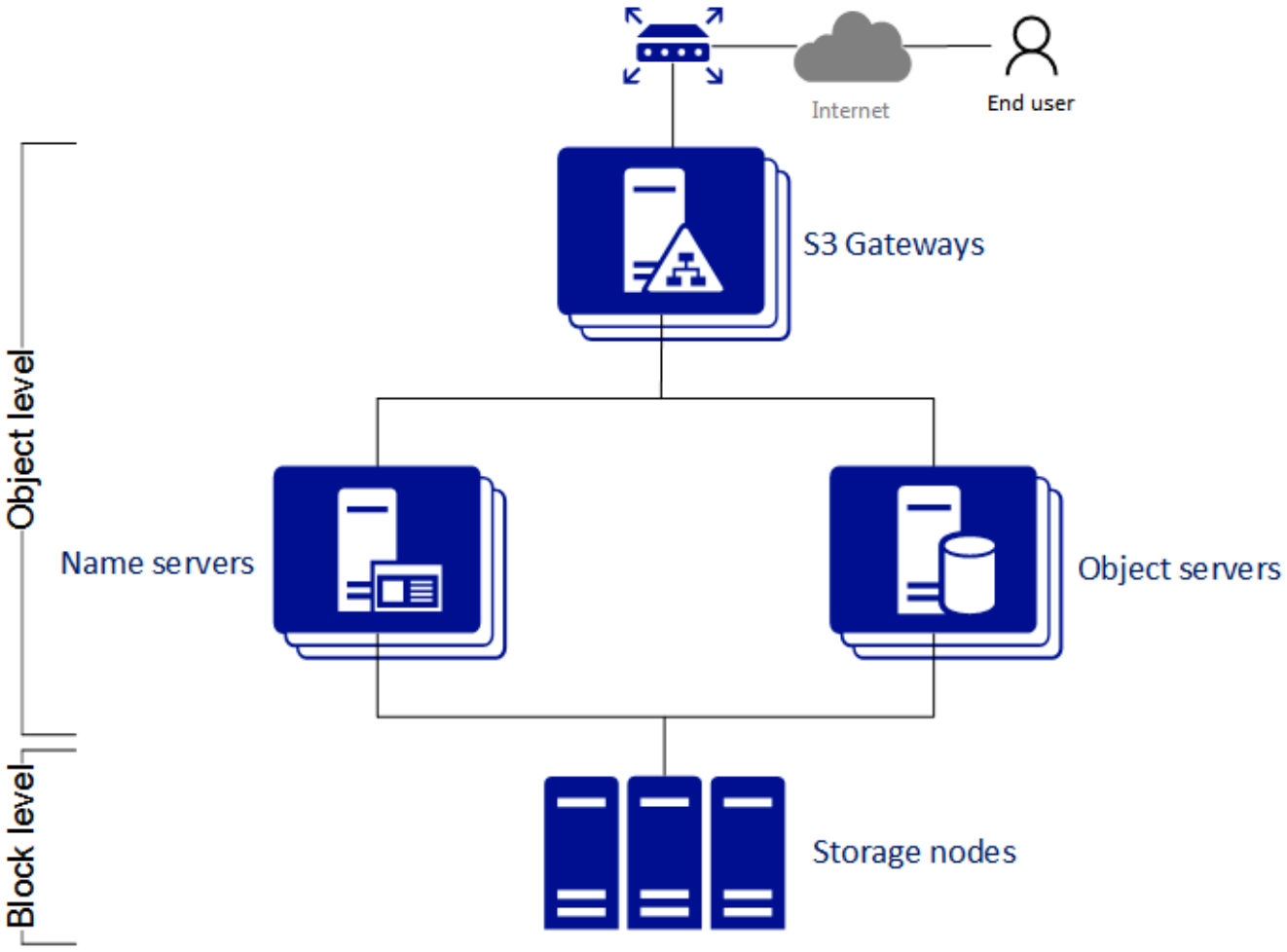
Another feature of object storage is eventual consistency. Eventual consistency does not guarantee that

reads are to return the new state after the write has been completed. Readers can observe the old state for an undefined period of time until the write is propagated to all the replicas (copies). This is very important for storage availability as geographically distant data centers may not be able to perform data update synchronously (e.g., due to network issues) and the update itself may also be slow as awaiting acknowledges from all the data replicas over long distances can take hundreds of milliseconds. So eventual consistency helps hide communication latencies on writes at the cost of the probable old state observed by readers. However, many use cases can easily tolerate it.

5.2.1 S3 Storage Infrastructure Overview

The object storage infrastructure consists of the following entities: object servers (OS), name servers (NS), S3 gateways (GW), and the block-level backend.

These entities run as services on the Acronis Software-Defined Infrastructure nodes. Each service should be deployed on multiple Acronis Software-Defined Infrastructure nodes for high availability.



- An object server stores actual object data received from S3 gateway. The data is packed into special containers to achieve high performance. The containers are redundant, you can specify the redundancy mode while configuring object storage. An object server also stores its own data in block storage with built-in high availability.
- A name server stores object metadata received from S3 gateway. Metadata includes object name, size, ACL (access control list), location, owner, and such. Name server (NS) also stores its own data in block storage with built-in high availability.
- An S3 gateway is a data proxy between object storage services and end users. It receives and handles Amazon S3 protocol requests and S3 user authentication and ACL checks. The S3 gateway uses the NGINX web server for external connections and has no data of its own (i.e. is stateless).
- The block-level backend is block storage with high availability of services and data. Since all object storage services run on hosts, no virtual environments (and hence licenses) are required for object storage.

5.2.2 Planning the S3 Cluster

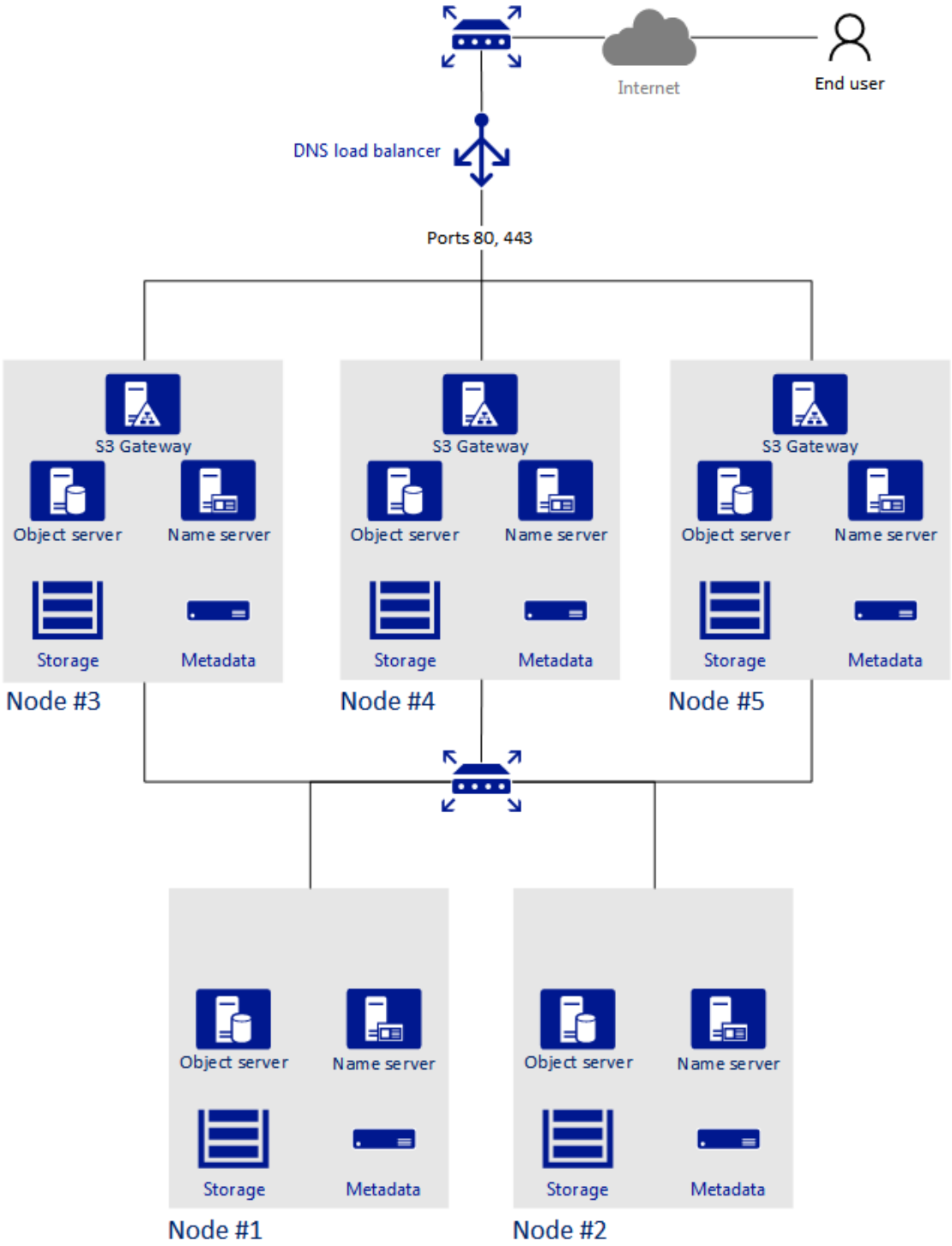
Before creating an S3 cluster, do the following:

1. Define which nodes of the storage cluster will run the S3 storage access point services. It is recommended to have all nodes available in Acronis Software-Defined Infrastructure run these services.
2. Configure the network so that the following is achieved:
    - All components of the S3 cluster communicate with each other via the S3 private network. All nodes of an S3 cluster must be connected to the S3 private network. Acronis Software-Defined Infrastructure internal network can be used for this purpose.
    - The nodes running S3 gateways must have access to the public network.
    - The public network for the S3 gateways must be balanced by an external DNS load balancer.

    For more details on network configuration, refer to the *Installation Guide*.
3. All components of the S3 cluster should run on multiple nodes for high-availability. Name server and object server components in the S3 cluster are automatically balanced and migrated between S3 nodes. S3 gateways are not automatically migrated; their high availability is based on DNS records. You need to maintain the DNS records manually when adding or removing S3 gateways.

5.2.3 Sample S3 Storage

This section shows a sample object storage deployed on top of a storage cluster of five nodes that run various services. The final setup is shown on the figure below.

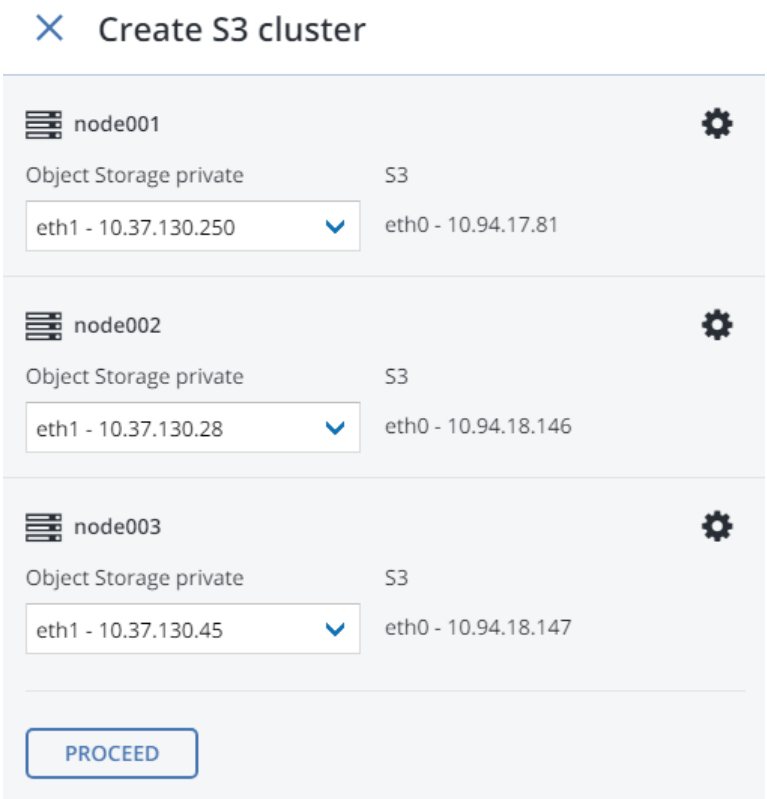


5.2.4 Creating the S3 Cluster

To set up object storage services on a cluster node, do the following:

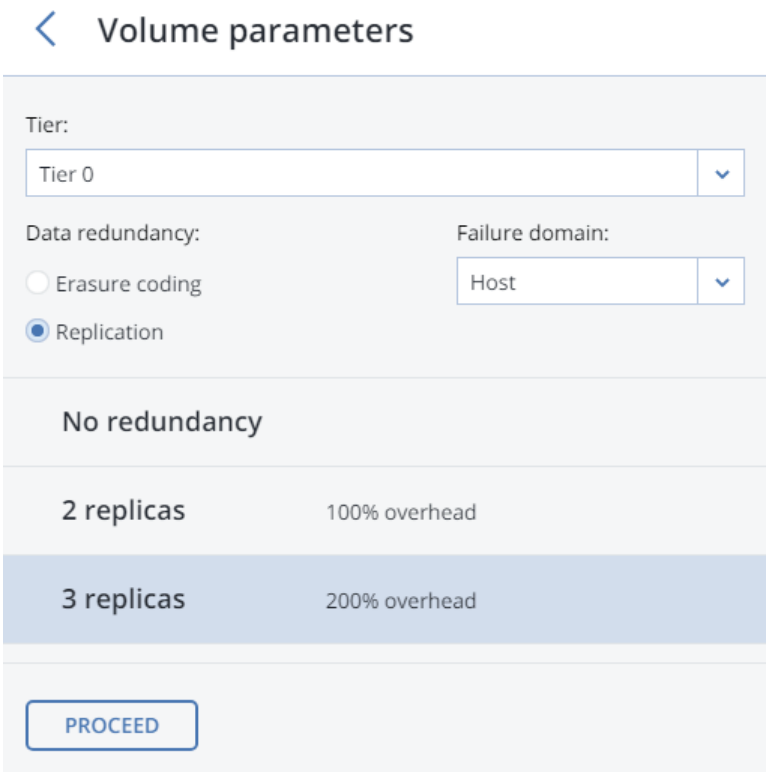
1. On the **INFRASTRUCTURE** > **Networks** screen, make sure that the **OSTOR private** and **S3 public** traffic types are added to your networks.
2. In the left menu, click **STORAGE SERVICES** > **S3**.
3. Select one or more nodes and click **Create S3 cluster** in the right menu. To create a highly available S3 cluster, select at least three nodes. It is also recommended to enable HA for the management node prior to creating the S3 cluster. See *Enabling High Availability* (page 152) for more details.
4. Make sure the correct network interface is selected in the corresponding drop-down list.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.



   Click **Proceed**.
5. In **Tier**, select the storage tier that will be used for the object storage.

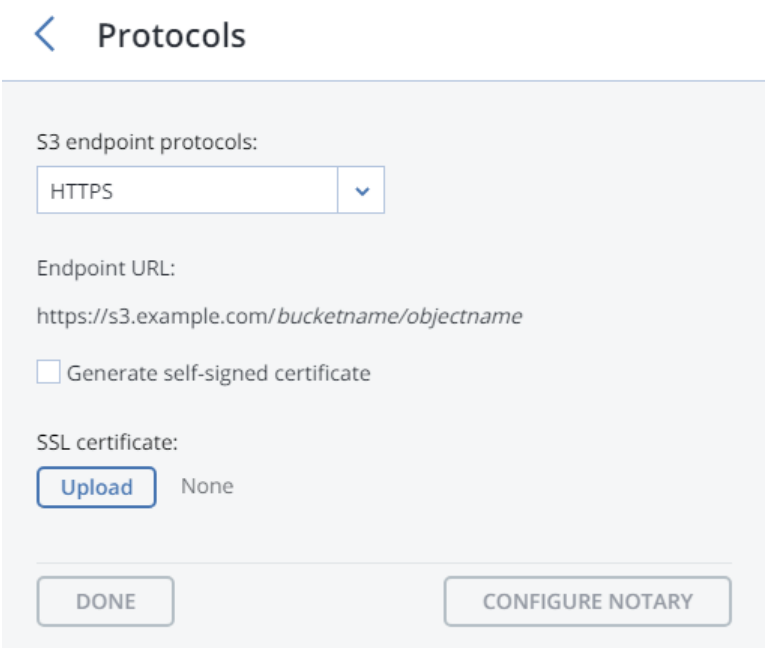
6. In **Failure domain**, choose a placement policy for replicas.
7. In **Data redundancy**, select the redundancy mode that the object storage will use.



   You can change the redundancy mode later on the **S3** > **OVERVIEW** > **Settings** panel. Click **Proceed**.
8. Specify the external (publicly resolvable) DNS name for the S3 endpoint that will be used by the end users to access the object storage. For example, `s3.example.com`. Click **Proceed**.

   Important: Configure your DNS server according to the example suggested in the admin panel.

9. From the drop-down list, select an S3 endpoint protocol: HTTP, HTTPS or both.



It is recommended to use only HTTPS for production deployments.

If you have selected HTTPS, do one of the following:

- Check **Generate self-signed certificate** to get a self-signed certificate for HTTPS evaluation purposes.

  Take note of the following:

  - S3 geo-replication requires a certificate from a trusted authority. It does not work with self-signed certificates.
  - To access the data in the S3 cluster via a browser, add the self-signed certificate to browser's exceptions.

- Acquire a key and a trusted wildcard SSL certificate for endpoint's bottom-level domain. For example, the endpoint `s3.storage.example.com` would need a wildcard certificate for `*.s3.storage.example.com` with the subject alternative name `s3.storage.example.com`.

  Upload the certificate, and, depending on the certificate type, do one of the following:

  - in case the certificate is contained in a PKCS#12 file, specify the passphrase;
  - upload the SSL key.

  You can change the redundancy mode later on the **S3** > **OVERVIEW** > **Protocol settings** panel. Click **Proceed**.

10. If required, click **Configure Acronis Notary** and specify **Notary DNS name** and **Notary user key**.
11. Click **Done** to create an S3 cluster.

After the S3 cluster is created, open the **S3 Overview** screen to view cluster status, hostname, used disk capacity, the number of users, I/O activity, and the state of S3 services.

To check if the S3 cluster is successfully deployed and can be accessed by users, visit https://<S3_DNS_name> or http://<S3_DNS_name> in your browser. You should receive the following XML response:

```
<Error>
<Code>AccessDenied</Code>
<Message/>
</Error>
```

To start using the S3 storage, you will also need to create at least one S3 user.

5.2.5 Managing S3 Users

The concept of S3 user is one of the base concepts of object storage along with those of object and bucket (container for storing objects). The Amazon S3 protocol uses a permission model based on access control lists (ACLs) where each bucket and each object is assigned an ACL that lists all users with access to the given resource and the type of this access (read, write, read ACL, write ACL). The list of users includes the entity owner assigned to every object and bucket at creation. The entity owner has extra rights compared to other users. For example, the bucket owner is the only one who can delete that bucket.

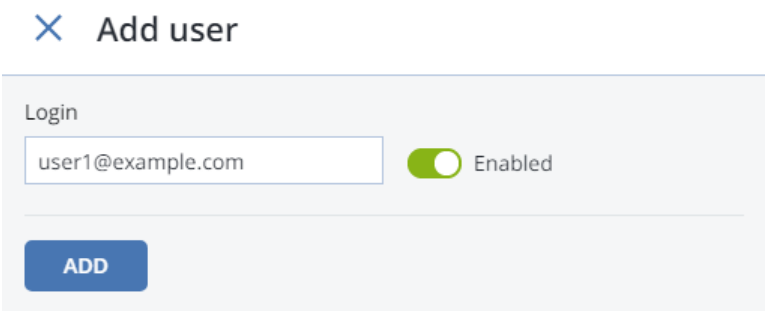
User model and access policies implemented in Acronis Software-Defined Infrastructure comply with the Amazon S3 user model and access policies.

User management scenarios in Acronis Software-Defined Infrastructure are largely based on the Amazon Web Services user management and include the following operations: create, query, and delete users as well as generate and revoke user access key pairs.

5.2.5.1 Adding S3 Users

To add an S3 user, do the following:

1. On the **STORAGE SERVICES** > **S3** > **Users** screen, click **Add user**.
2. Specify a valid email address as login for the user and click **ADD**.

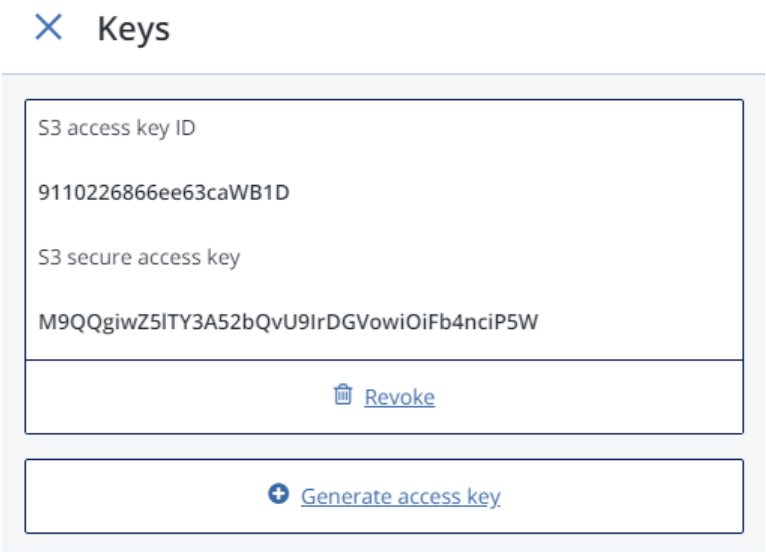


5.2.5.2 Managing S3 Access Key Pairs

Each S3 user has one or two key pairs (access key and secret key) for accessing the S3 cloud. You can think of the access key as login and the secret key as password. (For more information about S3 key pairs, refer to the Amazon documentation.) The access keys are generated and stored locally in the storage cluster on S3 name servers. Each user can have up to two key pairs. It is recommended to periodically revoke old and generate new access key pairs.

To view, add, or revoke the S3 access key pairs for an S3 user, do the following:

1. Select a user in the list and click **Keys**.



2. The existing keys will be shown on the **Keys** panel.
   - To revoke a key, click **Revoke**.
   - To add a new key, click **Generate access key**.

To access a bucket, a user will need the following information:

- admin panel IP address,
- DNS name of the S3 cluster specified during configuration,
- S3 access key ID,
- S3 secret access key,
- SSL certificate if the HTTPS protocol was chosen during configuration.

  The certificate file can be found in the `/etc/nginx/ssl/` directory on any node hosting the S3 gateway service.

To automatically log in to S3 with user credentials using the generated keys, select a user and click **Browse**.

To **Browse** using an SSL certificate, make sure it is valid or, in case of a self-signed one, add it to browser's exceptions.

5.2.6 Managing S3 Buckets

All objects in Amazon S3-like storage are stored in containers called "buckets". Buckets are addressed by names that are unique in the given object storage, so an S3 user of that object storage cannot create a bucket that has the same name as a different bucket in the same object storage. Buckets are used to:

- group and isolate objects from those in other buckets,
- provide ACL management mechanisms for objects in them,
- set per-bucket access policies, for example, versioning in the bucket.

In the current version of Acronis Software-Defined Infrastructure, you can enable and disable Acronis Notary for object storage buckets and monitor the space used by them on the **STORAGE SERVICES** > **S3** > **Buckets** screen. You cannot create and manage object storage buckets from Acronis Software-Defined Infrastructure admin panel. However, you can do it via the Acronis Software-Defined Infrastructure user panel or by using a third-party application. For example, the applications listed below allow you to perform the following actions:

- CyberDuck: create and manage buckets and their contents.
- MountainDuck: mount object storage as a disk drive and manage buckets and their contents.
- Backup Exec: store backups in the object storage.

5.2.6.1 Listing S3 Bucket Contents

You can list bucket contents with a web browser. To do this, visit the URL that consists of the external DNS name for the S3 endpoint that you specified when creating the S3 cluster and the bucket name. For example, `mys3storage.example.com/mybucket` or `mybucket.mys3storage.example.com` (depending on DNS configuration).

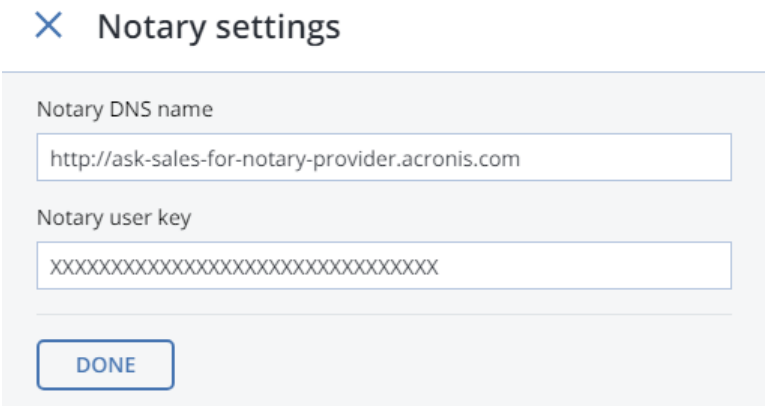
You can also copy the link to bucket contents by right-clicking it in CyberDuck, and then selecting **Copy URL**.

5.2.6.2 Managing Acronis Notary in S3 Buckets

Acronis Software-Defined Infrastructure offers integration with the Acronis Notary service to leverage blockchain notarization and ensure the immutability of data saved in object storage clusters. To use Acronis Notary in user buckets, you need to set it up in the S3 cluster and enable it for said buckets.

To set up Acronis Notary, do the following:

1. Get the DNS name and the user key for the notary service from your sales contact.
2. On the **STORAGE SERVICES** > **S3** screen, click **Notary settings**.
3. On the **Notary Settings** screen, specify the DNS name and user key in the respective fields and click **Done**.



To enable or disable blockchain notarization for a bucket, select a bucket on the **STORAGE SERVICES** > **S3** > **Buckets** screen and click **Enable Notary** or **Disable Notary**, respectively.

Notarization is disabled for new buckets by default.

Once you enable notarization for a bucket, certificates are created automatically only for the newly uploaded files. The previously uploaded files are left unnotarized. Once a file was notarized, it will remain notarized even if you disable notarization later.

5.2.7 Best Practices for Using S3 in Acronis Software-Defined Infrastructure

This section offers recommendations on how to best use the S3 feature of Acronis Software-Defined Infrastructure.

5.2.7.1 S3 Bucket and Key Naming Policies

It is recommended to use bucket names that comply with DNS naming conventions:

- can be from 3 to 63 characters long,
- must start and end with a lowercase letter or number,
- can contain lowercase letters, numbers, periods (.), hyphens (-), and underscores (_),
- can be a series of valid name parts (described previously) separated by periods.

An object key can be a string of any UTF-8 encoded characters up to 1024 bytes long.

5.2.7.2 Improving Performance of PUT Operations

Object storage supports uploading objects as large as 5 GB per single PUT request (5 TB via multipart upload). Upload performance can be improved by splitting large objects into pieces and uploading them concurrently (thus dividing the load between multiple OS services) with multipart upload API.

It is recommended to use multipart uploads for objects larger than 5 MB.

5.2.8 Replicating S3 Data Between Datacenters

Acronis Software-Defined Infrastructure can store replicas of S3 cluster data and keep them up-to-date in multiple geographically distributed datacenters with S3 clusters based on Acronis Software-Defined Infrastructure. Geo-replication reduces the response time for local S3 users accessing the data in a remote S3 cluster or remote S3 users accessing the data in a local S3 cluster as they do not need to have an Internet connection.

Geo-replication schedules the update of the replicas as soon as any data is modified. Geo-replication performance depends on the speed of Internet connection, the redundancy mode, and cluster performance.

If you have multiple datacenters with enough free space, it is recommended to set up geo-replication

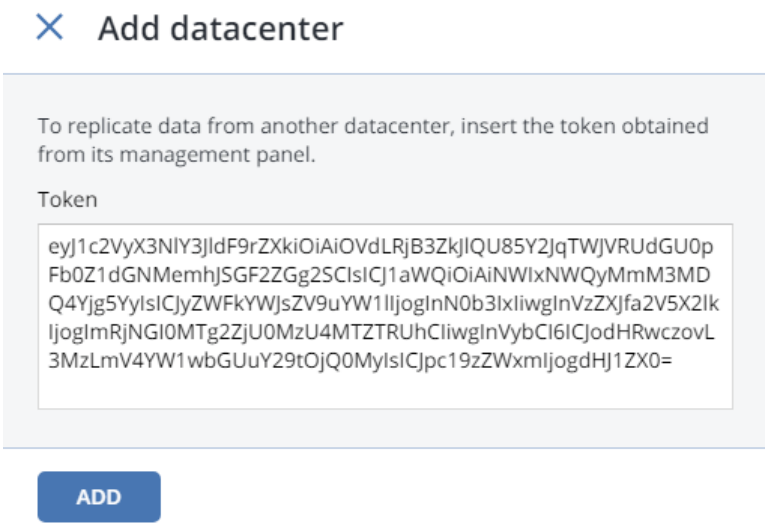
between S3 clusters residing in these datacenters.

Important: Each cluster must have its own SSL certificate signed by a global certificate authority.

To set up geo-replication between S3 clusters, exchange tokens between datacenters as follows:

1. In the admin panel of a remote datacenter, open the **STORAGE SERVICES** > **S3** > **GEO-REPLICATION** screen.

2. In the section of the home S3 cluster, click **TOKEN** and, on the **Get token** panel, copy the token.
3. In the admin panel of the local datacenter, open the **STORAGE SERVICES** > **S3** > **GEO-REPLICATION** screen and click **ADD DATACENTER**.



4. Enter the copied token and click **Done**.

5. Configure the remote S3 cluster the same way.

5.2.9 Monitoring S3 Access Points

The S3 monitoring screen enables you to inspect the availability of each S3 component as well as the performance of NS and OS services (which are highly available).

If you see that some of the NS or OS services are offline, it means that the S3 access point does not function properly, and you should contact support consult the CLI guide for low-level troubleshooting. S3 gateways are not highly available, but DNS load balancing should be enough to avoid downtime if the gateway fails.

The performance charts represent the number of operations that the OS/NS services are performing.

5.2.10 Releasing Nodes from S3 Clusters

Before releasing a node, make sure that the cluster has enough nodes running name and object servers as well as gateways left.

> **Warning:** When the last node in the S3 cluster is removed, the cluster is destroyed, and all the data is deleted.

To release a node from an S3 cluster, do the following:

1. On the **STORAGE SERVICES** > **S3 Nodes** screen, check the box of the node to release.
2. Click **Release**.

5.2.11 Supported Amazon S3 Features

This section lists Amazon S3 operations, headers, and authentication schemes supported by the Acronis Software-Defined Infrastructure implementation of the Amazon S3 protocol.

5.2.11.1 Supported Amazon S3 REST Operations

The following Amazon S3 REST operations are currently supported by the Acronis Software-Defined Infrastructure implementation of the Amazon S3 protocol:

Supported service operations: GET Service.

Supported bucket operations:

- DELETE/HEAD/PUT Bucket
- GET Bucket (List Objects)
- GET/PUT Bucket acl
- GET Bucket location (returns `US East`)
- GET Bucket Object versions
- GET/PUT Bucket versioning
- List Multipart Uploads

Supported object operations:

- DELETE/GET/HEAD/POST/PUT Object
- Delete Multiple Objects
- PUT Object - Copy
- GET/PUT Object acl
- Delete Multiple Objects
- Abort Multipart Upload
- Complete Multipart Upload
- Initiate Multipart Upload
- List Parts
- Upload Part

Note: For more information on Amazon S3 REST operations, see Amazon S3 REST API documentation.

5.2.11.2 Supported Amazon Request Headers

The following Amazon S3 REST request headers are currently supported by the Acronis Software-Defined Infrastructure implementation of the Amazon S3 protocol:

- Authorization
- Content-Length
- Content-Type
- Content-MD5
- Date
- Host
- x-amz-content-sha256
- x-amz-date
- x-amz-security-token

The following Amazon S3 REST request headers are ignored:

- Expect
- x-amz-security-token

Note: For more information on Amazon S3 REST request headers, see the Amazon S3 REST API documentation.

5.2.11.3 Supported Amazon Response Headers

The following Amazon S3 REST response headers are currently supported by the Acronis Software-Defined Infrastructure implementation of the Amazon S3 protocol:

- Content-Length
- Content-Type
- Connection
- Date

- ETag
- x-amz-delete-marker
- x-amz-request-id
- x-amz-version-id

The following Amazon S3 REST response headers are not used:

- Server
- x-amz-id-2

Note: For more information on Amazon S3 REST response headers, see the Amazon S3 REST API documentation.

5.2.11.4 Supported Amazon Error Response Headers

The following Amazon S3 REST error response headers are currently supported by the Acronis Software-Defined Infrastructure implementation of the Amazon S3 protocol:

- Code
- Error
- Message
- RequestId
- Resource

The following Amazon S3 REST error response headers are not supported:

- RequestId (not used)
- Resource

Note: For more information on Amazon S3 REST response headers, see the Amazon S3 REST API documentation.

5.2.11.5 Supported Authentication Scheme

The following authentication scheme is supported by the Acronis Software-Defined Infrastructure implementation of the Amazon S3 protocol:

- Signature Version 2.

5.3 Exporting Data via NFS

Acronis Software-Defined Infrastructure allows you to organize nodes into a highly available NFS cluster in which you can create NFS shares. In Acronis Software-Defined Infrastructure terms, an NFS share is an access point for a volume and as such it can be assigned an IP address or DNS name. The volume, in turn, can be assigned the usual properties: redundancy type, tier, and failure domain. In each share you can create multiple NFS exports which are actual exported directories for user data. Each export has, among other properties, a path that, combined with share's IP address, uniquely identifies the export on the network and allows you to mount it using standard commands.

On the technical side, NFS volumes are based on object storage. Aside from offering high availability and scalability, object storage eliminates the limit on the amount of files and the size of data you can keep in the NFS cluster. Each share is perfect for keeping billions of files of any size. However, such scalability implies IO overhead that is wasted on file size changes and rewrites. For this reason, an NFS cluster makes a perfect cold and warm file storage but is not recommended for hot and high performance, often rewritten data (like running virtual machines). Integration of Acronis Software-Defined Infrastructure with solutions from VMware, for example, is best done via iSCSI to achieve better performance.

Note: Acronis Software-Defined Infrastructure only supports NFS version 4 and newer, including pNFS.

5.3.1 Setting Up an NFS Cluster

Since NFS is based on object storage, creating an NFS cluster is similar to creating an S3 one. Do the following:

1. On the **INFRASTRUCTURE** > **Networks** screen, make sure that the **OSTOR private** and **NFS** traffic types are added to your networks.
2. In the left menu, click **STORAGE SERVICES** > **NFS**.

3. Select one or more nodes and click **Create NFS cluster** in the right menu.
4. Make sure the correct network interface is selected in the corresponding drop-down list.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.
5. Click **CREATE**.

After the NFS cluster has been created, you can proceed to creating NFS shares.

5.3.2 Creating NFS Shares

To create an NFS share, do the following:

1. On the **STORAGE SERVICES** > **NFS** > **SHARES** screen, click **ADD NFS SHARE**.
2. On the **Add NFS Share** panel, specify a unique name and an IP address, which must be unused and, if authentication is enabled, domain-resolvable. Click **PROCEED**.
3. In **Share size**, specify the size of the share in gigabytes. For users accessing exports, this value will be the filesystem size.
4. Select the desired tier, failure domain, and data redundancy type in the corresponding fields. For more details on these volume properties, see the *Installation Guide*.

   You will be able to change the redundancy mode later.
5. Click **DONE**.

After the share has been created, you can proceed to creating NFS exports.

5.3.3 Creating NFS Exports

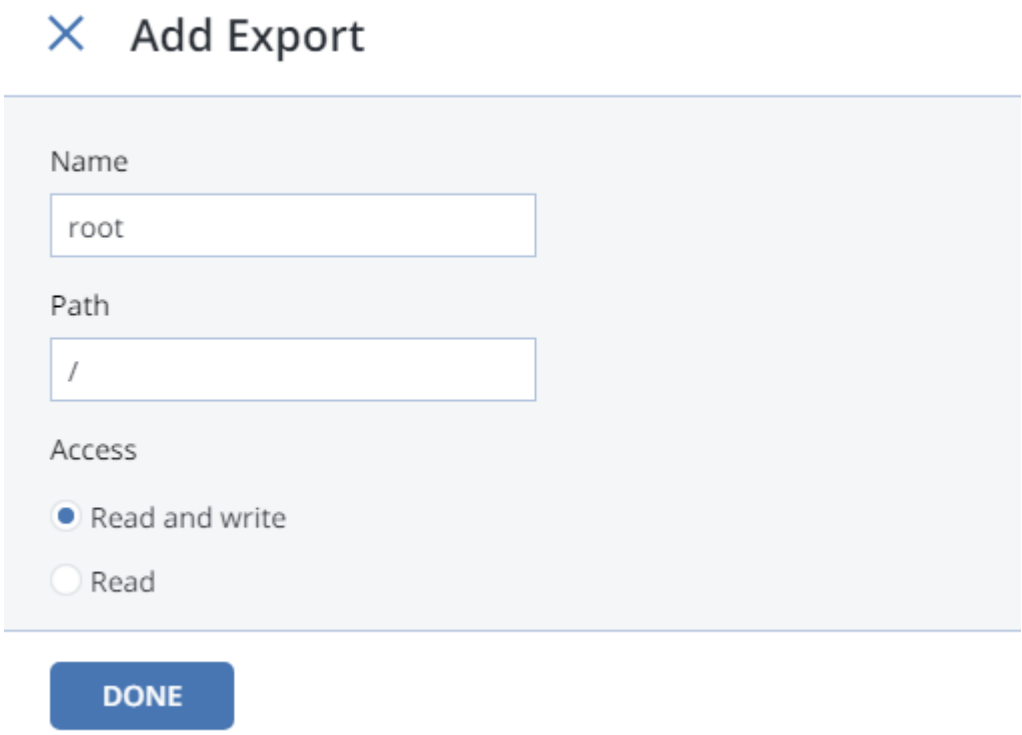
The process of creating NFS exports includes the following steps:

1. Creating a root export that will contain user exports.
2. Mounting the root export.
3. Creating user exports in the mounted root export.

5.3.3.1 Creating the Root Export

To create a root NFS export, do the following:

1. On the **STORAGE SERVICES** > **NFS** > **SHARES** screen, click the number in the **Exports** column in the row of the desired share. This will open the share screen.
2. On the share screen, click **ADD EXPORT**, specify `root` as the export name and `/` as path and select the `read and write` access mode.



This will create a directory with a default path that designates export location inside the share and is used (alongside share's IP address) to mount the export.

Important: Do not give the users access to the root export.

The root export will be shown in the export list.

After creating the root export, mount it as described in the *User's Guide*.

Warning: Do not mount NFS shares on cluster nodes. It may lead to node freeze.

5.3.3.2 Creating User Exports

After creating and mounting the root export, you can proceed to creating user NFS exports. To do this:

1. In the mounted root export, create a subdirectory for a user export, e.g., `export1`.
2. On the share screen, click **ADD EXPORT**, enter a user export name, specify `/export1` as path, and select the access mode.
3. Click **Done**.

The user export will appear in the export list.

5.3.4 Setting Up User Authentication and Authorization

Acronis Software-Defined Infrastructure allows you to authenticate users for access to specific NFS shares via Kerberos and authorize them to access specific NFS exports inside these shares via LDAP.

5.3.4.1 Authenticating NFS Share Users with Kerberos

To enable user authentication in an NFS share, do the following:

1. Assign a forward and reverse resolvable FQDN (fully qualified domain name) to share's IP address.
2. On the **SETTINGS** > **Security** > **KERBEROS** tab, specify the following Kerberos information:
    1. In **Realm**, your DNS name in uppercase letters.
    2. In **KDC service**, the DNS name or IP address of the host running the realm's KDC (key distribution center) service.
    3. In **KDC administration service**, the DNS name or IP address of the host running the realm's KDC administration service.

       Usually, the KDC and its administration service run on the same host.
3. On the Kerberos server, perform these steps:
    1. Log in as administrator to the Kerberos database administration program.

2. Add a principal for the share with the command `addprinc -randkey nfs/<share_FQDN>@<realm>`. For example:

```
# addprinc -randkey nfs/share1.example.com@example.com
```

3. Generate a keytab (key table) for the principal and save it to a directory you can upload from. For example:

```
# ktadd -k /tmp/krb5.keytab nfs/share1.example.com@example.com
```

4. On the **STORAGE SERVICES** > **NFS** > **SHARE** tab, select a share and click **Authentication**.
5. Upload the keytab file and click **SAVE**.

Important: Each share and client (user that mounts the export) must have their own principal and keytab.

5.3.4.2 Authorizing NFS Export Users with LDAP

By configuring access to a user directory via LDAP, you can control which users can access which NFS exports. You will need a directory of user accounts with desired NFS access parameters.

To configure access to an LDAP server, do the following:

1. On the **SETTINGS** > **Security** > **LDAP** tab, specify the following information:
   - **Address**, the IP address of the LDAP server;
   - **Base DN**, the distinguished name of the search starting point;
2. Click **Save**.

5.4 Connecting Acronis Backup Software to Storage Backends via Backup Gateway

The Backup Gateway storage access point (also called “gateway”) is intended for service providers who use Acronis Backup Cloud and/or Acronis Backup Advanced and want to organize an on-premise storage for their clients’ backed-up data.

Backup Gateway enables a service provider to easily configure storage for the proprietary

deduplication-friendly data format used by Acronis.

Backup Gateway supports the following storage backends:

- storage clusters with software redundancy by means of erasure coding,
- NFS shares,
- public clouds, including a number of S3 solutions as well as Microsoft Azure, OpenStack Swift, and Google Cloud Platform.

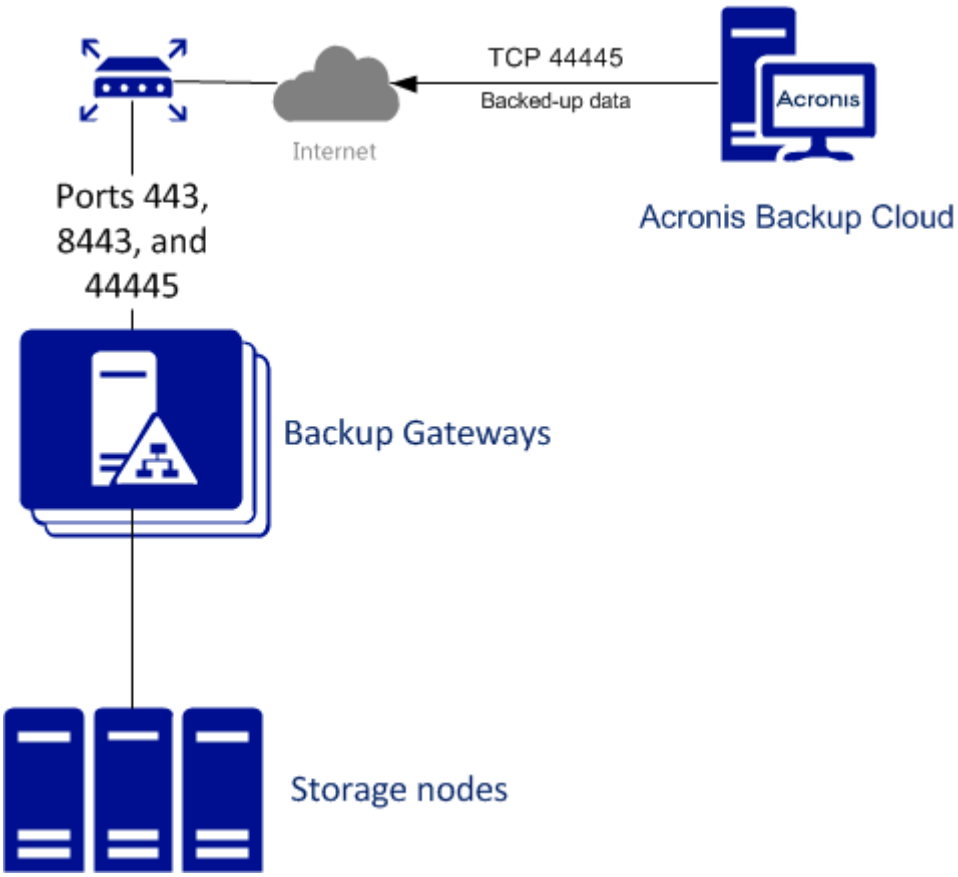
While your choice should depend on scenario and requirements, it is recommended to keep Acronis backup data in the local storage cluster. In this case, you can have the best performance due to WAN optimizations and data locality. Keeping backups in an NFS share or a public cloud implies the unavoidable data transfer and other overhead, which reduces overall performance.

Take note of the following:

- When configuring Backup Gateway, you will need to provide the credentials of your administrator account in the Acronis backup software.
- In cases when not local but external storage (e.g., NFS) is used with Backup Gateway, redundancy has to be provided by said external storage. Backup Gateway does not provide data redundancy or perform data deduplication itself.
- To enable geo-replication for Backup Gateway, consult the *Administrator's Command Line Guide*.

5.4.1 Understanding the Infrastructure

The Backup Gateway storage access point runs as services on the Acronis Software-Defined Infrastructure nodes. It is recommended to deploy it on two or more nodes for high availability.



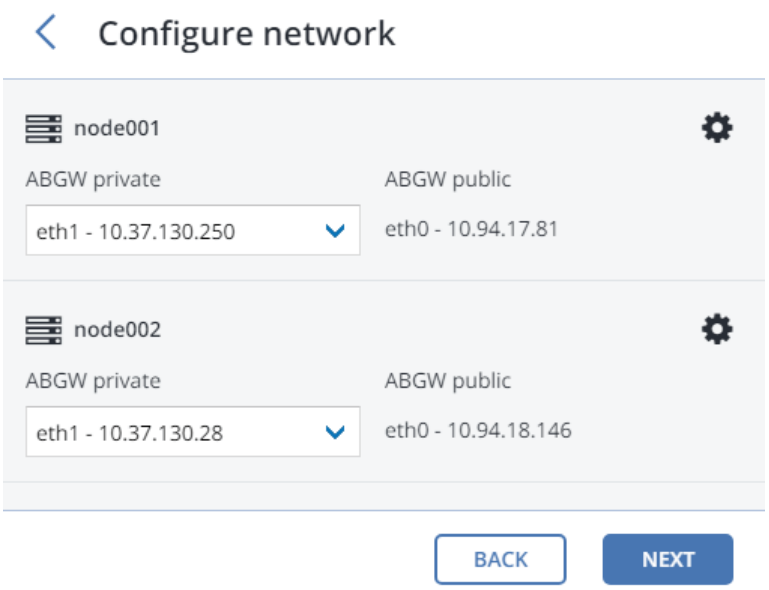
5.4.2 Connecting to the Local Storage Cluster via Backup Gateway

Before you proceed, make sure that the destination storage has enough space for both existing and new backups.

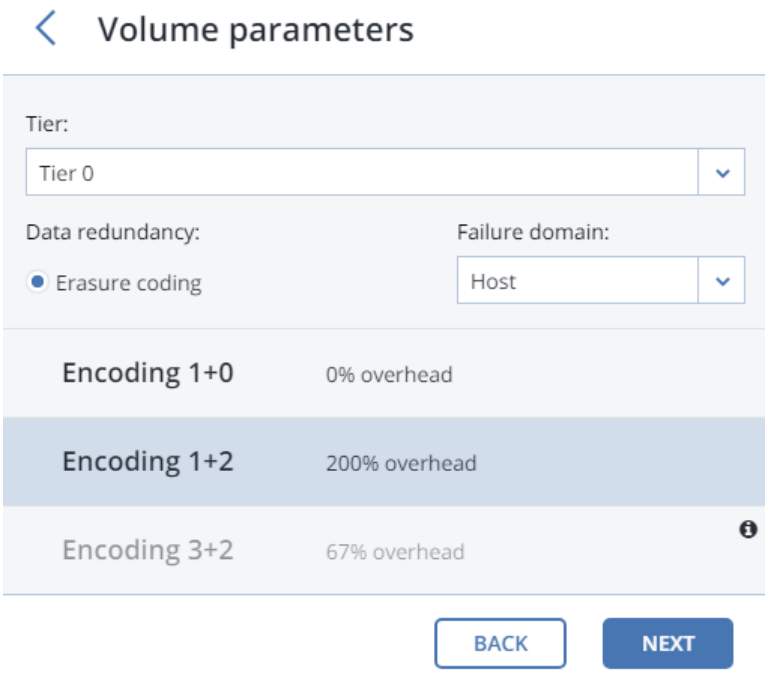
To set up Backup Gateway, do the following:

1. On the **INFRASTRUCTURE** > **Networks** screen, make sure that the **ABGW private** and **ABGW public** traffic types are added to your networks.
2. In the left menu, click **STORAGE SERVICES** > **Backup**.
3. Select the node(s) to run the gateway services on and click **Create gateway** in the right menu.
4. Select **This cluster** as storage type.
5. Make sure the correct network interface is selected in the corresponding drop-down list. Click **NEXT**.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.



6. On the **Volume Parameters** tab, select the desired tier, failure domain, and data redundancy mode.



   Redundancy by replication is not supported for Backup Gateway.

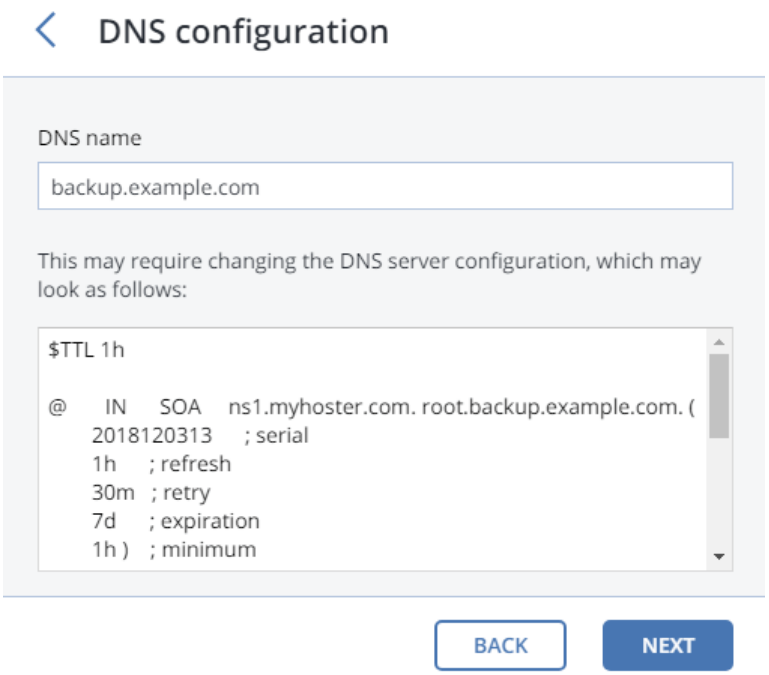
   You can later change the erasure coding mode on the **Backup** > **Parameters** panel.

7. On the **DNS Configuration** tab, specify the external DNS name for this gateway, e.g, `backupgateway.example.com`. Make sure that each node running the gateway service has a port open for

outgoing Internet connections and incoming connections from your Acronis backup software. Backup agents will use this address and port to upload the backup data.

Important: Configure your DNS server according to the example suggested in the admin panel.

Important: Each time you change nodes in the Backup Gateway cluster, adjust the DNS settings accordingly.



Click **Next**.

8. On the **Register in backup software** pane, specify the following information for your Acronis product:
   - In **Address**, specify the address of the Acronis Backup Cloud management portal (e.g., https://cloud.acronis.com/) or the hostname/IP address and port of the Acronis Backup Advanced management server (e.g., http://192.168.1.2:9877).
   - In **Account**, specify the credentials of a partner account in the cloud or of an organization administrator on the local management server.
9. Finally, click **DONE**.

5.4.3 Connecting to External NFS Shares via Backup Gateway

Take note of these limitations:

- Acronis Software-Defined Infrastructure does not provide data redundancy on top of NFS volumes. Depending on the implementation, NFS shares may use their own hardware or software redundancy.
- In the current version of Acronis Software-Defined Infrastructure, only one cluster node may store backups on an NFS volume.

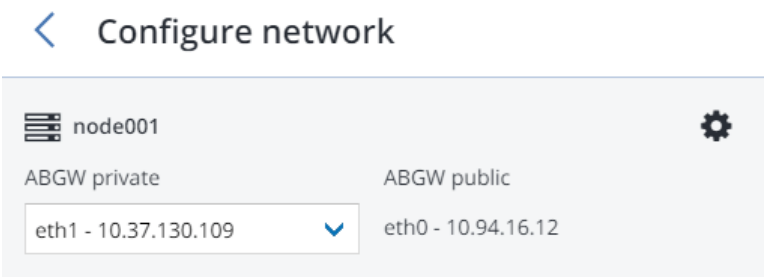
Before you proceed, make sure that:

1. The NFS share has enough space for backups.
2. Each NFS export is used by only one gateway. In particular, do not configure two Acronis Software-Defined Infrastructure installations to use the same NFS export for backup storage.

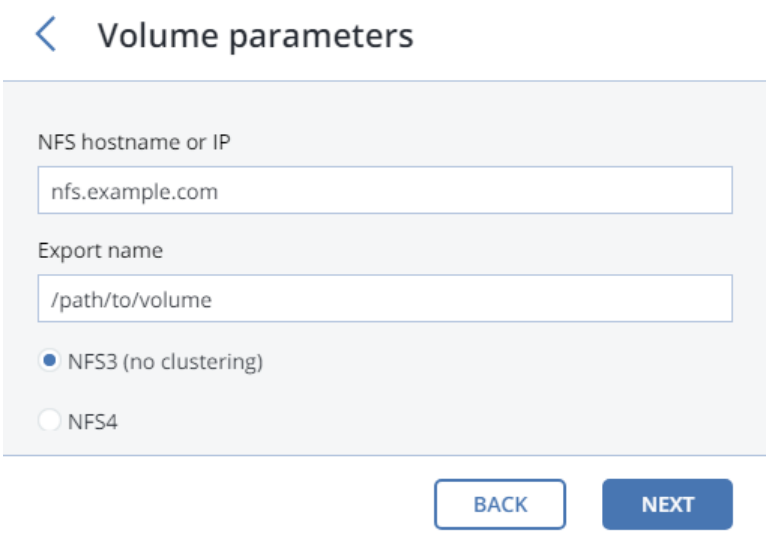
To set up Backup Gateway, do the following:

1. On the **INFRASTRUCTURE** > **Networks** screen, make sure that the **ABGW private** and **ABGW public** traffic types are added to your networks.
2. In the left menu, click **STORAGE SERVICES** > **Backup**.
3. Select the node(s) to run the gateway services on and click **Create gateway** in the right menu.
4. Select **Network File System** as storage type.
5. Make sure the correct network interface is selected in the corresponding drop-down list. Click **NEXT**.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.



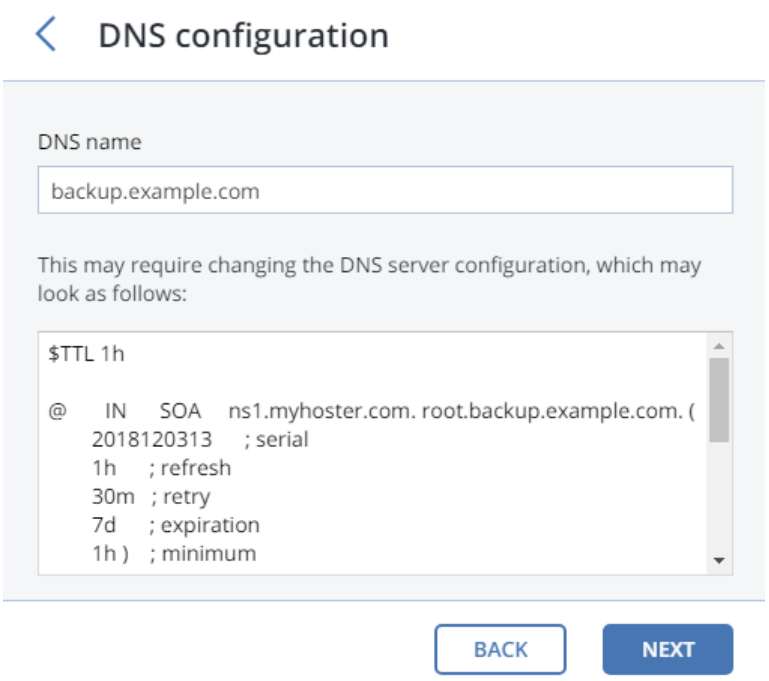
6. On the **Volume Parameters** tab, specify the hostname or IP address of the NFS share as well as the export name. Click **NEXT**.



7. On the **DNS Configuration** tab, specify the external DNS name for this gateway, e.g, `backupgateway.example.com`. Make sure that each node running the gateway service has a port open for outgoing Internet connections and incoming connections from your Acronis backup software. Backup agents will use this address and port to upload the backup data.

Important: Configure your DNS server according to the example suggested in the admin panel.

Important: Each time you change nodes in the Backup Gateway cluster, adjust the DNS settings accordingly.



Click **Next**.

8. On the **Register in backup software** pane, specify the following information for your Acronis product:
   - In **Address**, specify the address of the Acronis Backup Cloud management portal (e.g., https://cloud.acronis.com/) or the hostname/IP address and port of the Acronis Backup Advanced management server (e.g., http://192.168.1.2:9877).
   - In **Account**, specify the credentials of a partner account in the cloud or of an organization administrator on the local management server.
9. Finally, click **DONE**.

5.4.4 Connecting to Public Cloud Storage via Backup Gateway

With Backup Gateway, you can have Acronis Backup Cloud or Acronis Backup Advanced store backups in a number of public clouds: Amazon S3, IBM Cloud, Alibaba Cloud, IIJ, Cleversafe, Microsoft Azure, Swift object storage, Softlayer (Swift), Google Cloud Platform, as well as solutions using S3 with the older AuthV2-compatible authentication methods. However, compared to the local storage cluster, storing backup data in a public cloud increases the latency of all I/O requests to backups and reduces performance. For this reason, it is recommended to use the local storage cluster as storage backend.

Since backups are cold data with specific access rights, it is cost-efficient to use storage classes that are intended for long-term storage of infrequently accessed data. The recommended storage classes include the following:

- Infrequent Access for Amazon S3,
- Cool Blob Storage for Microsoft Azure,
- Nearline and Coldline Storage for Google Cloud Platform.

Note that real data storage costs may be 10-20% higher due to additional fees for operations like data retrieval and early deletion.

5.4.4.1 Important Requirements and Restrictions

1. When working with public clouds, Backup Gateway uses the local storage as the staging area as well as to keep service information. It means that the data to be uploaded to a public cloud is first stored locally and only then sent to the destination. For this reason, it is vital that the local storage is persistent and redundant so the data does not get lost. There are multiple ways to ensure the persistence and redundancy of local storage. You can deploy Backup Gateway on multiple cluster nodes and select a good redundancy mode. If Acronis Software-Defined Infrastructure with the gateway is deployed on a single physical node, you can make the local storage redundant by replicating it among local disks. If Acronis Software-Defined Infrastructure with the gateway is deployed in a virtual machine, make sure it is made redundant by the virtualization solution it runs on.
2. Make sure the local storage cluster has plenty of logical space for staging. For example, if you perform backup daily, provide enough space for at least 1.5 days' worth of backups. If the daily backup total is 2TB, provide at least 3TB of logical space. The corresponding raw storage required will vary depending on the encoding mode: 9TB (3TB per node) in the 1+2 mode, 5TB (1TB per node) in the 3+2 mode, etc.
3. You must update Acronis Backup Agents to version 12.0.4492 (Windows/Mac) or 12.0.4470 (Linux). Otherwise agents' attempts to place backups in the new storage backend will result in "Backup failed" errors.
4. If you are to store backups in an Amazon S3 cloud, keep in mind that Backup Gateway may sometimes block access to such backups due to the eventual consistency of Amazon S3. It means that Amazon S3 may occasionally return stale data as it needs time to render the most recent version of the data accessible. Backup Gateway detects such delays and protects backup integrity by blocking access until the cloud updates.

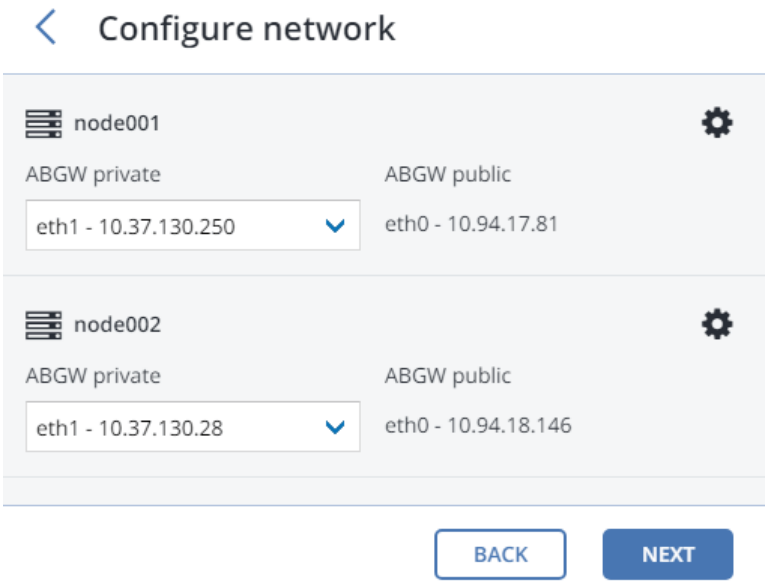
5.4.4.2 Setting Up Backup Gateway

Before you proceed, make sure that the destination storage has enough space for both existing and new backups.

To set up Backup Gateway, do the following:

1. On the **INFRASTRUCTURE** > **Networks** screen, make sure that the **ABGW private** and **ABGW public** traffic types are added to your networks.
2. In the left menu, click **STORAGE SERVICES** > **Backup**.
3. Select the node(s) to run the gateway services on and click **Create gateway** in the right menu.
4. Select **Public Cloud** as storage type.
5. Make sure the correct network interface is selected in the corresponding drop-down list. Click **NEXT**.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.



6. On the **Public cloud parameters** pane, do the following:
   1. Select a public cloud provider. If your provider is S3-compatible but not in the list, try **AuthV2 compatible**.
   2. Depending on the provider, specify **Region**, **Authentication (keystone) URL**, or **Endpoint URL**.

3. In case of Swift object storage, specify the authentication protocol version and attributes required by it.
4. Specify user credentials. In case of Google Cloud, select a JSON file with keys to upload.
5. Specify the folder (bucket, container) to store backups in. The folder must be writeable.

Click **NEXT**.

7. On the **Register in backup software** pane, specify the following information for your Acronis product:
   - In **Address**, specify the address of the Acronis Backup Cloud management portal (e.g., https://cloud.acronis.com/) or the hostname/IP address and port of the Acronis Backup Advanced management server (e.g., http://192.168.1.2:9877).
   - In **Account**, specify the credentials of a partner account in the cloud or of an organization administrator on the local management server.
8. Finally, click **DONE**.

5.4.5 Re-registering Backup Gateway in a New Acronis Backup Advanced

To switch a configured Backup Gateway to a different Acronis Backup Advanced instance, re-register the gateway with that instance. To do this:

1. On the **STORAGE SERVICES** > **Backup** screen, click **Re-register**.
2. On the **Registration** tab, specify the following:
   - In **Account Server Name**, specify the hostname/IP address and port of the Acronis Backup Advanced management server (e.g., http://192.168.1.2:9877).
   - In **Acronis Account**, specify the credentials of the Acronis Backup Advanced administrator account.
3. Click **DONE**.

5.4.6 Migrating Backups from Older Acronis Solutions

By means of Backup Gateway, you can migrate backups from Acronis Storage 1.5 and Acronis Storage Gateway 1.6 and 1.7 to a storage backend of your choice: the local storage cluster, external NFS, or public cloud.

Migration to NFS backends is not available, however, if multiple nodes are selected as Backup Gateway.

Important: Before you proceed, make sure that the destination storage has enough space for both existing and new backups.

The migration procedure can be described as follows:

1. Root credentials for SSH access to the chosen source storage are provided to Backup Gateway.
2. Backup Gateway sets up a proxy on the source storage that starts redirecting requests incoming from Acronis Backup Agents from the source storage to Backup Gateway.
3. Backup Gateway starts relocating backups to the chosen storage backend. The data that remains to be migrated is shown in the **Migration Backlog** section on the Backup Gateway **Overview** screen. When the backlog empties, all data has been migrated.

   After the migration has started, the data of new and incremental backups is stored on the destination storage. Backups from the source storage are pulled in the background. The entire process is transparent to backup agents, which continue working uninterrupted.
4. To be able to dispose of the source storage after migration completes, requests from Acronis Backup Agents are directed straight to Backup Gateway, bypassing the proxy on the source storage. Steps that you need to take depend on how the source storage is registered in Acronis Backup Cloud: under the IP address or DNS name.

   - If the source storage is already registered under the DNS name, you need to change the IP address behind it to those of the Backup Gateway nodes.
   - If the source storage is registered under the IP address, it is strongly recommended to re-register Backup Gateway in Acronis Backup Cloud under a DNS name that resolves into the IP addresses of Backup Gateway nodes. Using a DNS name will provide a smoother transition and you will not need to reconfigure Acronis Backup Cloud even if you change nodes in the Backup Gateway (you will still need to adjust the IP addresses behind the DNS name accordingly).

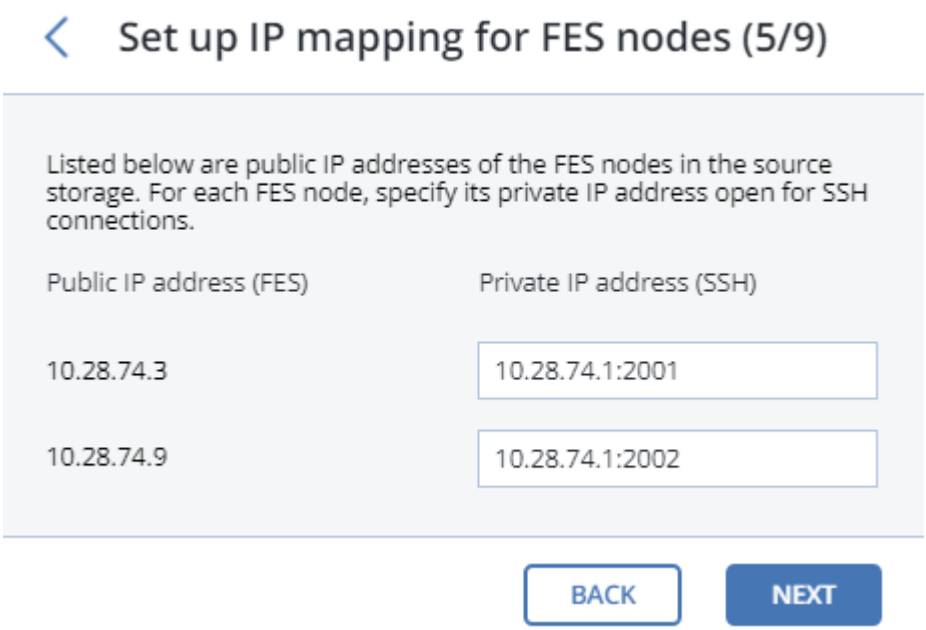
     Alternatively, if you do not want to use a DNS name, you need to wait for the migration to complete, shut down both the source and destination machines, and reconfigure your network so that the public interface of the destination machine gets the IP address of the source machine.

The concrete steps that you need to perform in the admin panel to initiate backup migration are described in the next subsections.

5.4.6.1 Migrating Backups from Acronis Storage 1.5

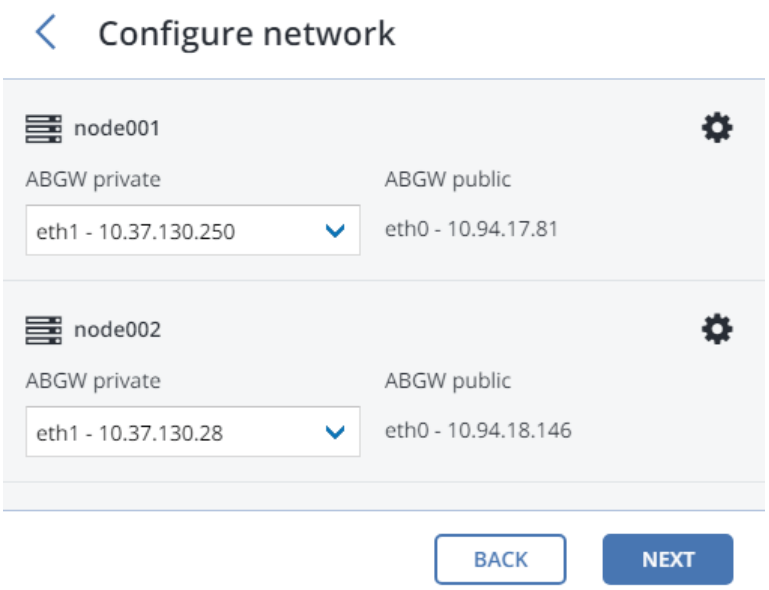
1. Update all Acronis Storage 1.5 nodes to version 1.5.65665 or newer as earlier versions are not eligible for migration. To do this, log in to the Acronis Storage web console, proceed to **SETTINGS** > **Software Update**, upload the latest ISO image, and click **Update**.
2. Log in to the new storage cluster and on the **STORAGE SERVICES** > **Backup** > **NODES** screen, select one or more nodes and click **Migrate**.
3. Select **Acronis Storage 1.5** and click **NEXT**.
4. Specify the DNS name of the source storage registered in Acronis Backup Cloud and click **NEXT**.

5. Provide the credentials for the cloud management portal of the Acronis Backup Cloud installation that the source storage is registered in and click **NEXT**.
6. Enable SSH access on all FES nodes of Acronis Storage 1.5 as instructed and click **NEXT**.
7. Map the public IP addresses of FES nodes accessible via SSH to their private IP addresses and click **NEXT**. This step is required to access FES nodes via SSH through tunnels.



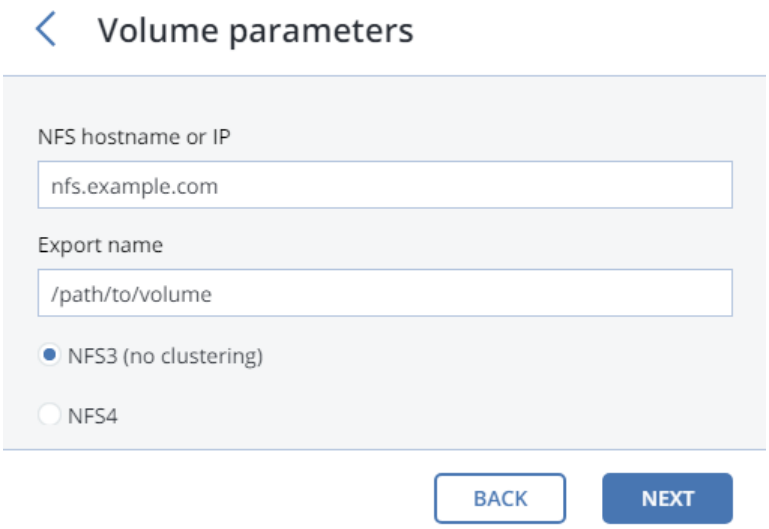
8. Choose a destination storage type to create a gateway to:
   - local storage cluster,
   - external NFS, or
   - public cloud.
9. Make sure the correct network interface is selected in the corresponding drop-down list. Click **NEXT**.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.



10. Configure the destination storage backend:

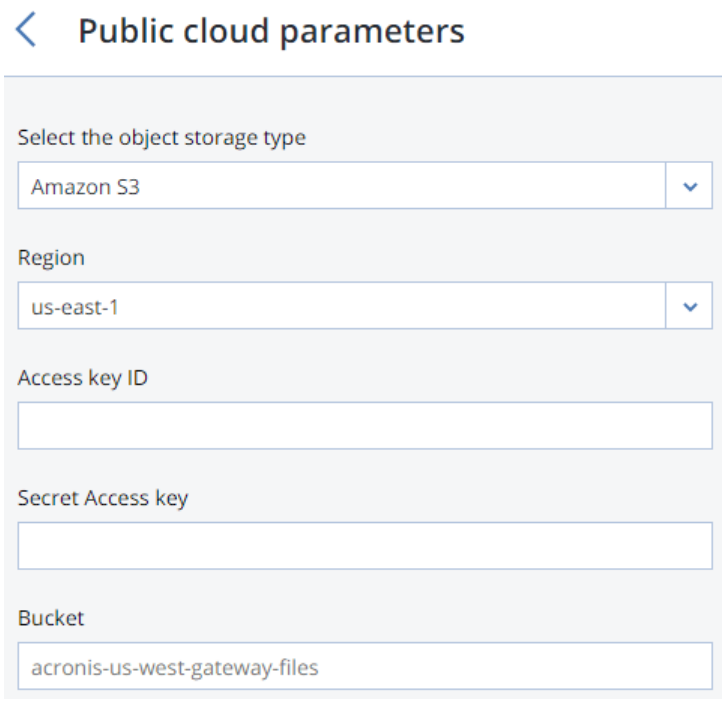
    - For a storage cluster, select the desired tier, failure domain, and redundancy mode.
    - For NFS, specify a hostname or IP address, an export name and path, and choose the NFS version.



    - For public cloud, select a public cloud provider, specify credentials, and the name of the folder (bucket, container).

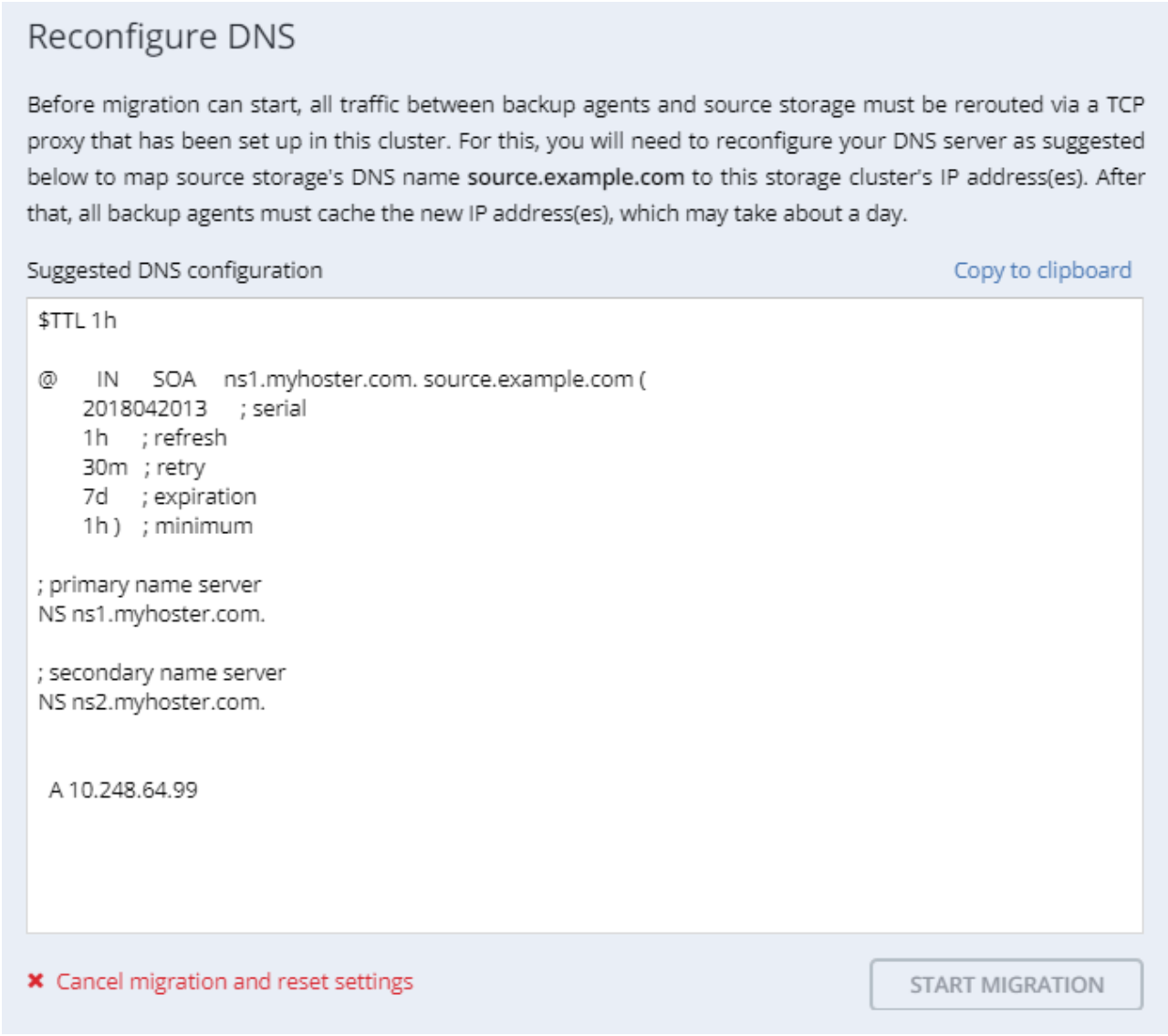
Important: You must update Acronis Backup Agents to version 12.0.4492 (Windows/Mac) or 12.0.4470 (Linux). Otherwise agents' attempts to place backups in the new storage backend will

result in “Backup failed” errors.



Click **NEXT**.

11. Review the source and destination storages and click **PROCEED**.
12. On the next panel, follow the instructions to point the source storage DNS name to the IP addresses of your new storage cluster. Having updated the DNS configuration, wait for 24 hours for all backup agents to cache the new IP addresses. Until this happens, the **START MIGRATION** button will be disabled. After all backup agents have been rerouted to the new cluster, the button will become enabled and you can click it to start migration.



Depending on data size, migration may take as long as several days.

5.4.6.2 Migrating Backups from Acronis Storage Gateway 1.6 and 1.7 (NFS)

1. Disable the firewall or explicitly open TCP port 44446 on the source Acronis Storage Gateway.
   - To disable the firewall, run

     ```
     # systemctl stop firewalld
     ```

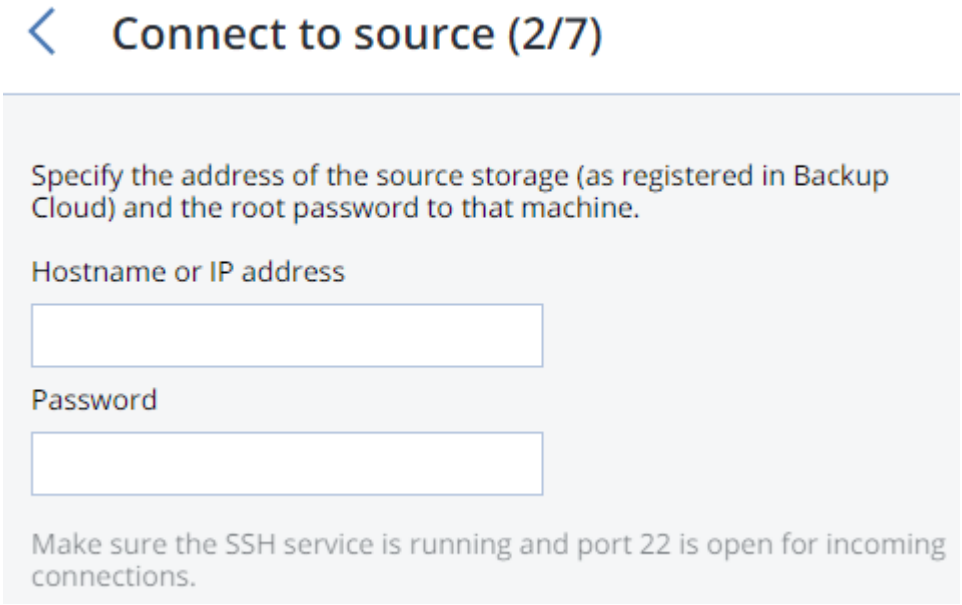
   - To open TCP port 44446 in the firewall, do the following:
     1. Find out the zone where port 44445 is open:

```
# firewall-cmd --list-all-zones | grep active
mix_eth0 (active)
```

2. Add the required port to the same zone:

```
# firewall-cmd --zone=mix_eth0 --permanent --add-port=44446/tcp
# firewall-cmd --reload
```

2. In the admin panel of the ABGW node, proceed to **STORAGE SERVICES** > **Backup** > **NODES**, select the node(s) to run the gateway services on, and click **Migrate**.
3. Select the source storage version and click **NEXT**.
4. Specify the connection details for the source storage and click **NEXT**.



5. Provide the credentials for the cloud management portal of the Acronis Backup Cloud installation that the source storage is registered in and click **NEXT**.
6. If the source storage is registered in Acronis Backup Cloud under an IP address, you will see the DNS configuration screen. On it, click **RE-REGISTER WITH DNS** and specify the source storage DNS name (recommended, see above). Or, if you want to keep using the IP address, click **PROCEED WITH IP**.

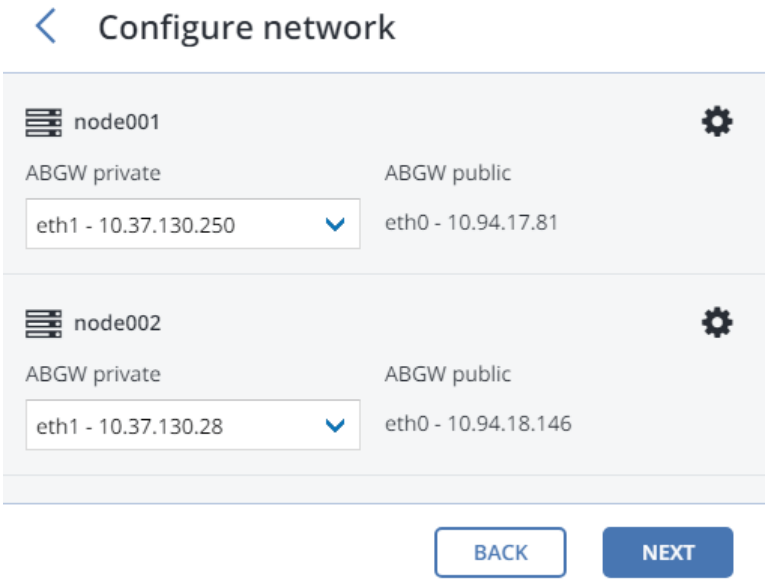
   If you specified a DNS name, configure your DNS server according to the suggested example.

Important: Each time you change nodes in the Backup Gateway cluster, adjust the DNS settings accordingly.

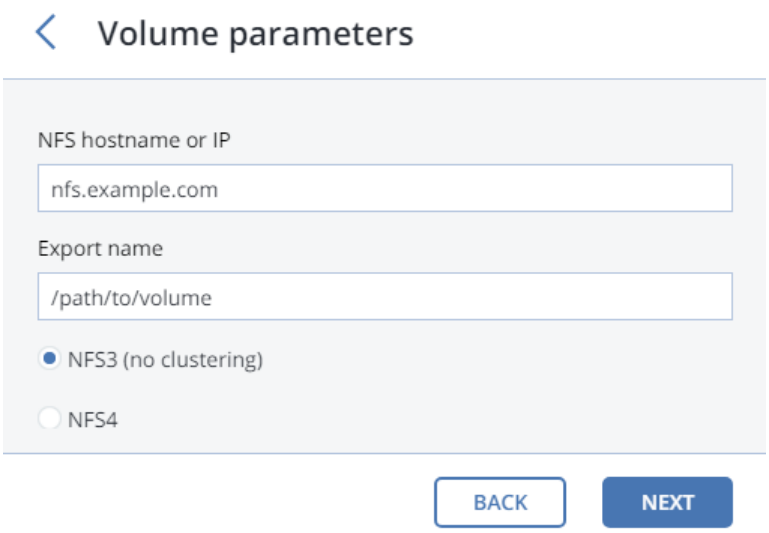
---

7. Choose a destination storage type to create a gateway to:
   - local storage cluster,
   - external NFS, or
   - public cloud.
8. Make sure the correct network interface is selected in the corresponding drop-down list. Click **NEXT**.

   If necessary, click the cogwheel icon and configure node's network interfaces on the **Network Configuration** screen.

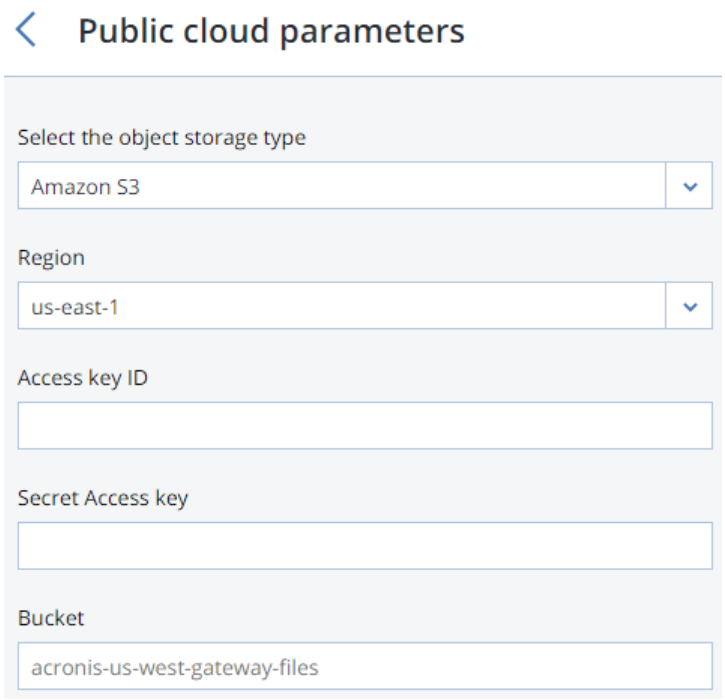


9. Configure the destination storage backend:
   - For a storage cluster, select the desired tier, failure domain, and redundancy mode.
   - For NFS, specify a hostname or IP address, an export name and path, and choose the NFS version.



- For public cloud, select a public cloud provider, specify credentials, and the name of the folder (bucket, container).

Important: You must update Acronis Backup Agents to version 12.0.4492 (Windows/Mac) or 12.0.4470 (Linux). Otherwise agents' attempts to place backups in the new storage backend will result in "Backup failed" errors.



Click **NEXT**.

10. Review the source and destination storages and click **START MIGRATION**.

Depending on data size, migration may take as long as several days.

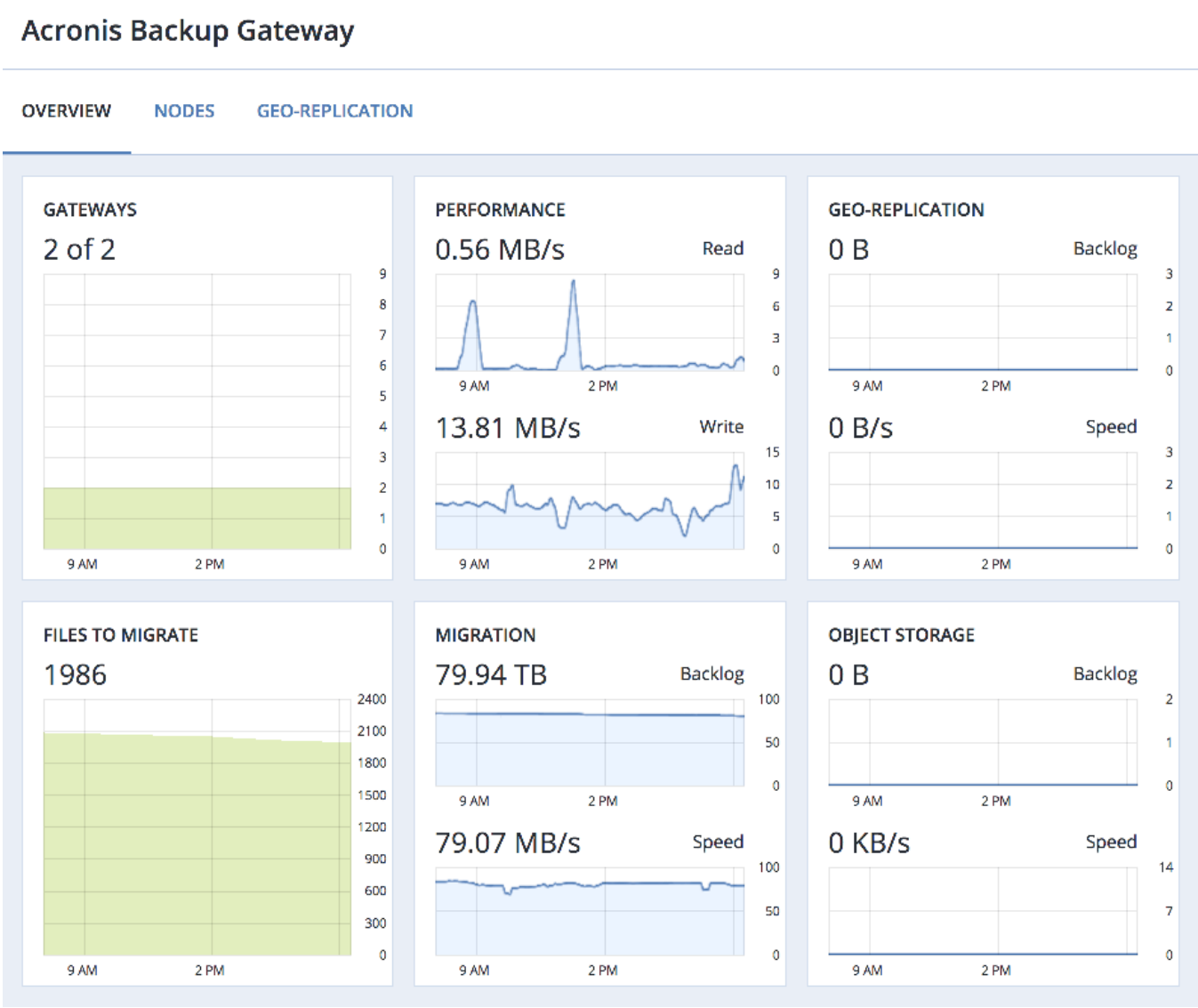
5.4.7 Monitoring Backup Gateway

After you create a Backup Gateway, you can monitor it on the **STORAGE SERVICES** > **Backup** > **OVERVIEW** screen. The charts show the following information:

- the performance of Backup Gateway services,
- the geo-replication speed and backlog (the amount of data waiting to be replicated),
- object storage speed and backlog (the amount of data waiting to be uploaded to public cloud),
- migration speed and backlog (the amount of data waiting to be migrated),
- how many files are left in migration queue.

If you migrate backups from Acronis Storage 1.5 or 1.7, migration backlog will be larger than the amount of data on the source storage. The reason is that Acronis Storage versions prior to 2.x use the old backup (FES) protocol that sends more data over network. The difference between source data size and backlog also very much depends on the retention policy utilized by the backup solution. Despite this, the resulting space occupied by migrated data on the destination will be similar to that on the source.

If backlogs do not decrease over time, it means the data cannot be replicated, migrated, or uploaded fast enough. The reason may be insufficient network transfer speed, and you may need to check or upgrade your network.



5.4.8 Releasing Nodes from Backup Gateway

Backup Gateway is meant to provide access to one specific storage backend. If you need to switch the backend, e.g., from a public cloud to a local storage cluster or one public cloud bucket to another, you need to delete the Backup Gateway by releasing all its nodes and create a new one.

To release one or more nodes from the Backup Gateway cluster, select them on the **STORAGE SERVICES** > **Backup** > **NODES** screen and click **Release**. The Backup Gateway cluster will remain operational until there is at least one node in it.

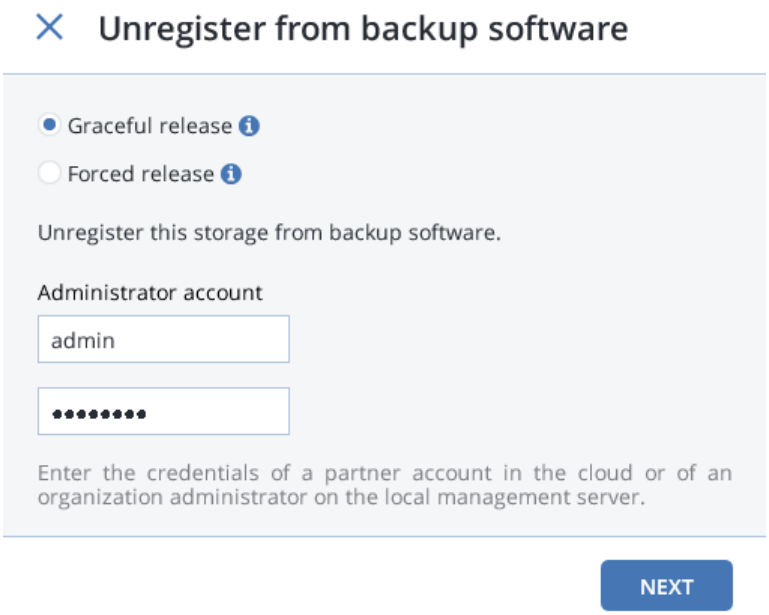
When the Backup Gateway is deleted, it is also unregistered from your Acronis backup software, which loses

access to the storage backend.

Do the following to release the last node in the gateway:

1. On the **STORAGE SERVICES** > **Backup** > **NODES** screen, select the node and click **Release**.
2. On the **Unregister from backup software** panel, choose one of the following:
   - **Graceful release** (recommended, see note below). Releases the node, deletes the Backup Gateway and unregisters it from your Acronis backup software.
   - **Force release**. Releases the node, deletes the Backup Gateway but does not unregister it from your Acronis backup software.

   Important: Choose this option only if you are sure that the gateway has already been unregistered from your Acronis backup software. Otherwise, you will need to register a new gateway in your Acronis backup software and for that you will need to delete and recreate not just the Backup Gateway but also the entire storage cluster.



3. Specify the credentials of your administrator account in your Acronis backup software and click **NEXT**. In case the release is forced, simply click **NEXT**.

CHAPTER 6

Managing General Settings

This chapter describes how you can configure Acronis Software-Defined Infrastructure settings.

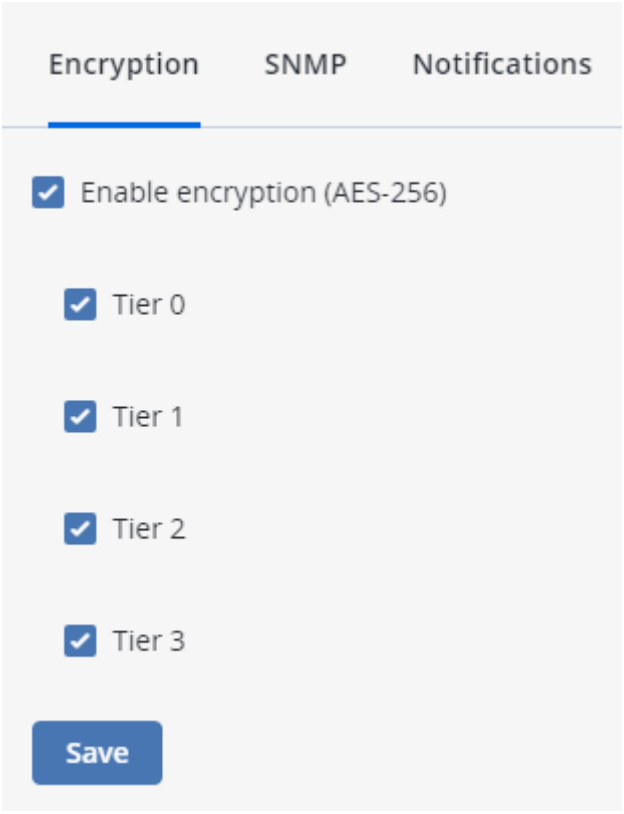
6.1 Managing Tier Encryption

Acronis Software-Defined Infrastructure can encrypt data stored on disks with the AES-256 standard, so if a disk gets lost or stolen the data will be safe. Acronis Software-Defined Infrastructure stores disk encryption keys in cluster's metadata (MDS).

Encryption can be enabled or disabled only for the newly created chunk services (CS). Once tier encryption is enabled, you can decrypt disks (CSs) by manually releasing them from encrypted tiers. Correspondingly, simply enabling encryption on the disk's tier will not encrypt its data (CS). To encrypt a disk, you must assign it to an encrypted tier.

Take note of the following:

1. Acronis Software-Defined Infrastructure does not encrypt data transmitted over the internal network.
2. Enabled encryption slightly decreases performance.



To enable or disable tier encryption, on the **SETTINGS** > **Advanced settings** panel, select or deselect tiers and click **SAVE**.

6.2 Managing Users

During the admin panel installation on the first node, Acronis Software-Defined Infrastructure creates the default unique administrator account, superadmin. The user name for this account is `admin` and the password is specified during installation. This account cannot be deleted and its privileges cannot be changed. Other than that, superadmin does not differ from a user account assigned the **Administrator** role (i.e. an admin).

An admin can create user accounts and assign to them one or more roles listed below:

Administrator Can fully manage cluster and users.

Network Can modify network settings and roles.

Cluster Can create cluster, join nodes to cluster, and manage (assign and release) disks.

Compute Can create and manage compute cluster and virtual machines.

ABGW	Can create and manage Backup Gateway instances.
iSCSI	Can create and manage iSCSI targets and LUNs.
NFS	Can create and manage NFS shares and exports.
S3	Can create and manage S3 cluster.
SSH	Can add and remove SSH keys for cluster nodes access.
Updates	Can install Acronis Software-Defined Infrastructure updates.

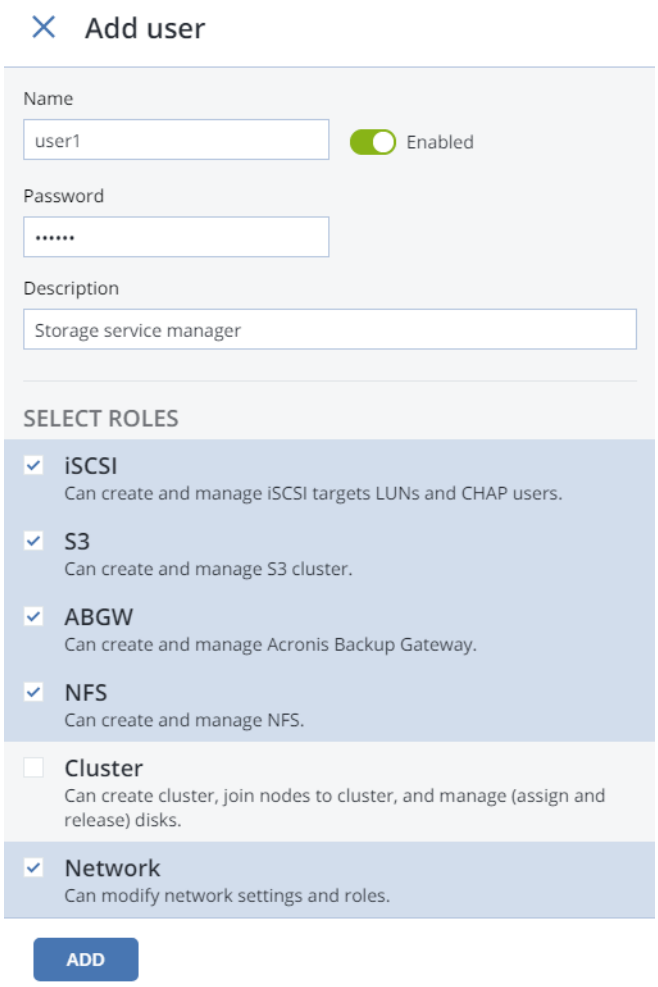
User accounts to which no roles are assigned are guest accounts. Guests can monitor Acronis Software-Defined Infrastructure performance and parameters but cannot change any settings.

All users, however, can change their own passwords (see *Managing User Accounts* (page 148)).

6.2.1 Creating User Accounts

To create a user account, do the following:

1. Log in to the admin panel as admin.
2. Open the **SETTINGS** > **Users** screen and click **ADD USER**.
3. On the **Add user** panel, specify the user name, password, and, if required, a user description in the corresponding fields.



4. Check the roles to assign to the account and click **ADD**.

6.2.2 Managing User Accounts

Any user can change their account password by clicking the user icon in the top right corner of the admin panel and then clicking **Change password**.

An admin can create/delete other users' accounts, add/remove roles from them, change their descriptions and passwords (although superadmin's password can only be changed by superadmin), as well as enable/disable user accounts (i.e. allow/prohibit user login). To manage a user account, login as an admin, open the **Settings** > **Users** screen, select a user from the list, and click **Configure** or **Delete** depending on what you need to do.

6.3 Managing Updates

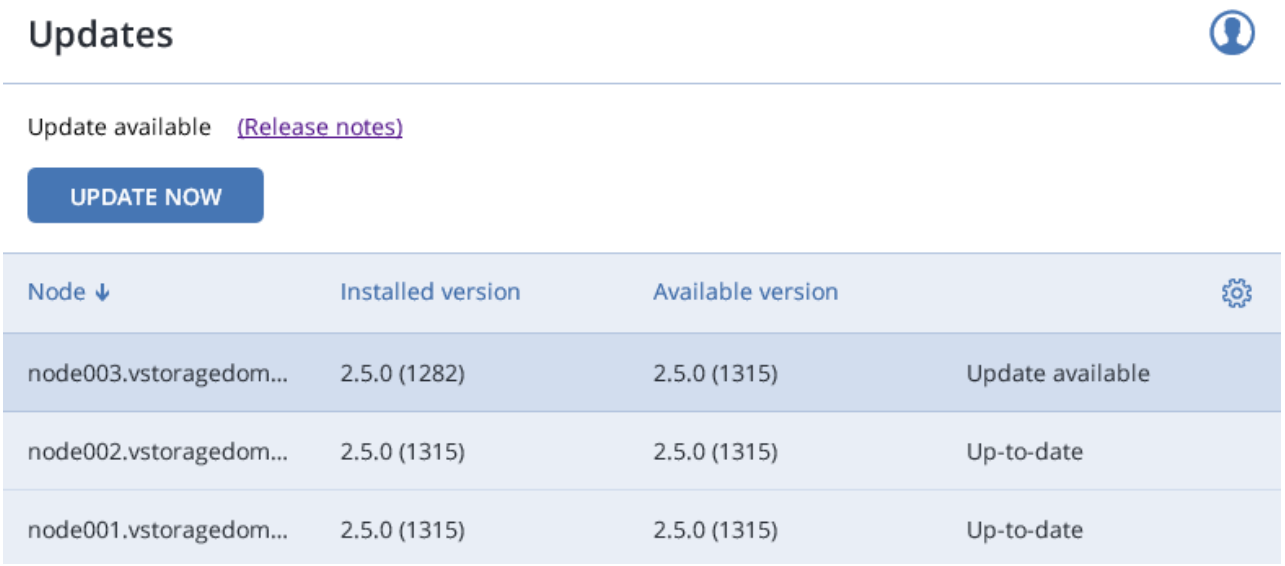
Take note of the following before you start updating nodes:

- To check for and download updates, the cluster must be healthy and each node in the infrastructure must be able to open outgoing Internet connections. This means, in particular, that cluster DNS must be configured and point to a DNS able to resolve external host names. For more details, see *Adding External DNS Servers* (page 163).
- Unassigned nodes cannot be updated.
- Updates are applied to one storage cluster node at a time.
- If a reboot is required:
  - Highly available storage services will continue working.
  - Virtual machines in the compute cluster will be suspended.
  - If the management node HA cluster is configured, the admin panel will remain accessible, although you may expect a lag when it moves to an online node from the one being rebooted.

Note: For details on upgrading to this version, see the Administrator's Guide for version 2.4.

To update the storage cluster from the admin panel, do the following:

1. Open the **SETTINGS** > **Updates** screen and click **CHECK FOR UPDATES**. The script will run `yum update` on each node. If updates are available for a node, that node's status will change to `Update available`.



2. To apply all available updates, click **UPDATE NOW**.

To update the kernel with ReadyKernel, consult the *Administrator's Command Line Guide*.

6.3.1 Upgrading to Version 3.0

You can upgrade your Acronis Software-Defined Infrastructure installation to version 3.0 in-place from the management panel.

The following conditions must be met in order to upgrade:

- All nodes in the storage cluster are online.
- All nodes in the storage cluster are updated to the latest version.
- All nodes in the storage cluster are running the latest kernel.
- The high availability cluster has exactly three nodes.
- No tasks are running. Make sure there are no running tasks like adding or removing cluster nodes, reconfiguring network adapters, or similar.

If the storage cluster does not meet any of these requirements, you will see corresponding alerts when attempting to upgrade.

Note: High availability will be temporarily disabled for the duration of upgrade. It will be re-enabled automatically after the last node has been upgraded. Do not power off the nodes during the upgrade

procedure.

To upgrade the cluster, do the following:

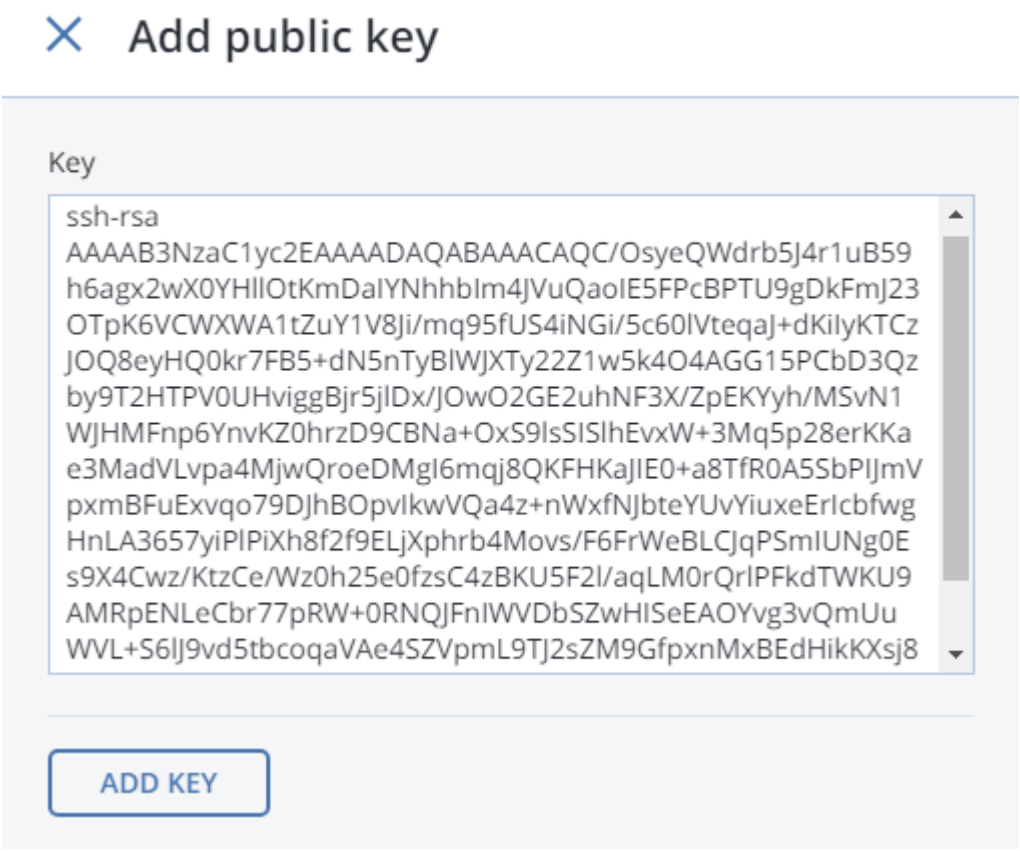
1. On the **SETTINGS** > **Updates** screen, click **DOWNLOAD**. You will see a pop-up screen with release notes. Click **DOWNLOAD** again to confirm. The pop-up screen will close and downloading will start.
2. Once the required packages are downloaded on each node, the button will change to **INSTALL**. Click it to proceed with the upgrade.

Nodes will be upgraded one at a time. Each node will reboot to finalize the procedure, so you may expect some downtime. Highly available storage services, however, will continue working.

6.4 Allowing root Access to Cluster Nodes Over SSH

In certain situations, you or the technical support team may need root access to cluster nodes via SSH. To allow root access to all nodes in the cluster, do the following:

1. Obtain an SSH public key from the technical support team.
2. Open the **SETTINGS** > **SSH** screen, click **ADD KEY**, paste the key, and click **Add key**.



To delete the key after root access is no longer required, select the key and click **Delete**.

6.5 Enabling High Availability

High availability keeps Acronis Software-Defined Infrastructure services operational even if the node they are located on fails. In such cases, services from a failed node are relocated to healthy nodes according to the Raft consensus algorithm. High availability is ensured by:

- Metadata redundancy. For a storage cluster to function, not all but just the majority of MDS servers must be up. By setting up multiple MDS servers in the cluster you will make sure that if an MDS server fails, other MDS servers will continue controlling the cluster.
- Data redundancy. Copies of each piece of data are stored across different storage nodes to ensure that the data is available even if some of the storage nodes are inaccessible.
- Monitoring of node health.

To achieve the complete high availability of the storage cluster and its services, we recommend that you do

the following:

1. deploy three or more metadata servers,
2. enable management node HA, and
3. enable HA for the specific service.

Note: The required number of metadata servers is deployed automatically on recommended hardware configurations; Management node HA must be enabled manually as described in the next subsection; High availability for services is enabled by adding the minimum required number of nodes to that service's cluster.

On top of highly available metadata services and enabled management node HA, Acronis Software-Defined Infrastructure provides additional high availability for the following services:

- Admin panel. If the management node fails or becomes unreachable over the network, an admin panel instance on another node takes over the panel's service so it remains accessible at the same dedicated IP address. The relocation of the service can take several minutes. Admin panel HA is enabled manually (see *Enabling Management Node High Availability* (page 154)).
- iSCSI service. If the active path to volumes exported via iSCSI fails (e.g., a storage node with active iSCSI targets fails or becomes unreachable over the network), the active path is rerouted via targets located on healthy nodes. Volumes exported via iSCSI remain accessible as long as there is at least one path to them.
- S3 service. If an S3 node fails or becomes unreachable over the network, name server and object server components hosted on it are automatically balanced and migrated between other S3 nodes. S3 gateways are not automatically migrated; their high availability is based on DNS records. You need to maintain the DNS records manually when adding or removing S3 gateways. High availability for S3 service is enabled automatically after enabling management node HA and creating an S3 cluster from three or more nodes. An S3 cluster of three nodes may lose one node and remain operational.
- Backup gateway service. If a backup gateway node fails or becomes unreachable over the network, other nodes in the backup gateway cluster continue to provide access to the chosen storage backend. Backup gateways are not automatically migrated; their high availability is based on DNS records. You need to maintain the DNS records manually when adding or removing backup gateways. High availability for backup gateway is enabled automatically after creating a backup gateway cluster from two or more nodes. Access to the storage backend remains until at least one node in the backup gateway cluster is healthy.

- NFS shares. If a storage node fails or becomes unreachable over the network, NFS volumes located on it are migrated between other NFS nodes. High availability for NFS volumes on a storage node is enabled automatically after creating an NFS cluster.

Also take note of the following:

1. Creating the compute cluster prevents (and replaces) the use of the management node backup and restore feature.
2. If nodes to be added to the compute cluster have different CPU models, consult the section "Setting Virtual Machines CPU Model" in the *Administrator's Command Line Guide*.

6.5.1 Enabling Management Node High Availability

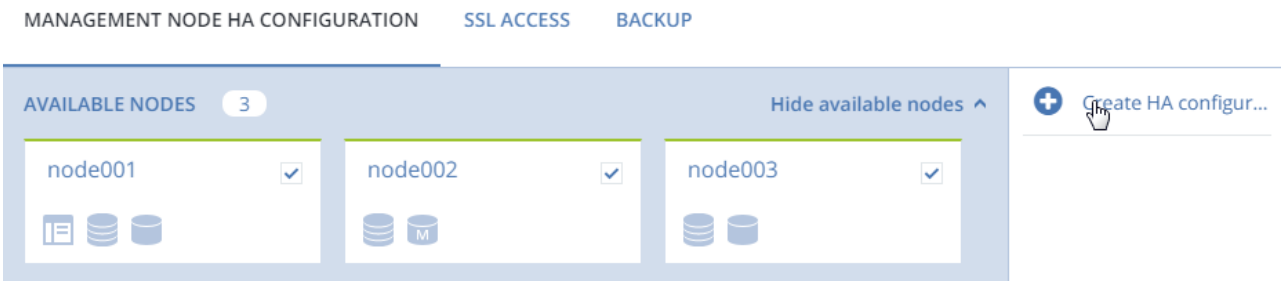
Management node HA and compute cluster are tightly coupled, so changing nodes in one usually affects the other. Take note of the following:

1. Each node in the HA configuration must meet the requirements to the management node listed in the *Installation Guide*. If the compute cluster is to be created, its hardware requirements must be added as well.
2. The HA configuration must include at least three nodes at all times. Because of this, removing nodes from the HA configuration (whether or not the compute cluster exists) is only possible if the required minimum remains after removal. For example, to remove one of the minimum three nodes from the HA configuration, a fourth node must be added to it first.
3. If the HA configuration has been created before the compute cluster, all nodes in it will be added to the compute cluster.
4. If the compute cluster has been created before HA configuration, only nodes in the compute cluster can be added to the HA configuration. For this reason, to add a node to HA configuration, add it to the compute cluster first.
5. If both the HA configuration and compute cluster include the same four or more nodes, a node must first be removed from the HA configuration to be removed from the compute cluster.

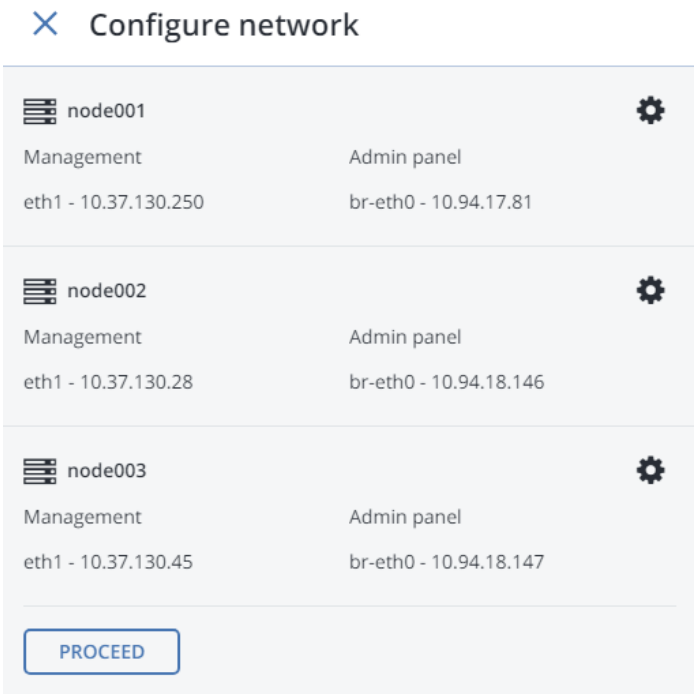
   If both the HA configuration and compute cluster include the same three nodes (the required minimum), single nodes cannot be removed from the compute cluster. In such a case, the compute cluster can be destroyed completely, but the HA configuration will remain; this is also true vice versa, the HA configuration can be deleted, but the compute cluster will continue working.

To enable high availability for the management node and admin panel, do the following:

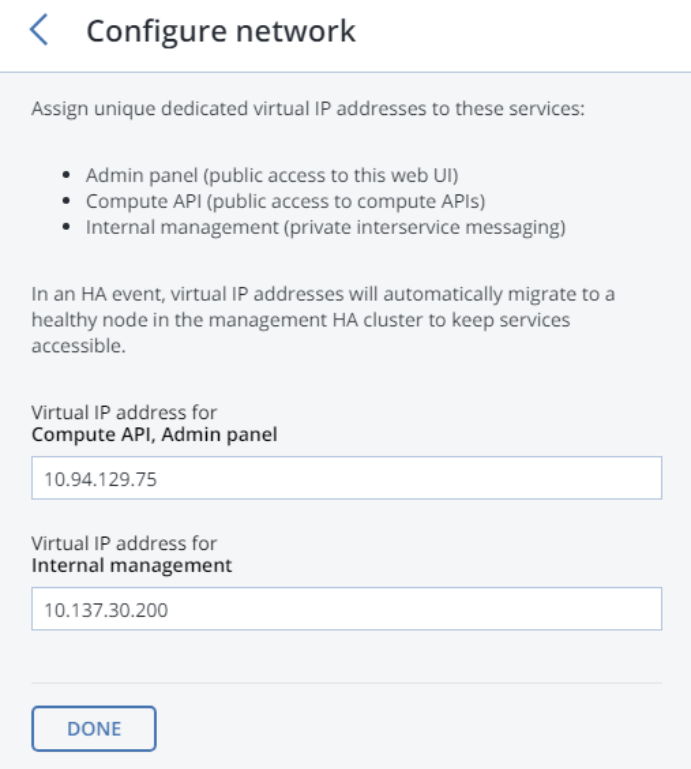
1. Make sure that each node is connected to a network with the **Admin panel** traffic type.
2. On the **SETTINGS** > **Management node** screen, open the **MANAGEMENT NODE HA CONFIGURATION** tab.



3. Select three to five nodes and click **Create HA configuration**.
4. On **Configure network**, check that correct network interfaces are selected on each node. Otherwise click the cogwheel icon for a node and assign networks with the **Internal management** and **Admin panel** traffic type to its network interfaces. Click **PROCEED**.



5. Next, on **Configure network**, provide one or more unique static IP addresses for the highly available admin panel, compute API endpoint, and interservice messaging. Click **DONE**.



Once the high availability of the management node is enabled, you can log in to the admin panel only at the specified static IP address (on the same port 8888).

To remove nodes from the HA setup, select them in the list on the **MANAGEMENT NODE HA** tab and click **Release nodes**.

6.6 Accessing the Admin Panel via SSL

When configuring various Acronis Software-Defined Infrastructure features, you may need to enter sensitive information like credentials for user and e-mail accounts, S3 services, and such. The system uses a pre-generated self-signed certificate by default, and you may want to upload one issued by a trusted CA instead.

Note the following before you proceed:

1. If you want to upload an SSL certificate before creating the HA cluster, you will need one issued for admin panel's current IP address. If you later create the HA cluster, the admin panel will move to the chosen virtual IP address, and you will need another SSL certificate issued for that address.
2. When you create or destroy the HA cluster, the current certificate is overwritten by a self-signed one

generated by the system. You will need to re-upload your certificate and key from a trusted CA after completing either operation.

To upload an SSL certificate, do the following:

1. On the **SETTINGS** > **Management node** > **SSL ACCESS** tab, click **UPLOAD**.
2. Upload an SSL certificate issued for admin panel's current IP address.
3. Upload the private key. This option shows after uploading a valid certificate.
4. Click **SAVE**.

The uploaded certificate will be added to the configuration of the web server that hosts the admin panel and you will be able to access it over HTTPS.

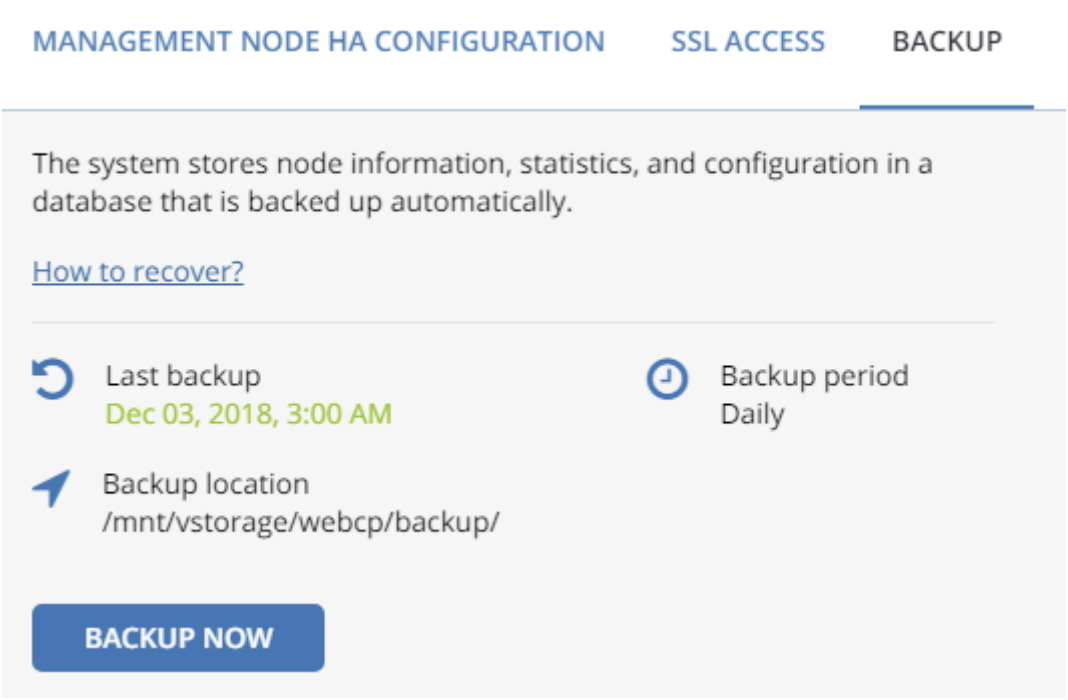
You can also generate a new self-signed certificate instead of the one used by default. However, it will not be trusted and you will have to manually accept it in your browser.

6.7 Backing Up and Restoring Management Database

Node information, statistics, and configurations are stored in a database on the management node (the one with the admin panel). Backups of this database are created automatically every day. If the management node is not highly available, restoring such a backup recovers the node in case of failure or database corruption.

Important: Database backups cannot be restored if management node high availability is enabled and/or if the compute cluster is deployed. For this reason, it is highly recommended to set up management node HA before deploying the compute cluster.

To back up the database manually, open the **SETTINGS** > **Management node** > **Backup** screen and click **BACKUP NOW**.



Once backup is completed, the **Last backup** date will be refreshed.

Warning: Do not rename the backup file! Otherwise you will not be able to restore the management database from it.

6.7.1 Restoring Management Database from Backup

You can restore a management node database from backup on the same management node or any node assigned to the cluster. Run the following script:

```
# /usr/libexec/vstorage-ui-backend/bin/restore-management-node.sh \
-x <public_network_interface> -i <private_network_interface>
```

where `<public_network_interface>` and `<private_network_interface>` are interfaces assigned the **Public** and **Private** networks, respectively. If required, you can specify the same network interface in both parameters.

6.8 Managing Licenses

Acronis Software-Defined Infrastructure comes with a trial license that allows you to evaluate its features. The trial license has no expiration date but limits storage capacity to 1TB.

Acronis Software-Defined Infrastructure supports the following licensing models for production environments:

- License key. Implementing the provisioning model, keys are time-limited (subscription) or perpetual and grant a certain storage capacity. If a commercial license is already installed, a key augments its expiration date or storage limit.
- Services provider license agreement (SPLA). SPLA implements the pay-as-you-go model: it grants unlimited storage capacity and customers are charged for the actual usage of these resources. With SPLA, Acronis Software-Defined Infrastructure automatically sends reports to Acronis Data Cloud once every four hours. If no reports have been received for two weeks, the license expires.

  Note: SPLA license is valid for Cloud Partners. If SPLA is enabled, you can connect Backup Gateway only to Acronis Backup Cloud and not to Acronis Backup 12.5 or Acronis Backup Advanced 12.5. To connect ABGW to these products, you will need to use license keys. Furthermore, Acronis Backup Gateway usage is not counted in SPLA in Acronis Software-Defined Infrastructure. SPLA only counts universal usage that is not related to backup. Backup usage is shown in the Acronis Backup Cloud section of Acronis Data Cloud.

You can switch the licensing model at any time:

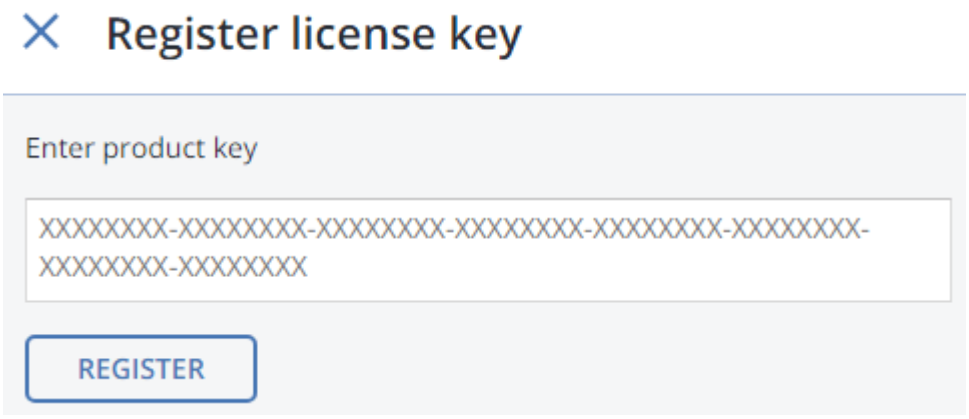
- Switching from a license key to SPLA terminates the key even if it has not yet expired. Terminated keys cannot be used anymore.
- Switching from SPLA to a license key changes the licensing model to subscription or perpetual. After doing so, ask your service provider to terminate your SPLA by either disabling the Storage application for your account or deleting the account.

Important: If a license expires, all write operations to the storage cluster stop until a valid license is installed.

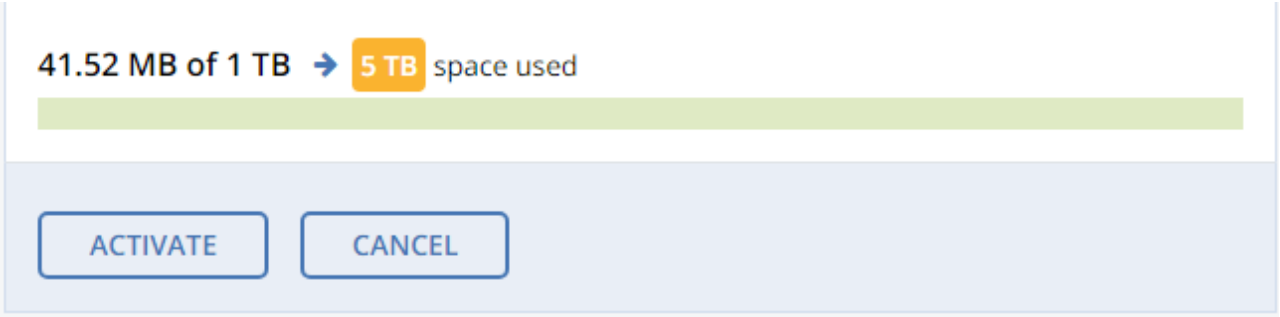
6.8.1 Installing License Keys

To install a license key, do the following:

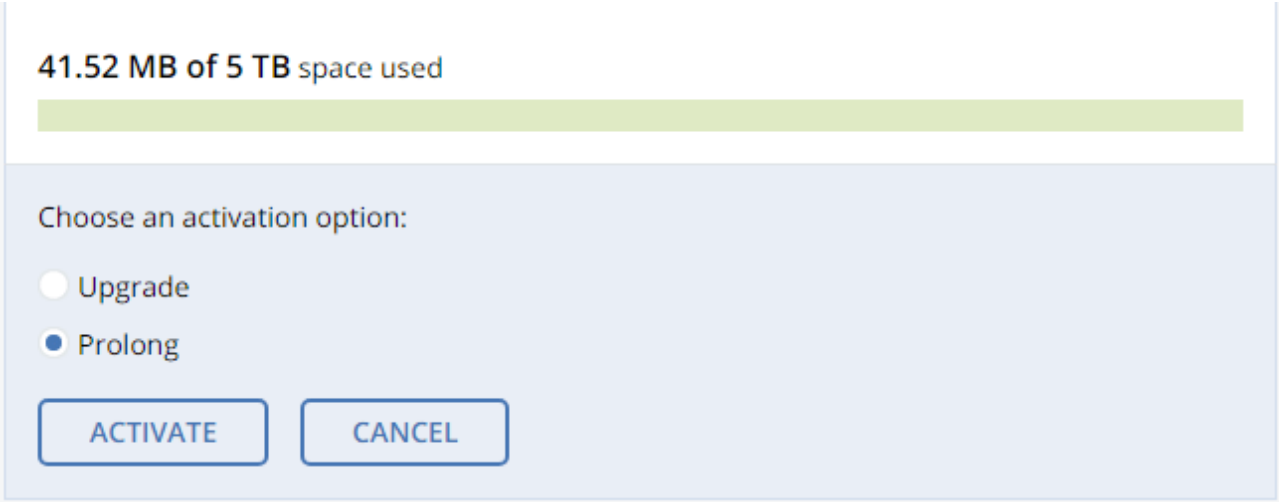
1. If you are switching from SPLA, ask your service provider to terminate the agreement by either disabling the **Software-Defined Infrastructure** application for your account or deleting the account.
2. On the **SETTINGS** > **Licenses** screen, click **Upgrade** and **Register key**.



3. In the **Register license key** window, paste the license key and click **REGISTER**.



4. Back on the **Licenses** screen, click **Activate** if you are activating from a trial or choose one of the following:



- **Upgrade**, to add storage capacity to the active license.
- **Prolong**, to prolong the soon-to-be-expired license.

And click **Activate**.

The expiration date or storage capacity will change according to what the key grants.

6.8.2 Installing SPLA Licenses

To install a SPLA license, do the following:

1. On the **SETTINGS** > **Licenses** screen, click **Upgrade** and **Use SPLA**.
2. In the **Use SPLA** window, select a region from the drop-down list and click **Activate**. You will be redirected to a login page of Acronis Data Cloud.

   Note: For more information on datacenters, see https://kb.acronis.com/servicesbydc.

3. Log in to Acronis Data Cloud.
4. In the **Register cluster** window, accept the license agreement.
5. In the registration confirmation window, click **Done**.

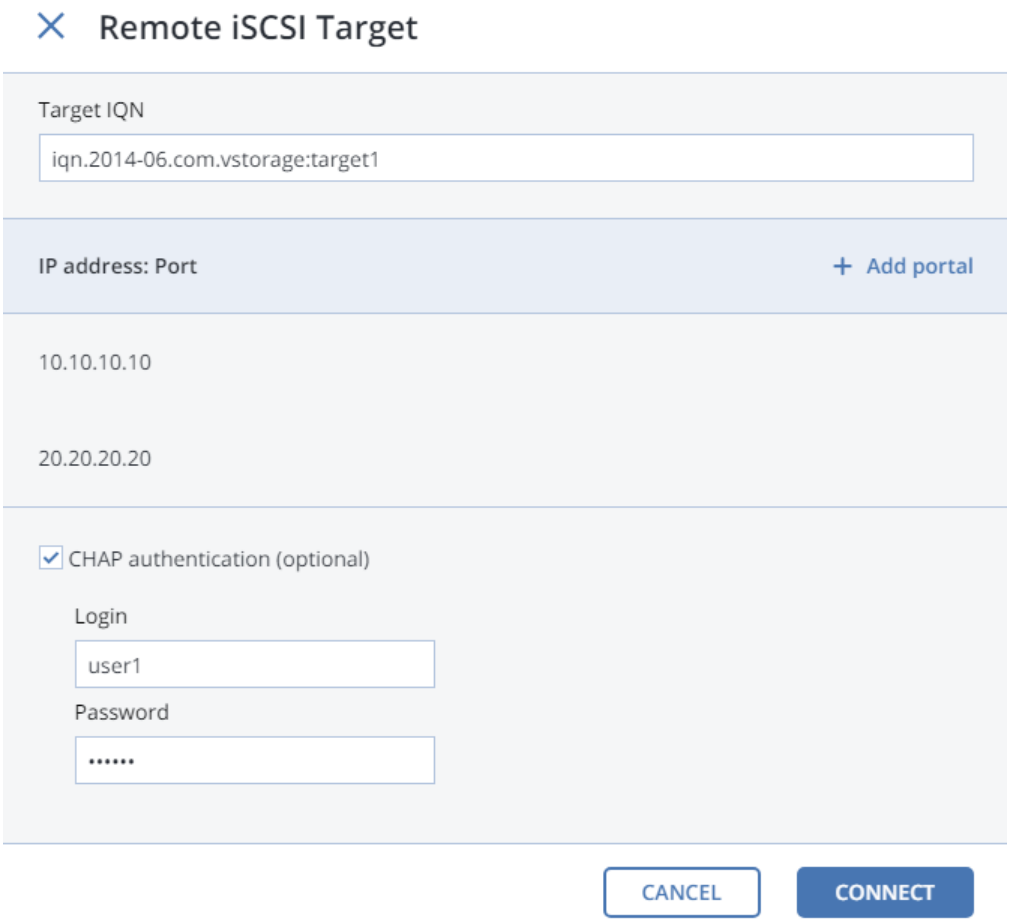
The registered cluster will show up in Acronis Data Cloud. You will be able to monitor its resource usage and download reports.

6.9 Connecting Remote iSCSI Devices to Storage Cluster Nodes

Acronis Software-Defined Infrastructure allows you to connect remote iSCSI devices to nodes and perceives their LUNs as storage disks. You can connect iSCSI devices to nodes at any time.

To connect a remote iSCSI device to a node, do the following:

1. On the **INFRASTRUCTURE** > **Nodes** screen, select a node, open its **DISKS** tab, and click **iSCSI target**.



2. In the **Remote iSCSI Target** window, do the following:
    1. Specify the IQN of the target.
    2. In the **Portal** and **Port** fields, specify the target's IP address and port (optional) and click the corresponding check icon.

3. (Optional) If the target has multiple paths, click **Add portal** and configure it as in the previous step.
4. (Optional) If necessary, check **CHAP authentication** and specify the credentials.
5. Click **Connect**.

Acronis Software-Defined Infrastructure will connect the target (i.e. all its LUNs) and initiate it; corresponding entries with the **iSCSI** type will appear in the node's **DISKS** list.

To remove the iSCSI target, click **iSCSI Target**, **DELETE CONNECTION**, and **DELETE**.

6.9.1 Assigning Disk Roles To Remote iSCSI Devices

If the node had already been in the cluster before you connected the iSCSI device to it, assign disk roles to all its LUNs. To do this:

1. Select a disk with the **iSCSI** type and click **Assign**.
2. In the **Choose role** window, select **Storage** and click **Done**.
3. Repeat the above steps for every disk with the **iSCSI** type.

Even though you can assign **Metadata** or **Cache** roles to such disks, it is recommended only for single-node ABGW installations with SAN-provided redundancy. For more information on disk roles, see *Assigning Disk Roles Manually* (page 15).

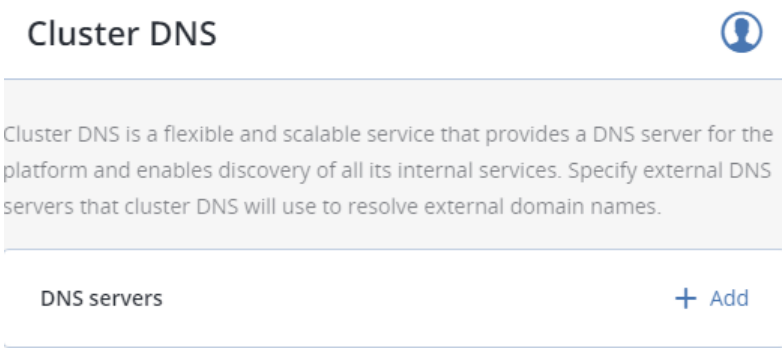
6.10 Adding External DNS Servers

Acronis Software-Defined Infrastructure features a built-in DNS server that enables discovery of all its internal services. For resolving external domain names, you can add DNS servers that already exist in your network infrastructure.

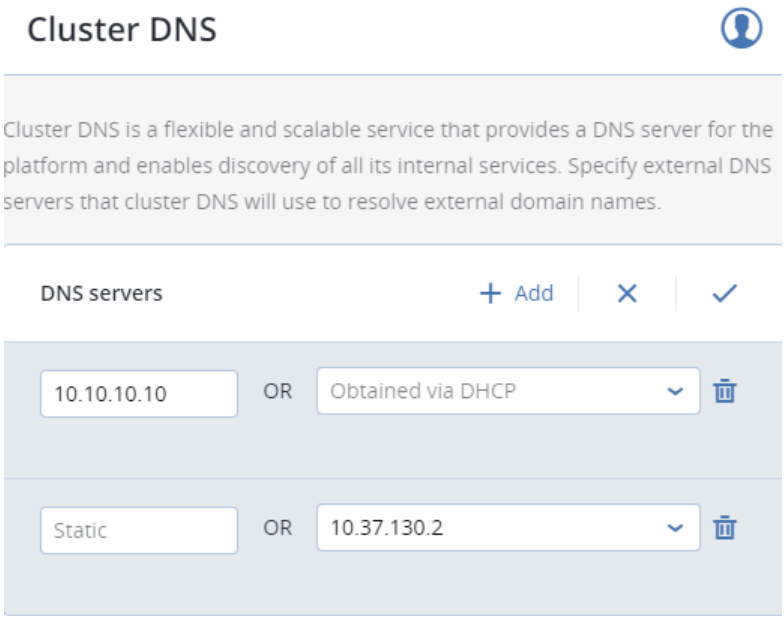
Important: Specify a DNS that belongs to a public network to be able to reach external locations like the updates repository as well as any public networks.

Do the following:

1. On the **SETTINGS** > **Cluster DNS** screen, click **Add**.



2. Either specify a static DNS IP address in the **Static** field or select a DHCP-provided DNS IP address from the list. Click **Add** multiple times to specify multiple external DNS servers.



3. Click the check mark icon to save changes.

6.11 Enabling RDMA

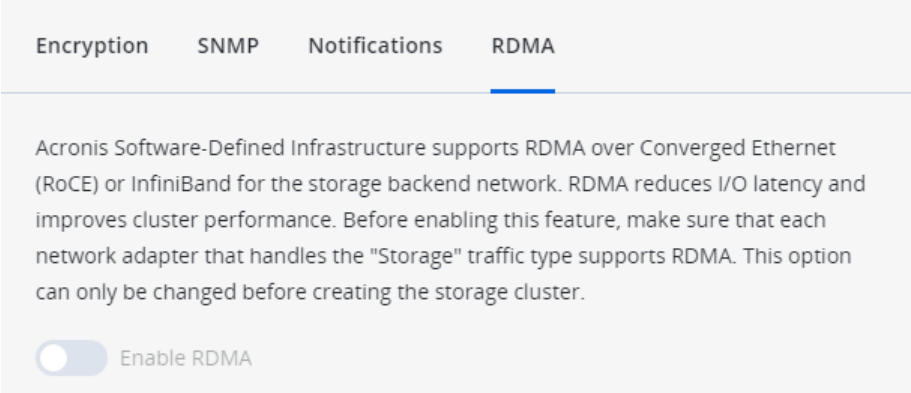
Acronis Software-Defined Infrastructure supports remote direct memory access (RDMA) over Converged Ethernet (RoCE), Internet Wide-area RDMA Protocol (iWARP), or InfiniBand (IB) for the storage backend network. The RDMA technology allows servers in this network to exchange data in main memory without involving their processors, cache or operating systems, thus freeing up resources and improving throughput and performance.

Your RDMA network infrastructure must be ready before you install Acronis Software-Defined Infrastructure.

Important: In the current version of Acronis Software-Defined Infrastructure, you can only enable (or disable) RDMA before creating the storage cluster.

By default, RDMA is disabled. Before enabling it, make sure that each network adapter connected to a network with the **Storage** traffic type supports RDMA.

To enable or disable RDMA, use the switcher on the **SETTINGS** > **Advanced settings** > **RDMA** tab. Changing this option may temporarily affect cluster availability.



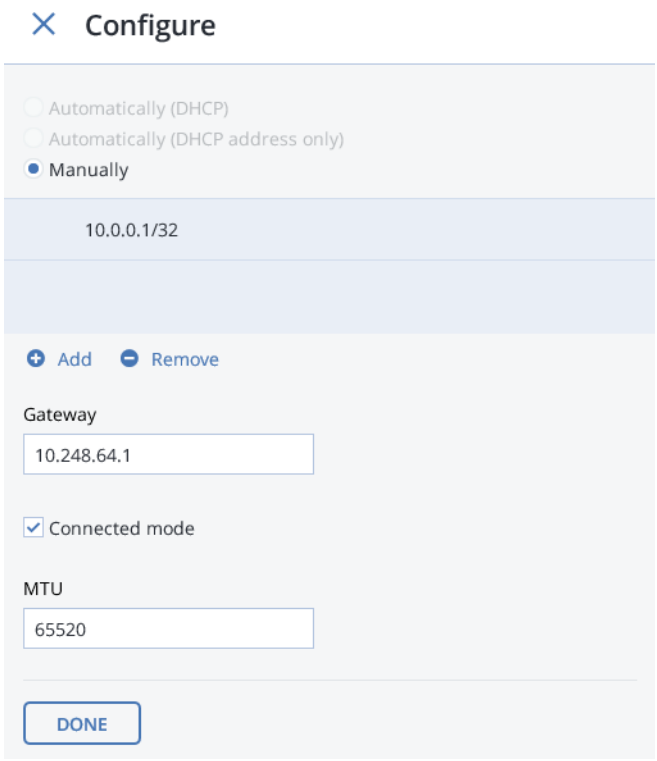
6.11.1 Configuring InfiniBand Devices

Note: As the admin panel only shows IP states and does not show InfiniBand connection states, it may report plugged in but yet unconfigured IB devices as **UNPLUGGED**. The status will change to **OK** once you assign an IP address to such a device.

If you have an InfiniBand infrastructure, do the following before enabling RDMA:

1. Assign the traffic type **Storage** to an empty network (without any other traffic types) on the **INFRASTRUCTURE** > **Networks** screen. Create a new network if needed by clicking **Edit** > **Create network**.
2. Configure each IB device on registered nodes:
    1. Open **INFRASTRUCTURE** > **Nodes** > <node> > **Network**, and select the device.
    2. Click **Configure**. In the pane that opens:

- Assign an IP address (**Manually** will be selected by default).
- Specify the gateway.
- Check the **Connected mode** box.
- Set MTU to 65520.



Click **DONE**.

3. Click **Assign network**. In the pane that opens, select the network with just the **Storage** traffic type and click **DONE**.

6.11.2 Configuring RoCE and iWARP Devices

If you have a RoCE or iWARP infrastructure, do the following for each network device in it before enabling RDMA:

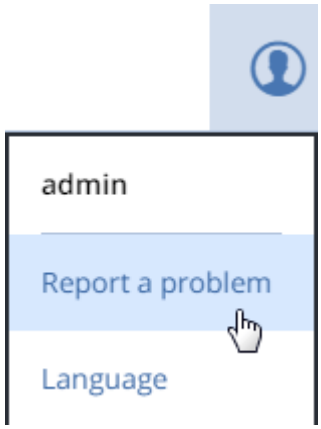
1. Open **INFRASTRUCTURE** > **Nodes** > <node> > **Network**, and select the device.
2. Click **Configure**. In the pane that opens, assign an IP address if the device does not have one yet and specify the gateway. Click **DONE**.

3. Click **Assign network**. In the pane that opens, select the network with the **Storage** traffic type (and possibly other traffic types like **Internal management**, **OSTOR private**, and **ABGW private**) and click **DONE**.

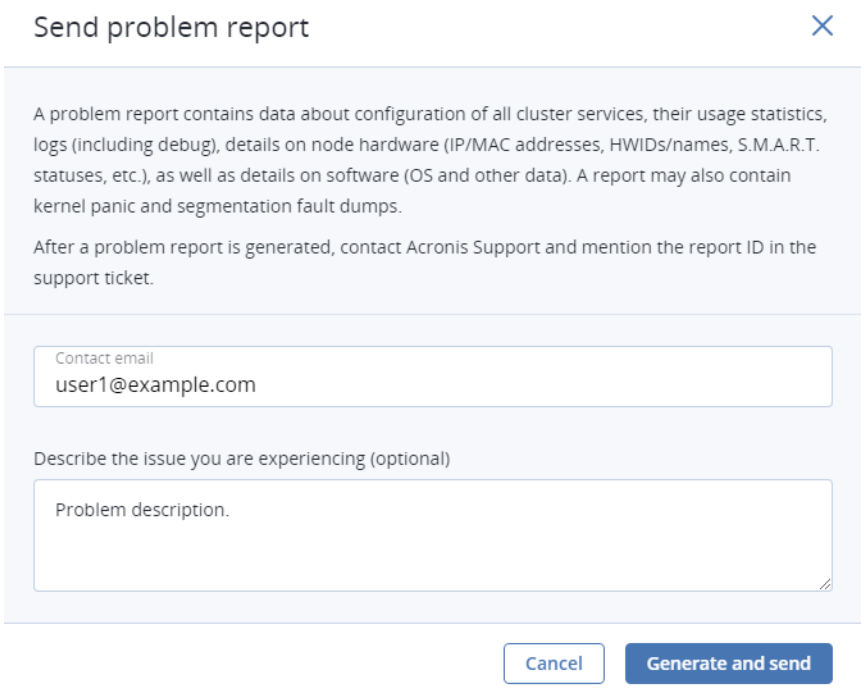
6.12 Sending Problem Reports

To send a problem report to the technical support team, do the following:

1. On any screen, click the user icon in the top right corner and select **Report a problem**.



2. Enter your contact email and a problem description in the corresponding fields and click **Generate and send**.



The problem report will be generated and assigned an ID. Make sure to mention this ID in the support ticket.