Accelerating Hyper-Converged Enterprise Virtualization using Proxmox and Ceph

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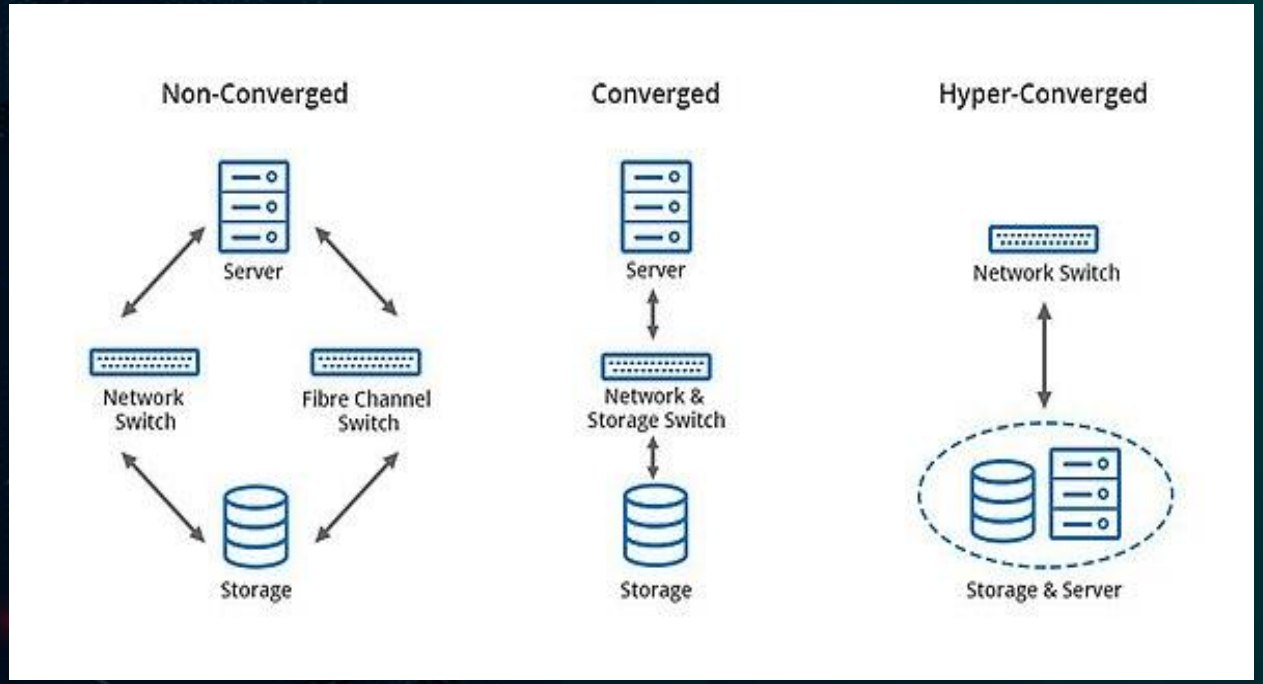
Hyper-Converged Infrastructure (HCI)

- ✓ **Hyper-converged infrastructure (HCI)** is a software-defined infrastructure that virtualizes all the elements of conventional "hardware-defined" systems.
- ✓ It's integrating computing (hypervisor), software-defined storage, and virtualized networking (software-defined networking).

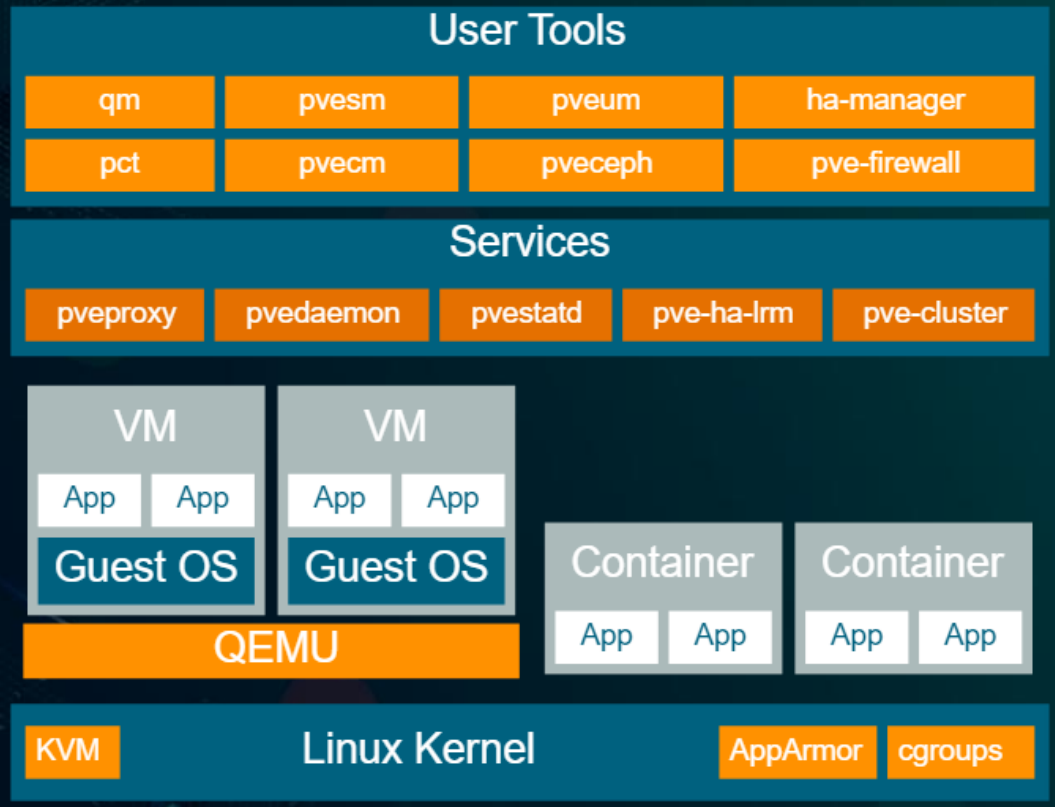


Difference between non-converged, converged and hyper-converged System
Image Source: Wikipedia

Proxmox Virtual Environment (Proxmox VE)

Proxmox Virtual Environment (Proxmox VE):

- ✓ Stands as a leading open-source virtualization platform
- ✓ That revolutionizes the way organizations manage and deploy virtualized workloads.



Proxmox VE Architecture
Source: Proxmox.com

Key Features and Advantages of Ceph

KVM and LXC:
KVM for VM and LXC for containerization

High Availability:
Live Migration and Fault Tolerance minimizing downtime

Backup and Restore:
Built-in backup and restore provide data protection and recovery capabilities.

Web-Based Management:
Web-based interface makes it user-friendly, to manage Proxmox

Storage Integration:
Support ZFS, Ceph, NAS and SAN Storage for flexible and scalable management.

Resource Management:
Precise resource allocation of CPU, Memory, and Storage.

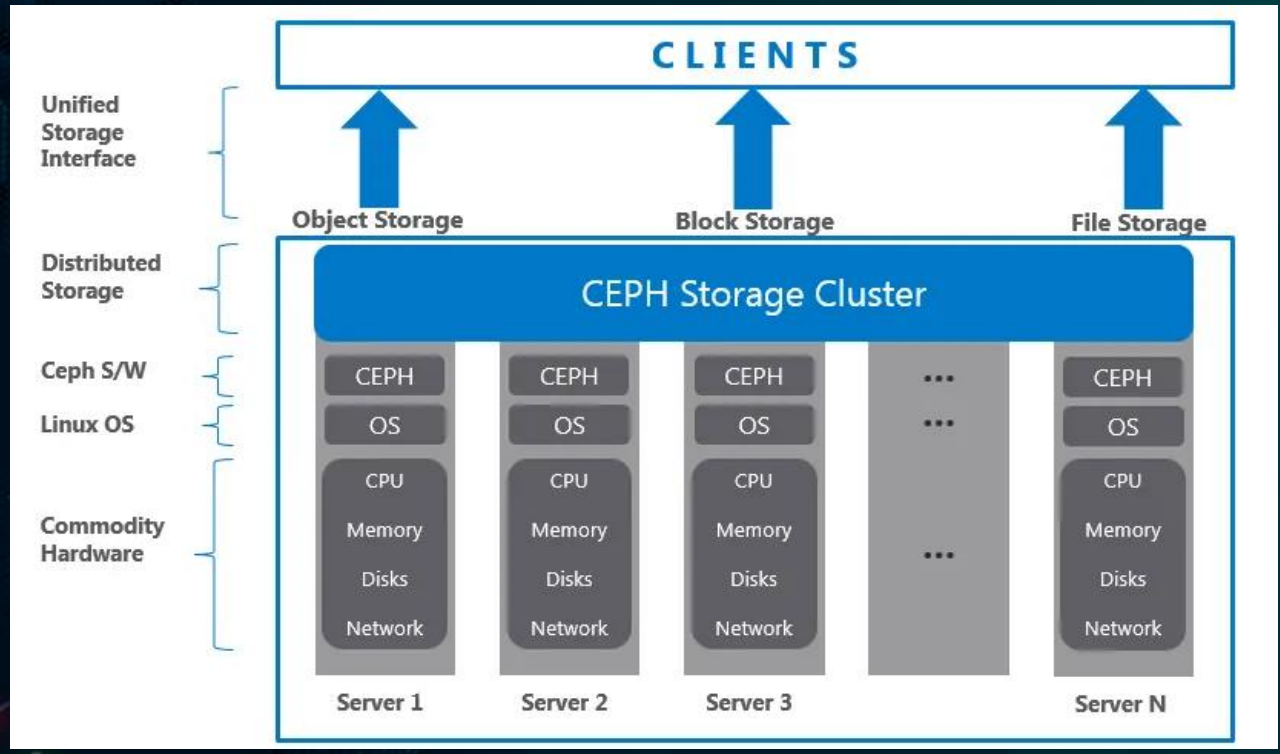
Ceph Storage

Open source, software-defined storage, Support of block, object, and file storage.

Ceph clusters run on any hardware with the help of CRUSH algorithm

Distributes data across the clustered nodes for highly fault-tolerant and scalable storage

Ensures data is both resilient and readily available, even in the hardware failures.



Ceph Cluster Architecture
Image Source: Medium.com

Key Features and Advantages of Ceph

Scalability:
Scales effortlessly by adding more nodes making it suitable for enterprises storage needs.

Data Redundancy:
Redundancy techniques, like replication and erasure coding, to protect data loss and data integrity.

Self-Healing:
Its self-healing capability, automatically detect and repair data inconsistencies, ensuring data consistency and reliability.

Block and File Storage:
Block storage for virtual machines and containers and file storage for shared data access.

Distributed Object Store:
RADOS (Reliable Autonomic Distributed Object Store) forms distributed storage

Ceph Cluster components

OSD (Object Storage Daemon):
Each node runs one or more OSD daemons (one per disk).
It does all data storage, replication and data recovery operations.

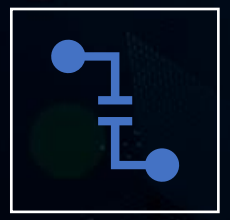
Rados Gateway:
delivers an api service and it connect via S3 or Swift directly with Ceph.

Ceph Manager:
Provide additional monitoring and interfaces to external monitoring and management systems.

Monitor:
Responsible for maintaining a master copy of the cluster map. The Ceph cluster needs a minimum quorum of 3 or more to ensure high availability

Metadata Server: MDS handles all file operations and uses RADOS objects to store data and file system attributes.

Managing Data with Ceph



Ceph Object Storage:

Automatically replicated across different storage devices.

The CRUSH algorithm, a scalable hashing technique, controls how the objects are distributed and accessed, thus avoiding any single point of failure.

Block Storage:

Block Devices, or RADOS Block Devices (RBD), allows Ceph to interact with block storage.

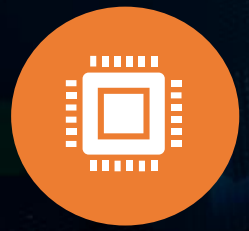
Providing storage solution for virtual machines and support thin provisioning and cache tiering

Ceph File System:

It's a POSIX-compliant file system that uses a Ceph Storage Cluster to store data

Allowing for the usual file operations while adding scalability, reliability, and performance.

Deployment Considerations



Compute nodes: ensure that, compute nodes meet the minimum requirements for proxmox VE. Consider factors like CPU capacity, RAM, and storage.

Storage nodes:

for ceph storage, dedicate nodes with ample storage capacity.

Disk speed and redundancy are critical considerations.

Networking:

high-speed and low-latency networking is essential.

Implement redundant network connections to ensure reliability.

Separation of traffic: for management, storage, and VM/container workloads.

This separation improves security, simplifies troubleshooting, and optimizes performance.

Disadvantages of Proxmox VE

Learning Curve:

Proxmox VE, while user-friendly, may still have a learning curve for those new to virtualization and HCI technologies.

Limited Support:

While Proxmox offers community support, enterprise-level support options are available but at an additional cost.

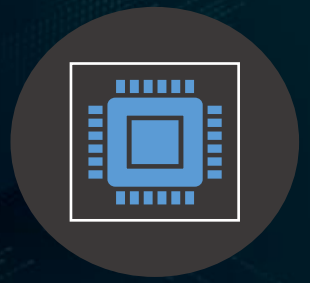
Compatibility:

Proxmox VE primarily supports KVM for virtualization, which may not be compatible with all operating systems or software applications.

Disadvantages of Ceph

Complexity:

its distributed and highly configurable nature, can be complex to set up and manage, especially for those without prior experience.



Resource Intensive:

Ceph can be resource-intensive, particularly in terms of CPU and memory usage.

Data Recovery:

While Ceph is known for its self-healing capabilities, data recovery from failed nodes or storage pools can be time-consuming and may require expertise.

Network Dependencies:

Ceph relies heavily on a high-speed and low-latency network.

Organizations with network constraints may experience performance bottlenecks

Performance Comparison Local Storage vs Ceph

- ✓ **Disk Read/Write Speed in Local Storage:**

```
mahedi@dns1:~$ sudo hdparm -tT /dev/xvda

/dev/xvda:
 Timing cached reads:   17316 MB in  1.99 seconds = 8702.99 MB/sec
 Timing buffered disk reads: 1032 MB in  3.00 seconds = 343.76 MB/sec
mahedi@dns1:~$ sudo dd if=/dev/zero of=test bs=10G count=1 oflag=direct
0+1 records in
0+1 records out
2147479552 bytes (2.1 GB, 2.0 GiB) copied, 8.70109 s, 247 MB/s
```

- ✓ **Disk Read/Write Speed in Ceph Storage:**

```
[root@oia ~]# sudo hdparm -tT /dev/sda

/dev/sda:
 Timing cached reads:   21354 MB in  1.99 seconds = 10733.85 MB/sec
 Timing buffered disk reads: 4042 MB in  3.00 seconds = 1346.62 MB/sec
[root@oia ~]#
[root@oia ~]# sudo dd if=/dev/zero of=test bs=10G count=1 oflag=direct
0+1 records in
0+1 records out
2147479552 bytes (2.1 GB, 2.0 GiB) copied, 2.3077 s, 931 MB/s
```

Case Study of Dhaka University

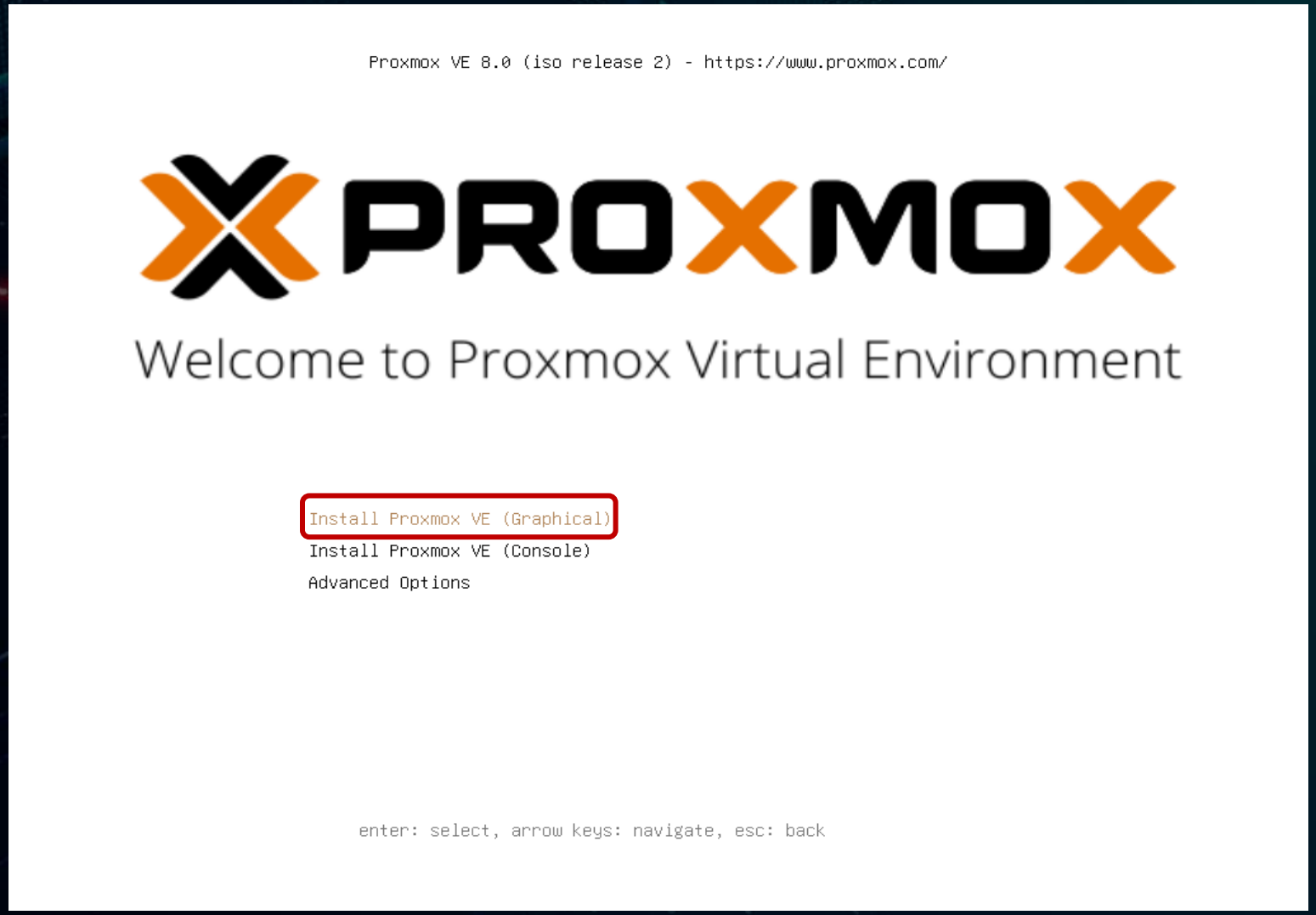
- ✓ **Before Proxmox:**
  - ✓ We are using VMware ESXi virtualization on servers in a rack, but we cannot use clustering due to licensing issues. And licensing costs are higher than our server hardware costs.
  - ✓ When we purchased another rack of servers, we encountered the same issue regarding commercial licensing for virtualization.
  - ✓ We then started using Xenserver, but its free version has limited features.
  - ✓ Meanwhile, ZenServer has stopped providing free version since its new version.
  - ✓ It would not have been possible to ensure high availability as there was no clustering.
  - ✓ We need hyper-converged solutions to ensure high availability and robust performance.

Case Study of Dhaka University

- ✓ **After Proxmox:**
  - ✓ We choose Proxmox and Ceph, which are completely free with no feature restrictions.
  - ✓ Its hyper-converged clustering solutions ensure high availability and automated fault tolerance for our applications.
- ✓ **Benefit:**
  - ✓ This saves roughly $5K/year per server.
  - ✓ Due to the use of Ceph with this, we don't need extra storage devices like SAN.
  - ✓ Overall, the availability of our application is more assured than ever.
  - ✓ Ensure Uptime up to 99.99%

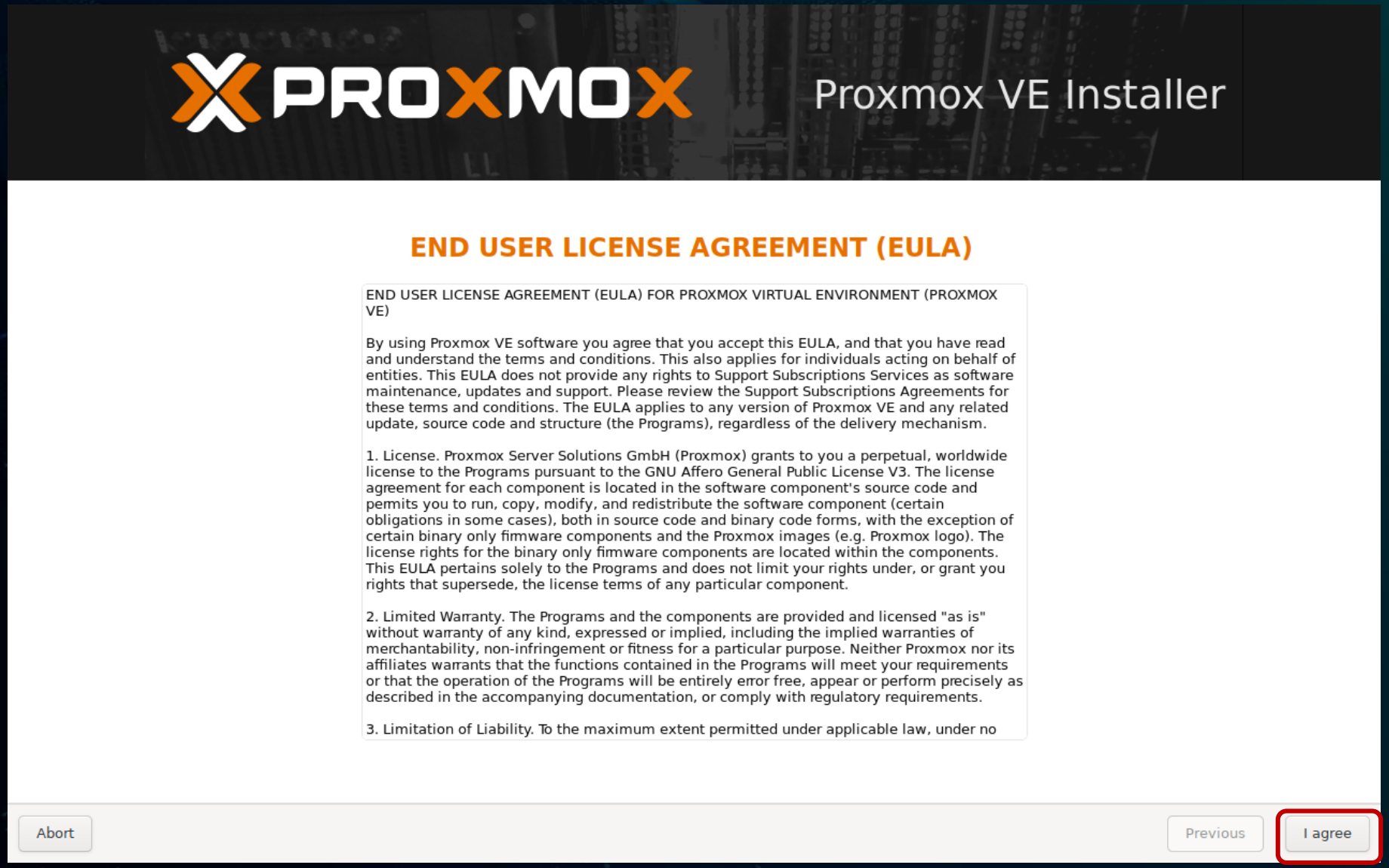
Install Proxmox

✓ Boot Proxmox:



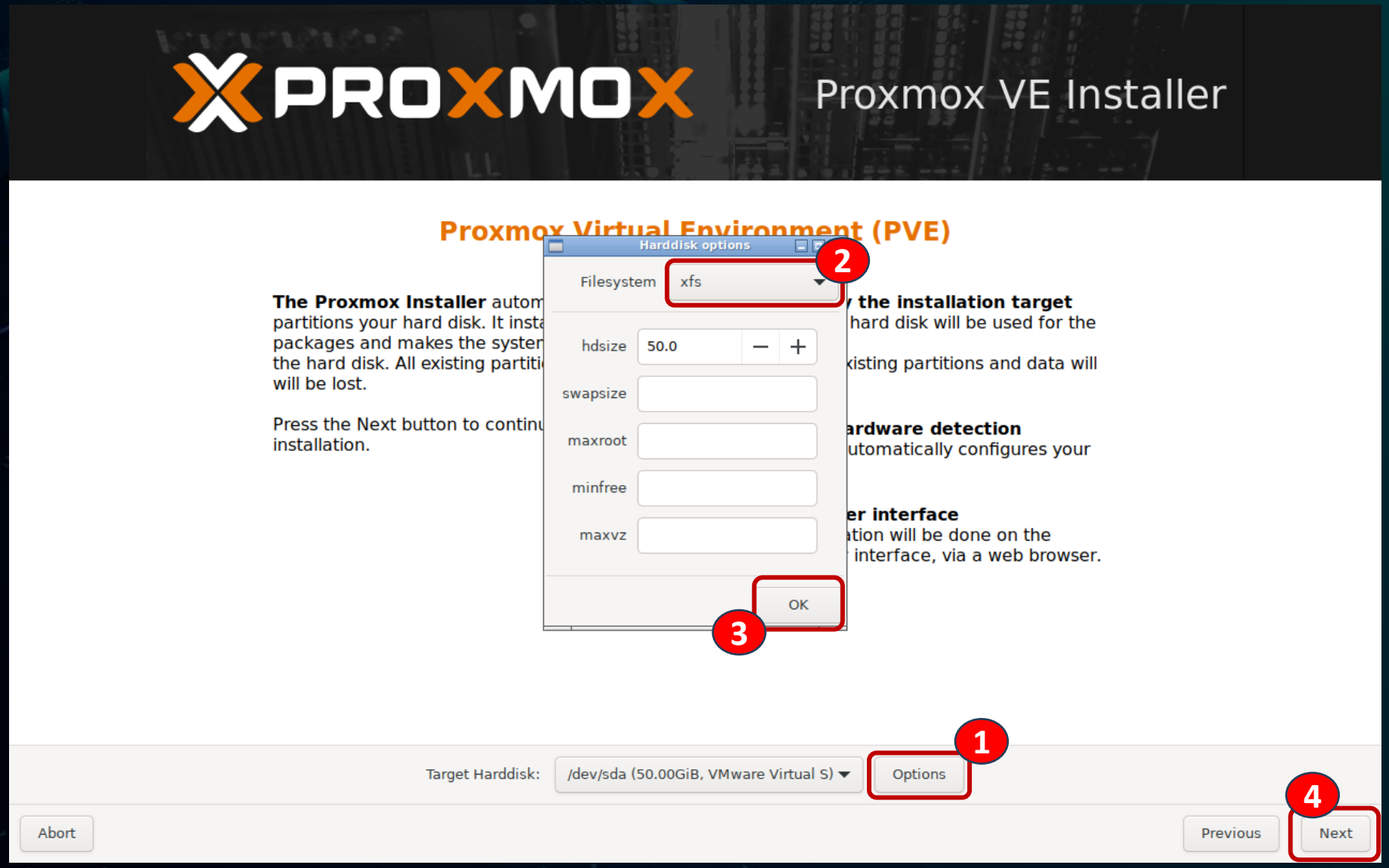
Install Proxmox

✓ Accept license agreement:



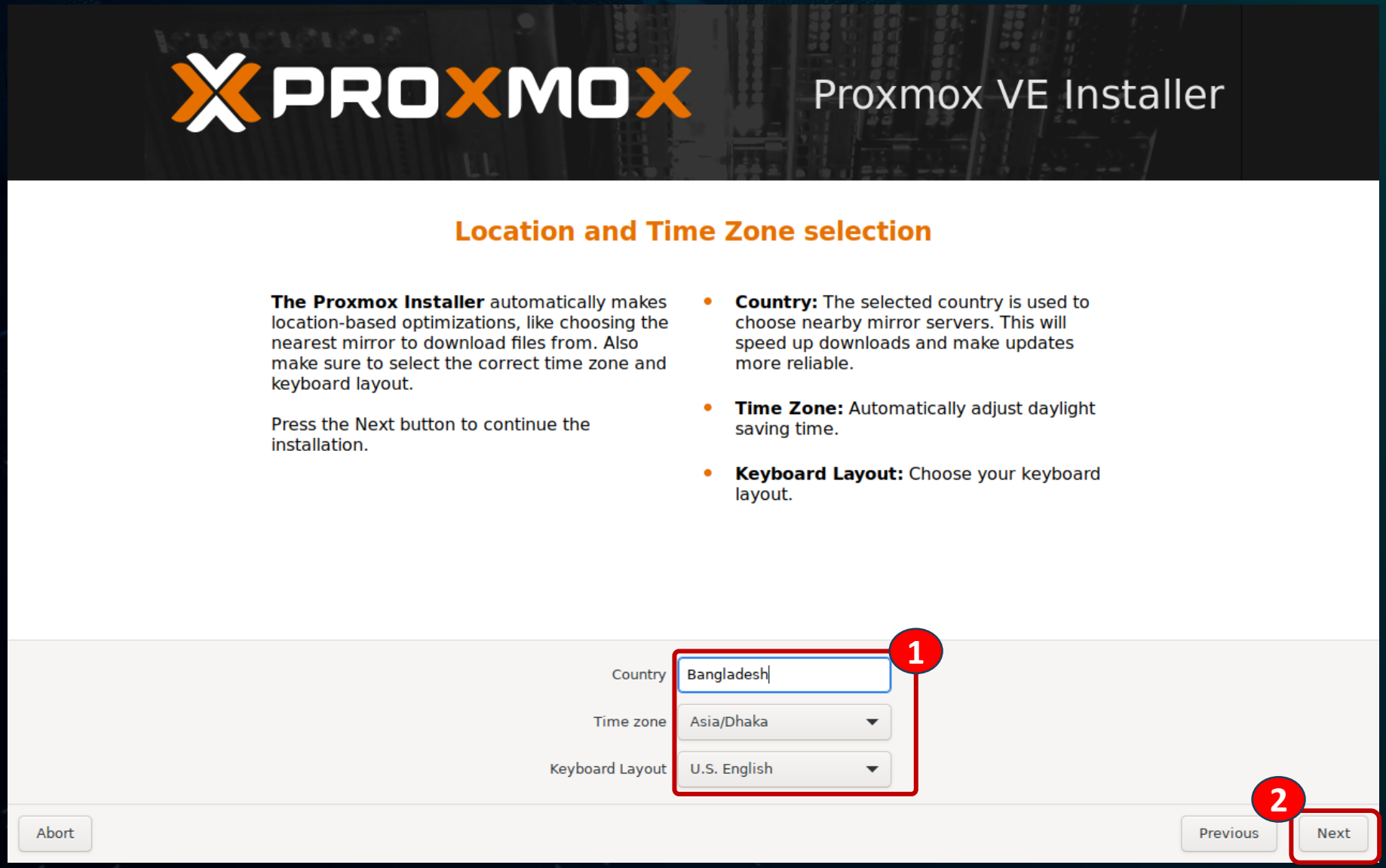
Install Proxmox

✓ Configure Disk:



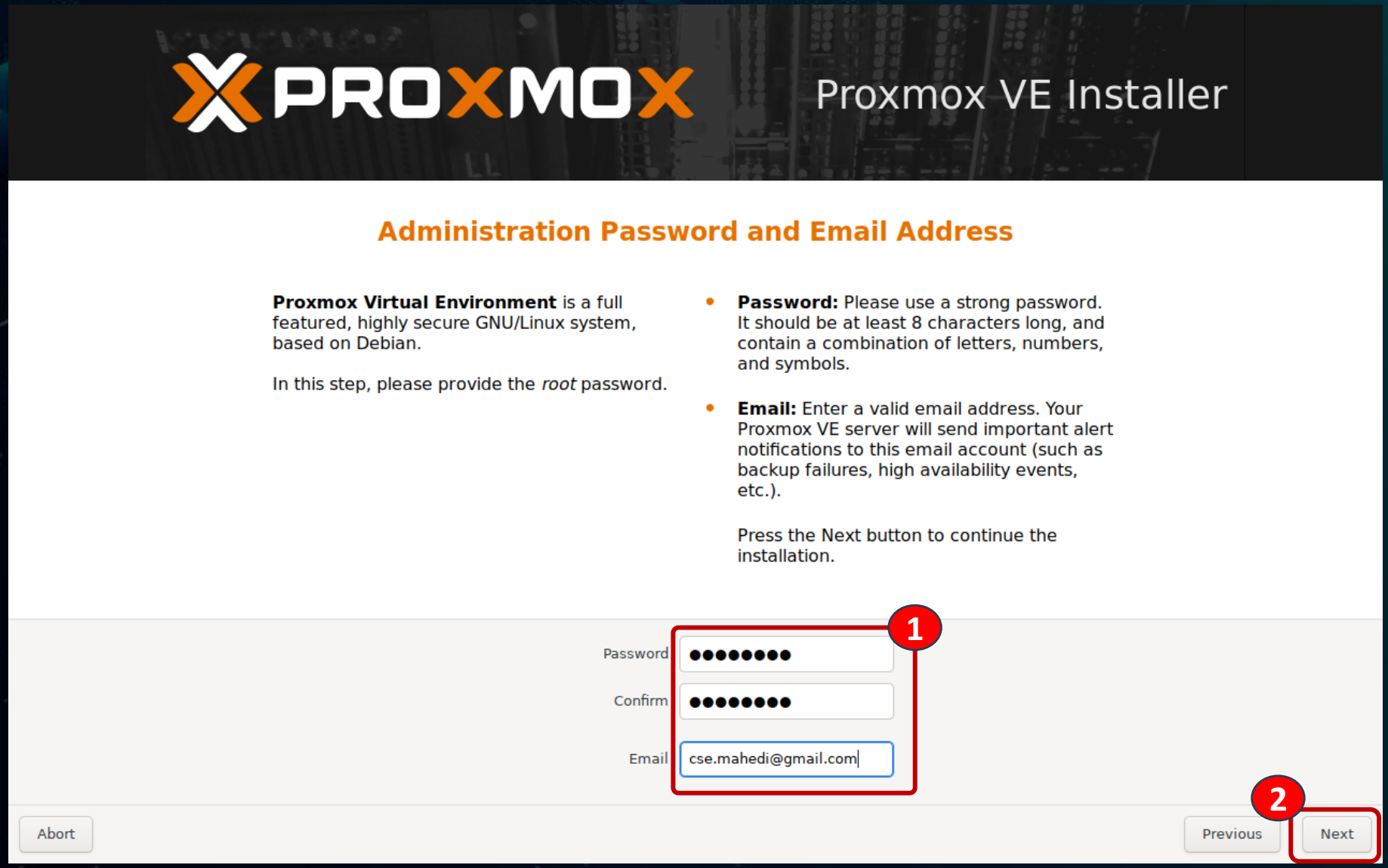
Install Proxmox

✓ Set Location and Timezone:



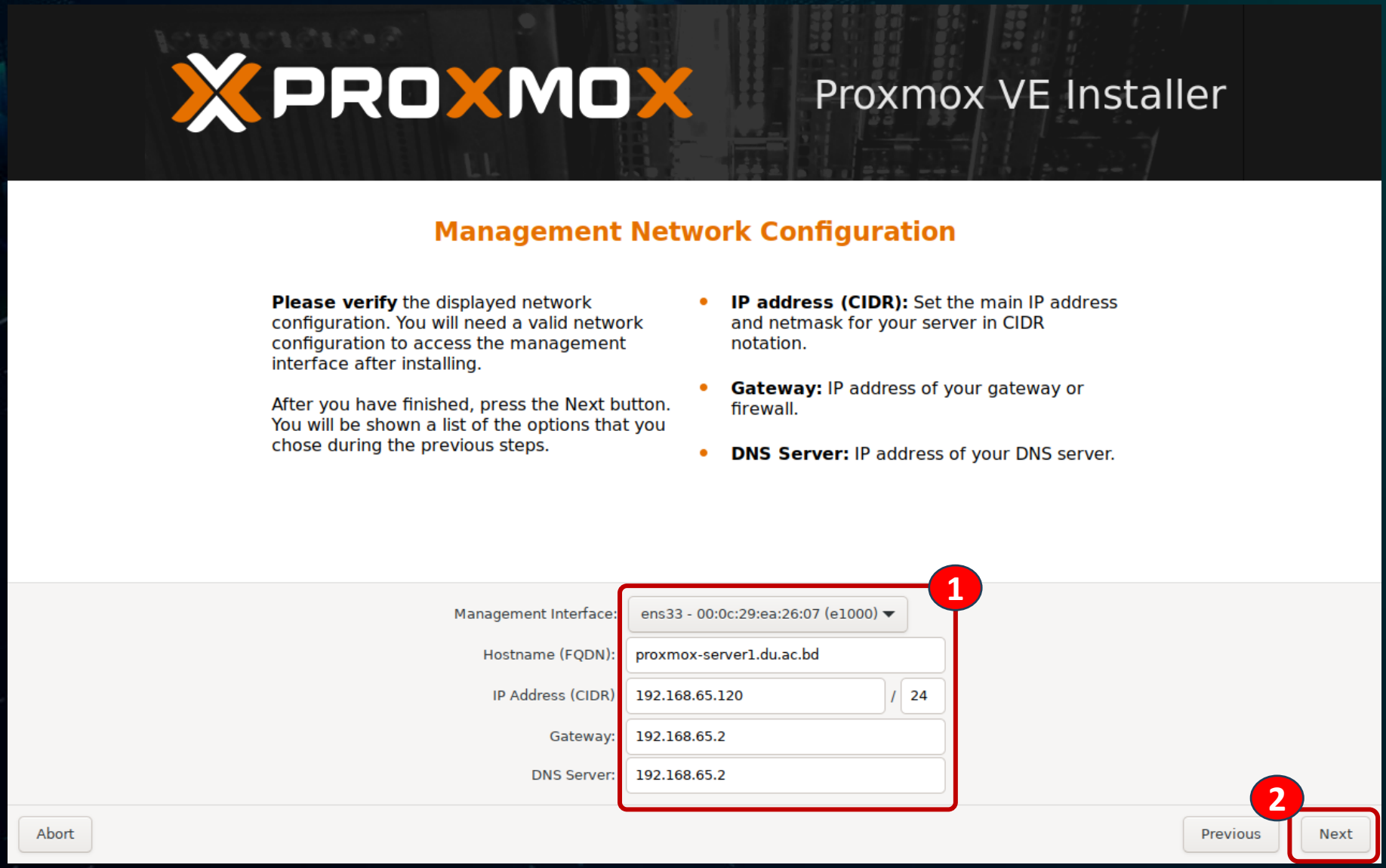
Install Proxmox

✓ Configure Root password and Email:



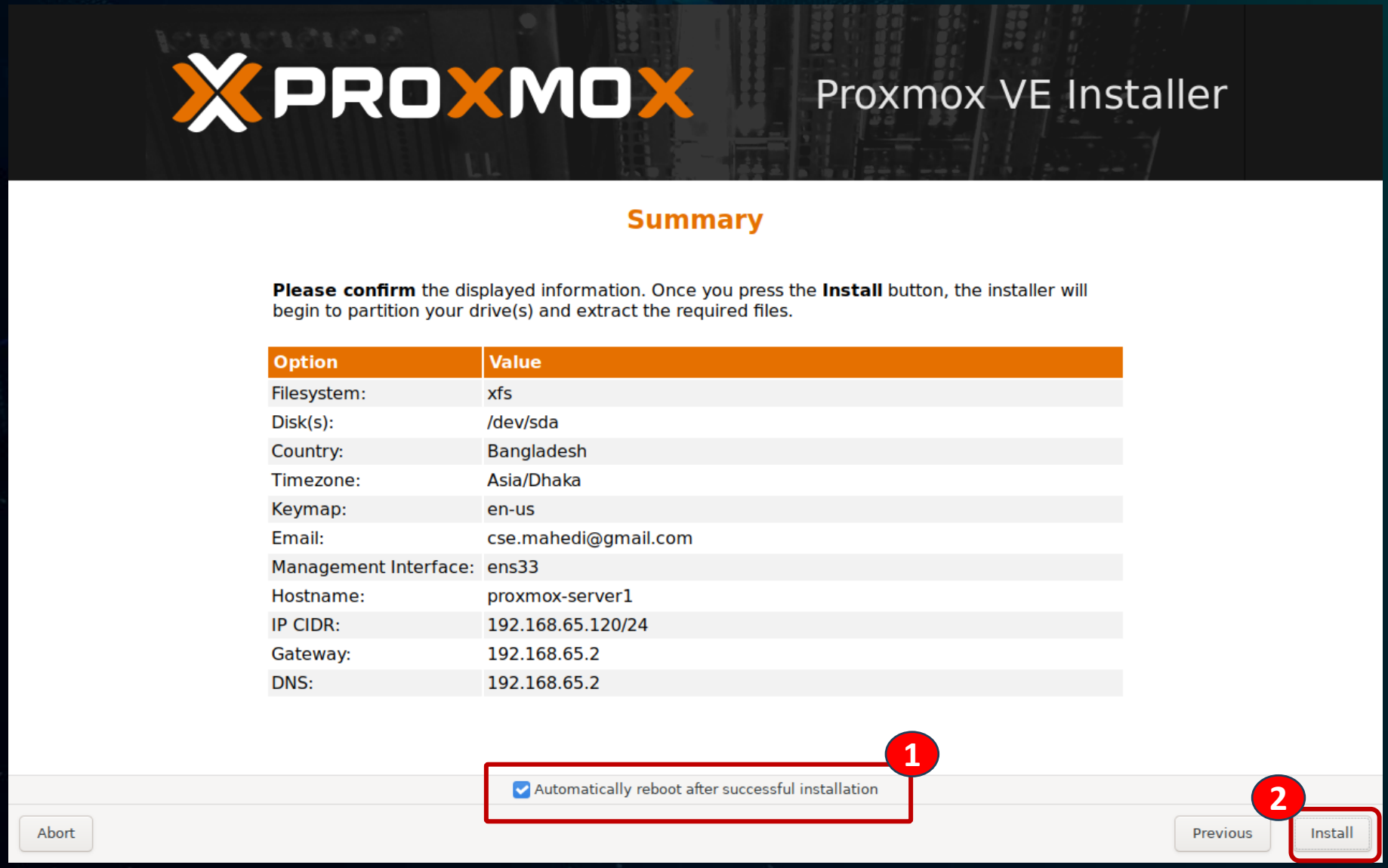
Install Proxmox

✓ Set Hostname and Configure Network:



Install Proxmox

✓ Check Summary and Start Install:



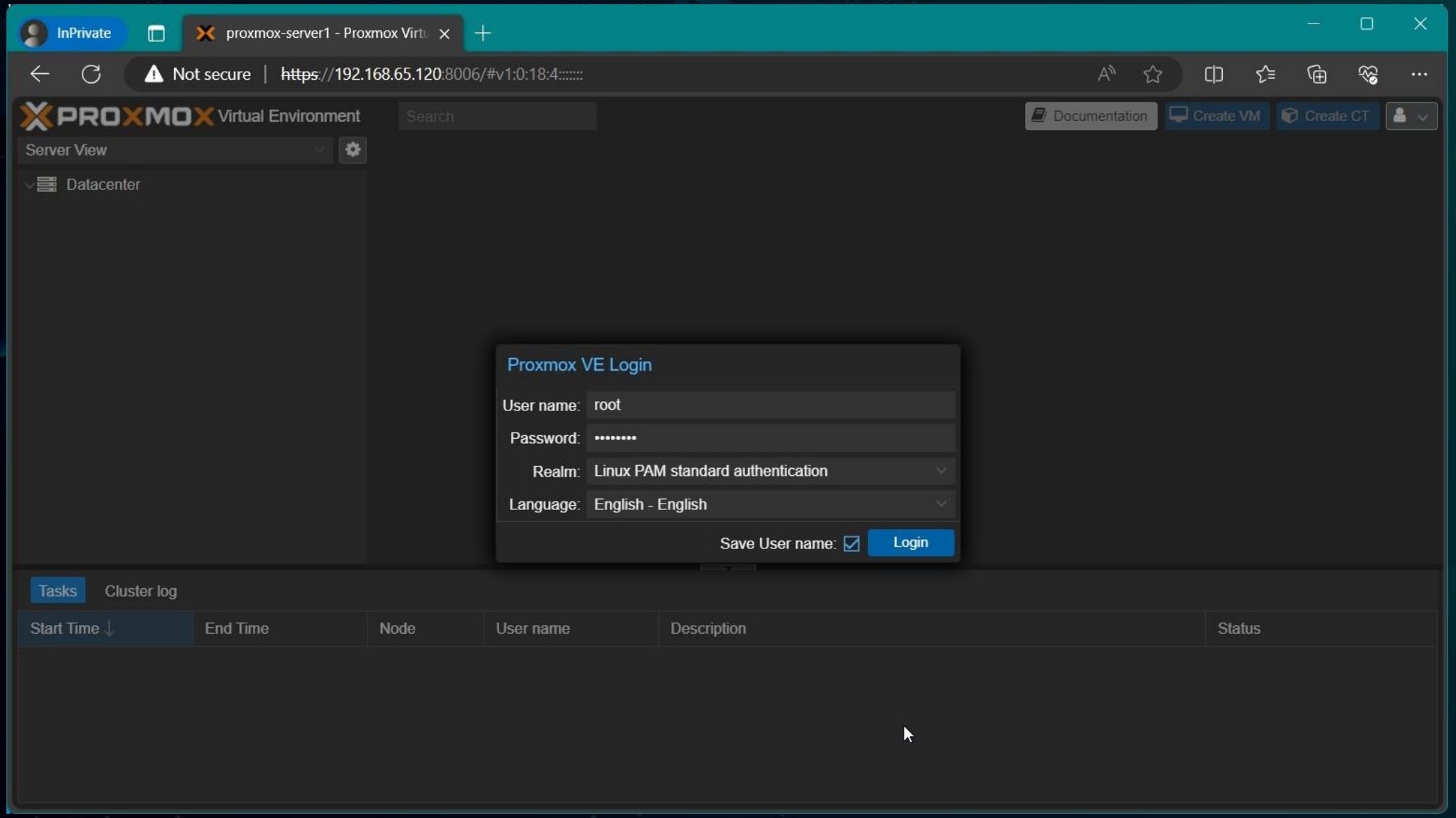
Install Proxmox

✓ Proxmox Login:

```
--------------------------------------------------------------------------------

Welcome to the Proxmox Virtual Environment. Please use your web browser to
configure this server - connect to:

  https://192.168.65.120:8006/

--------------------------------------------------------------------------------

proxmox-server1 login: _
```

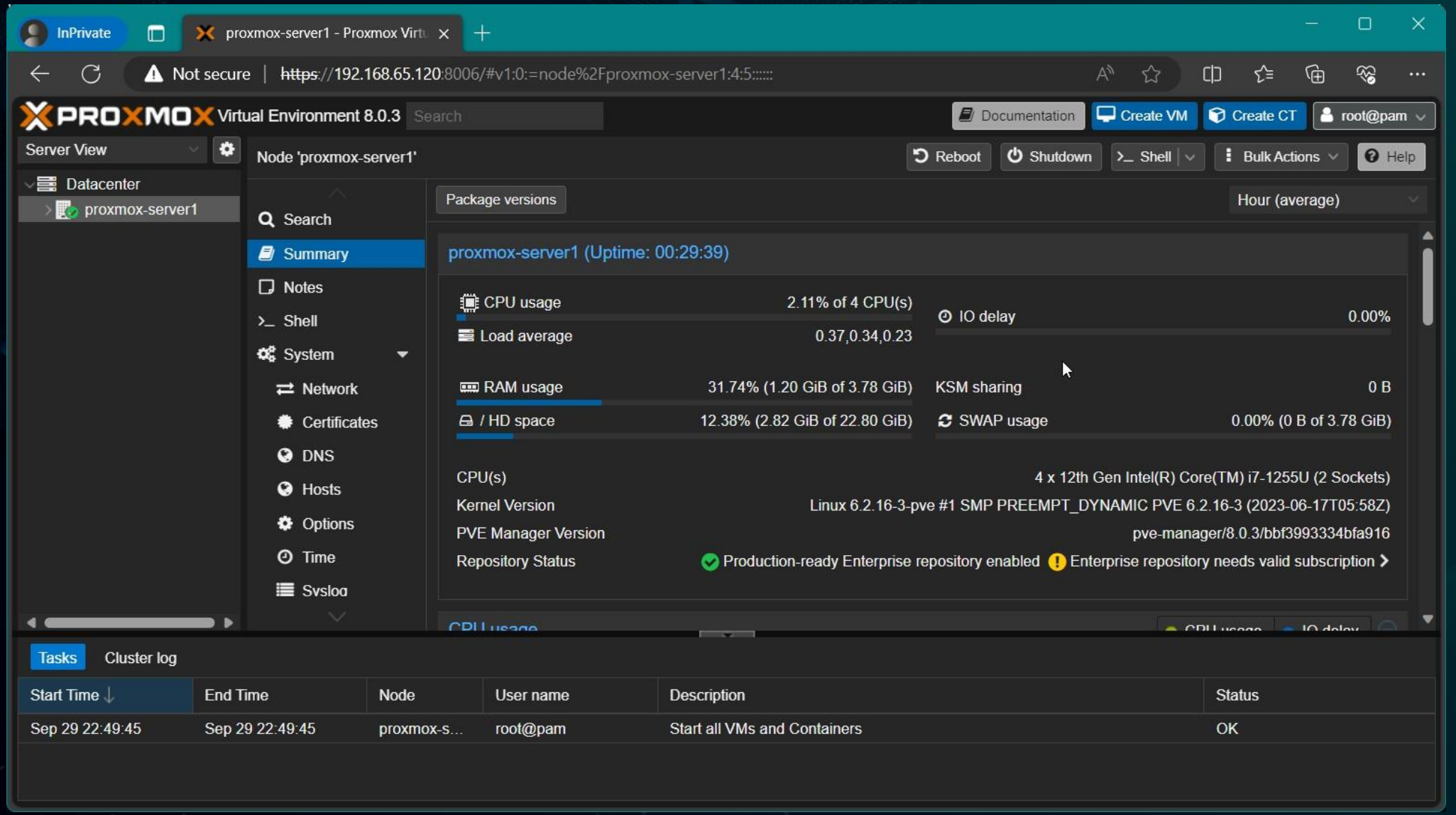
Install Proxmox

✓ Login from browser:

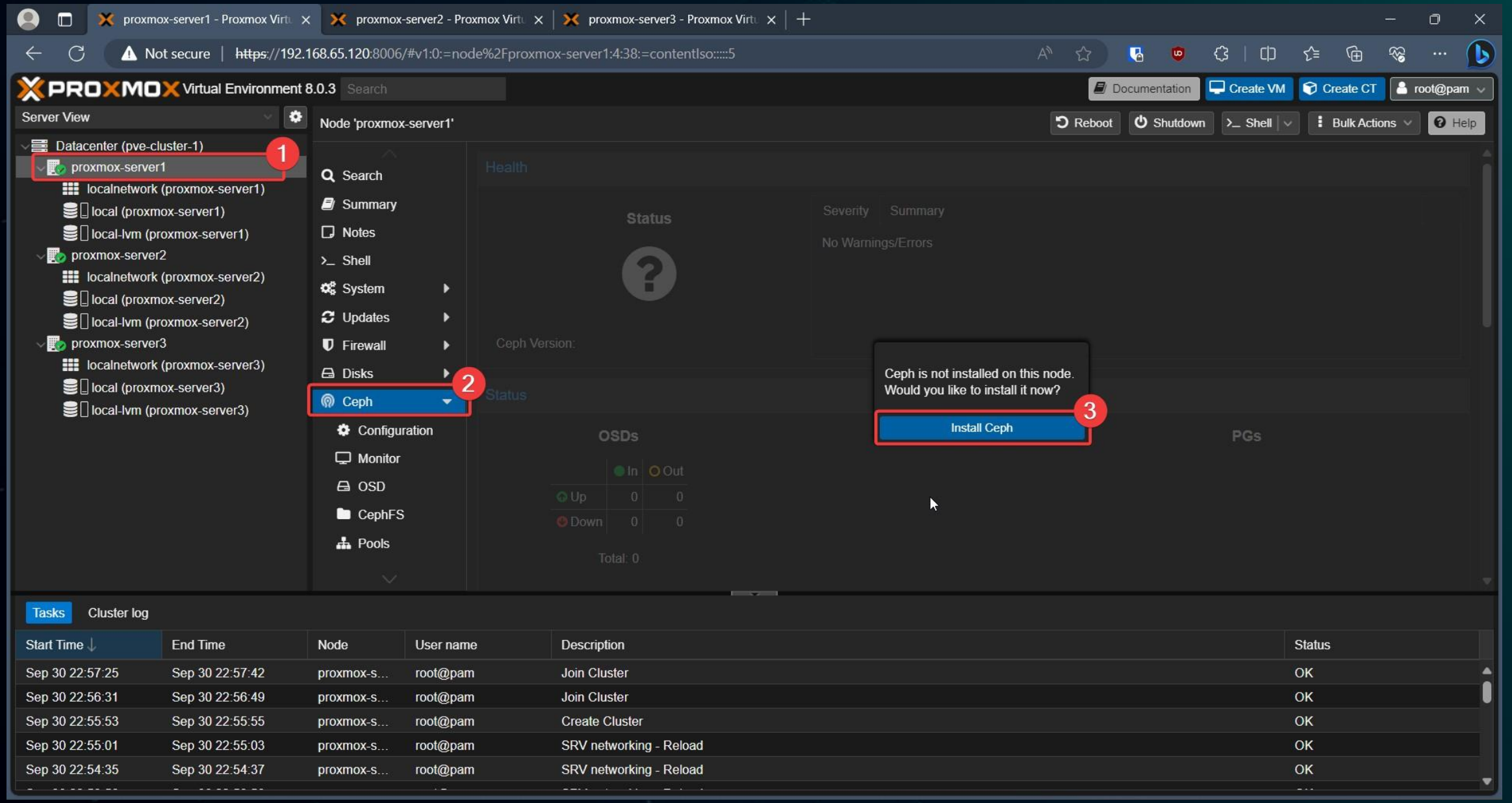


Install Proxmox

✓ User Dashboard:



Steps to Install Ceph on Proxmox



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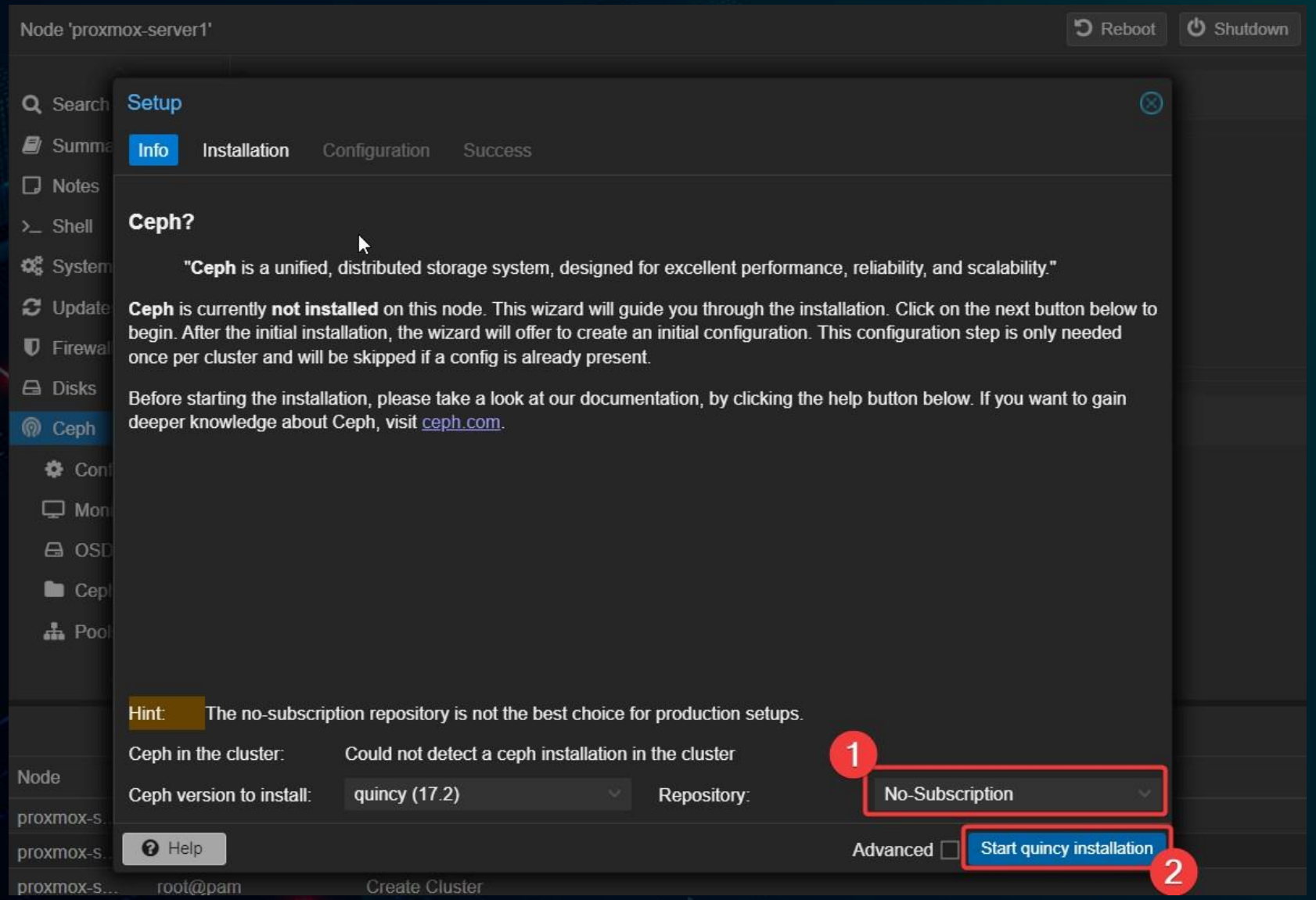

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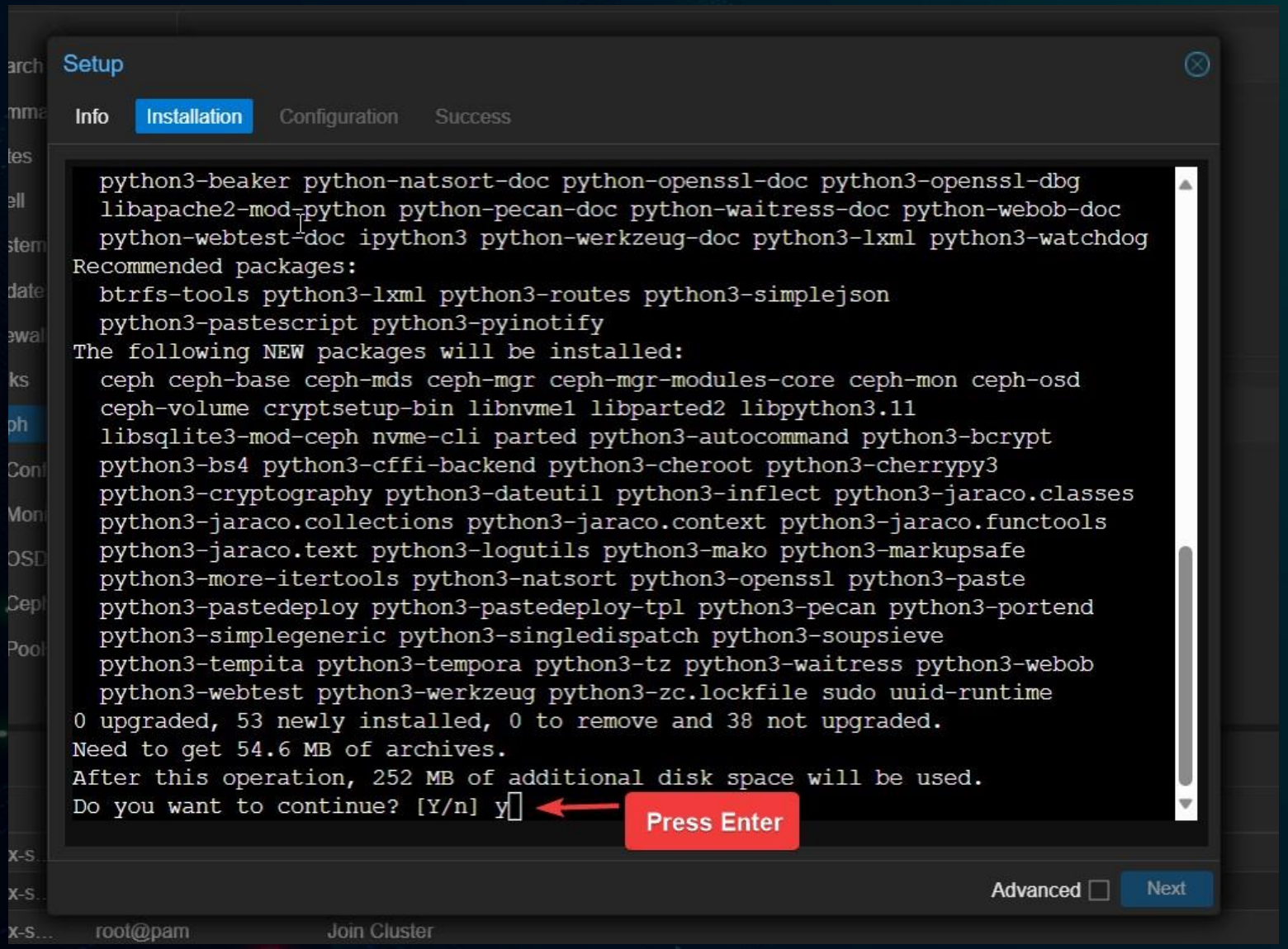

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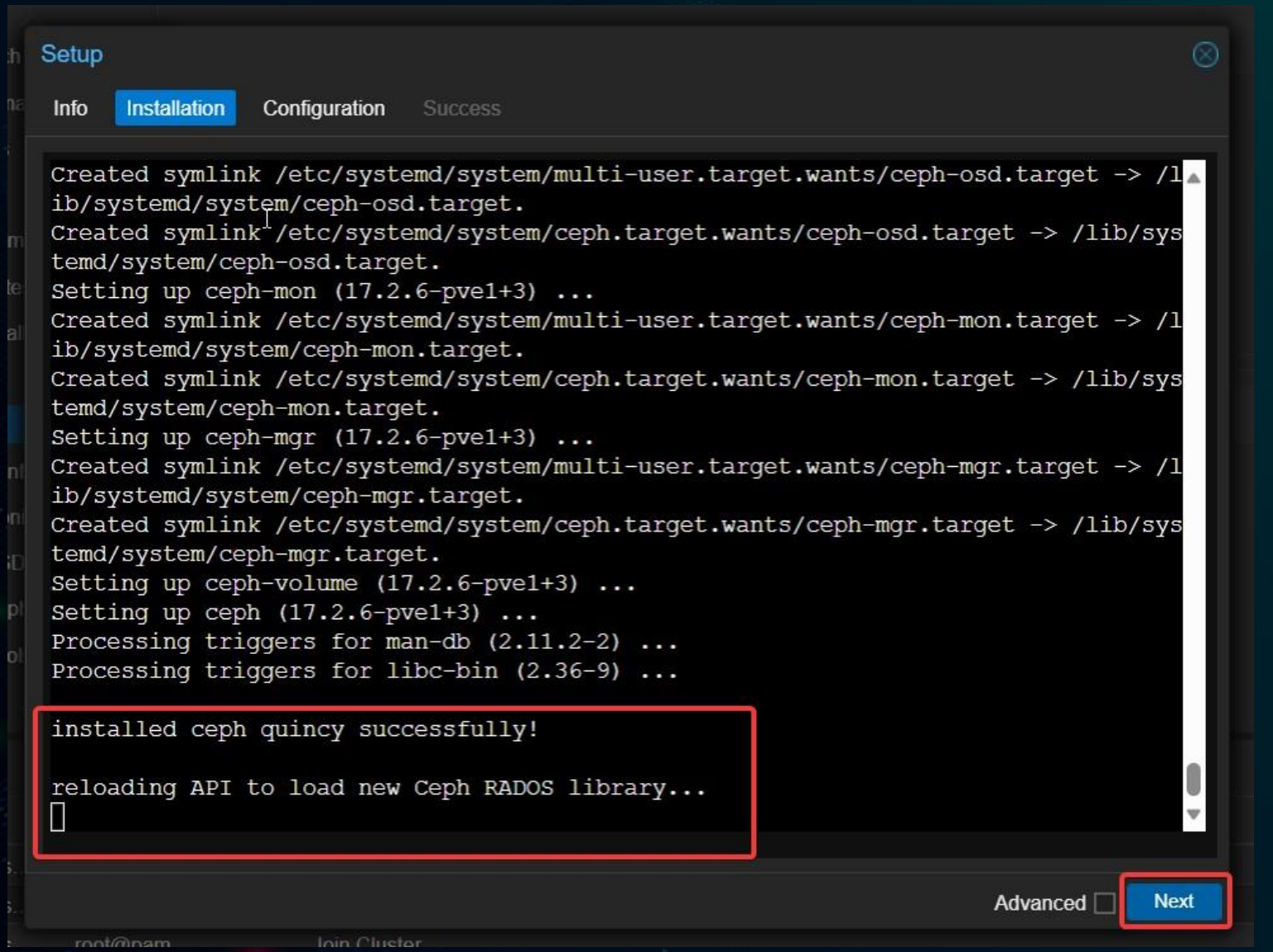

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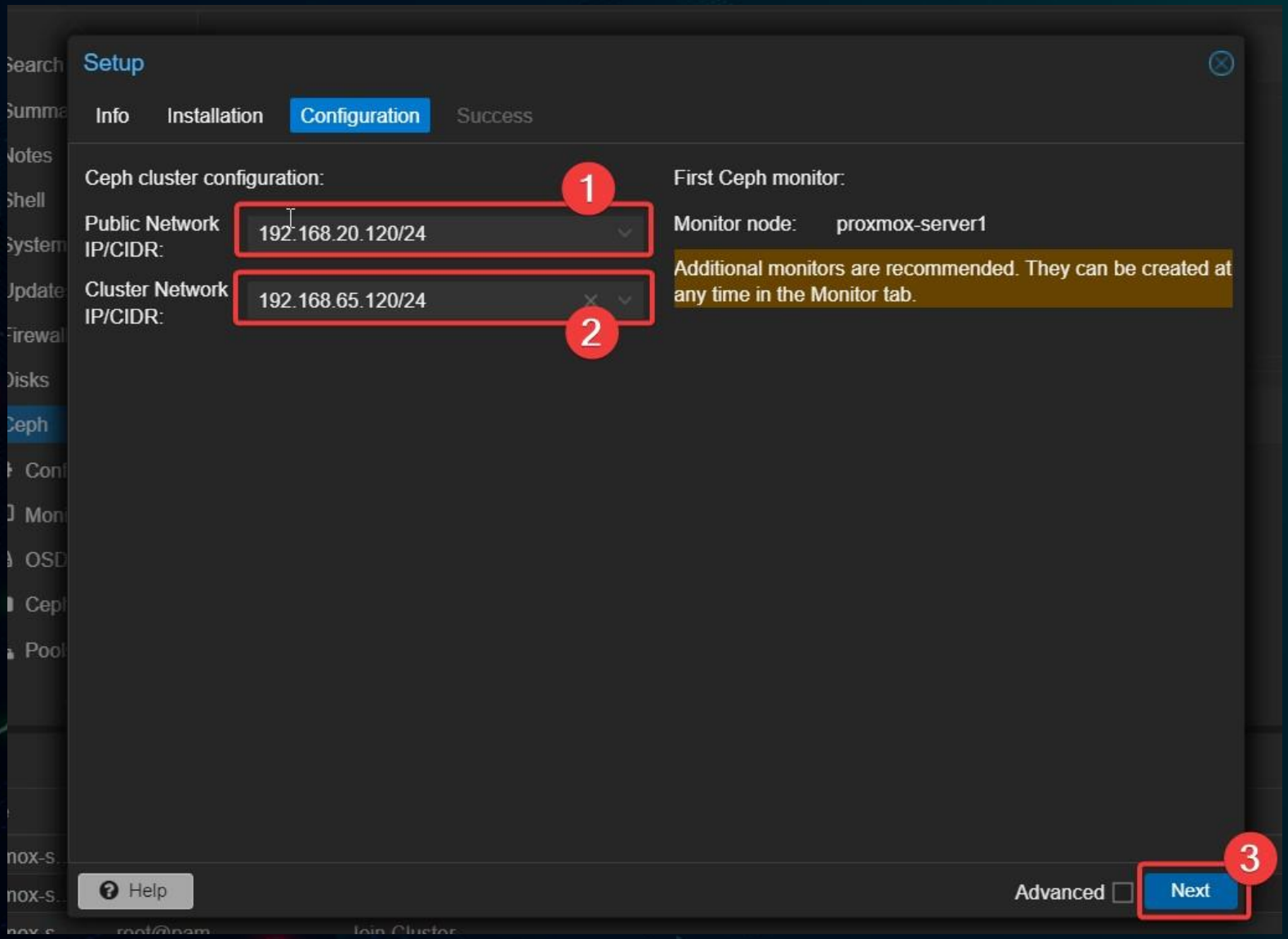
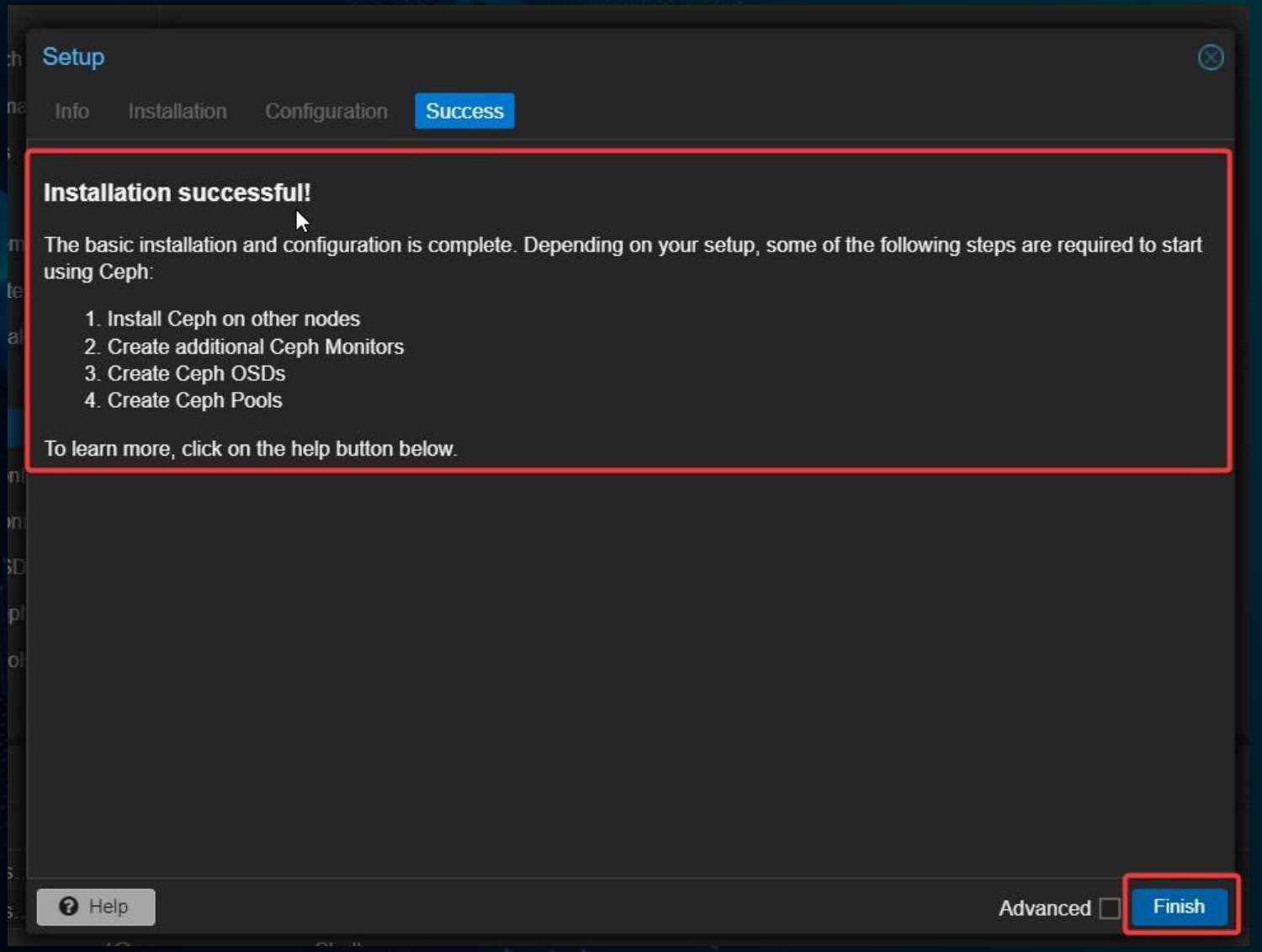
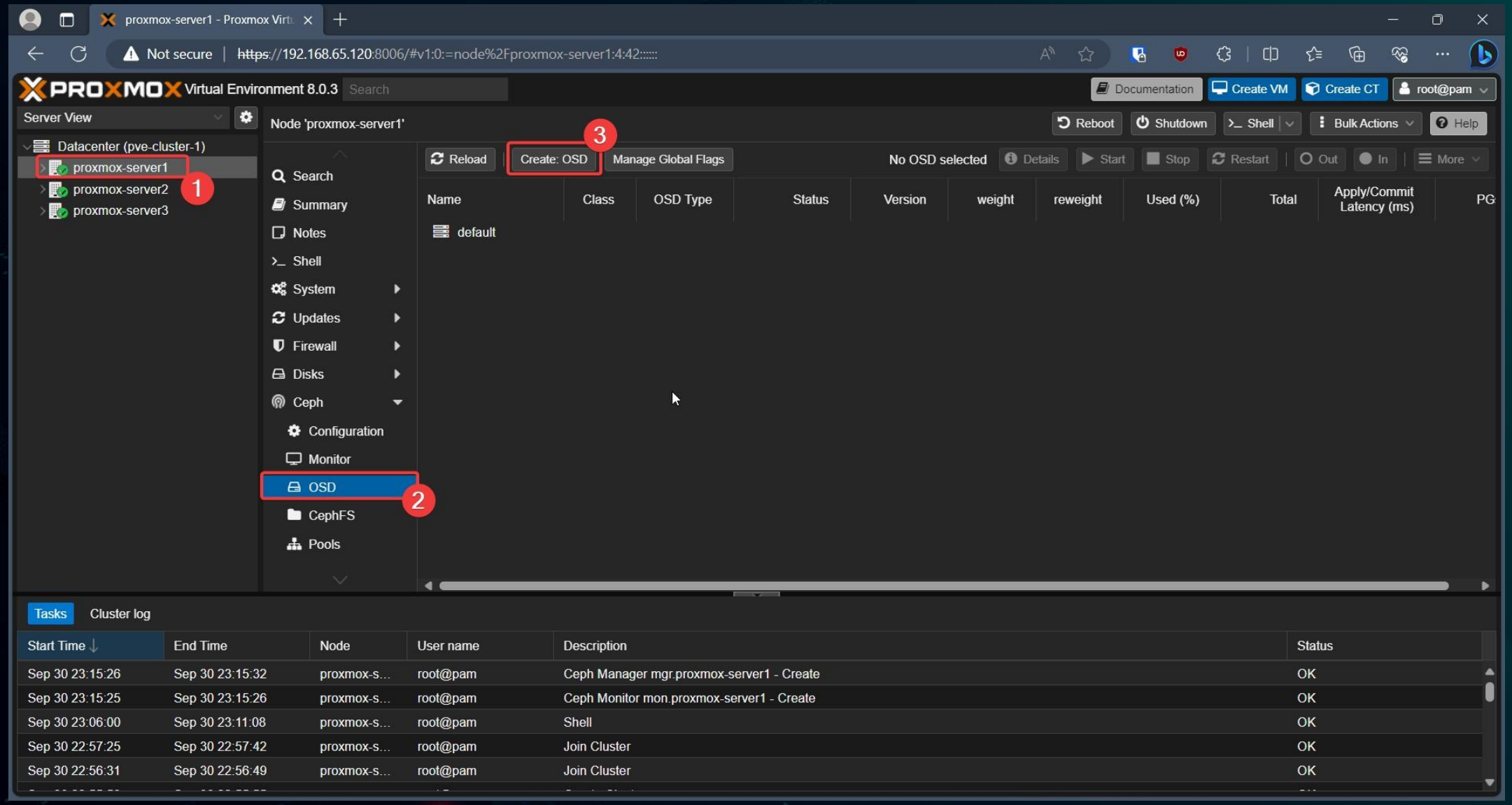


Steps to Install Ceph on Proxmox

- Install successfully, repeat these steps on other nodes:



Create Ceph OSD Daemons



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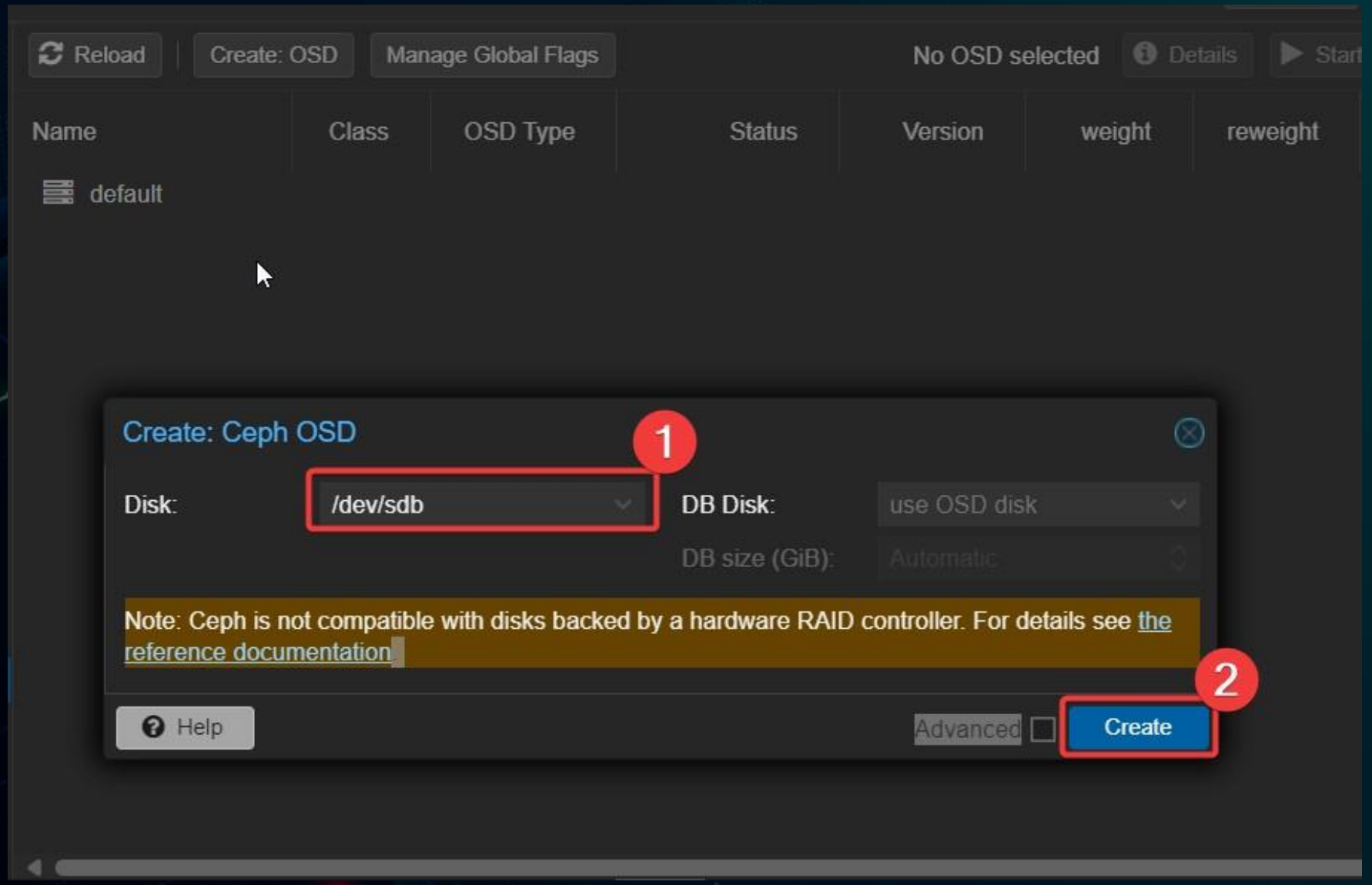

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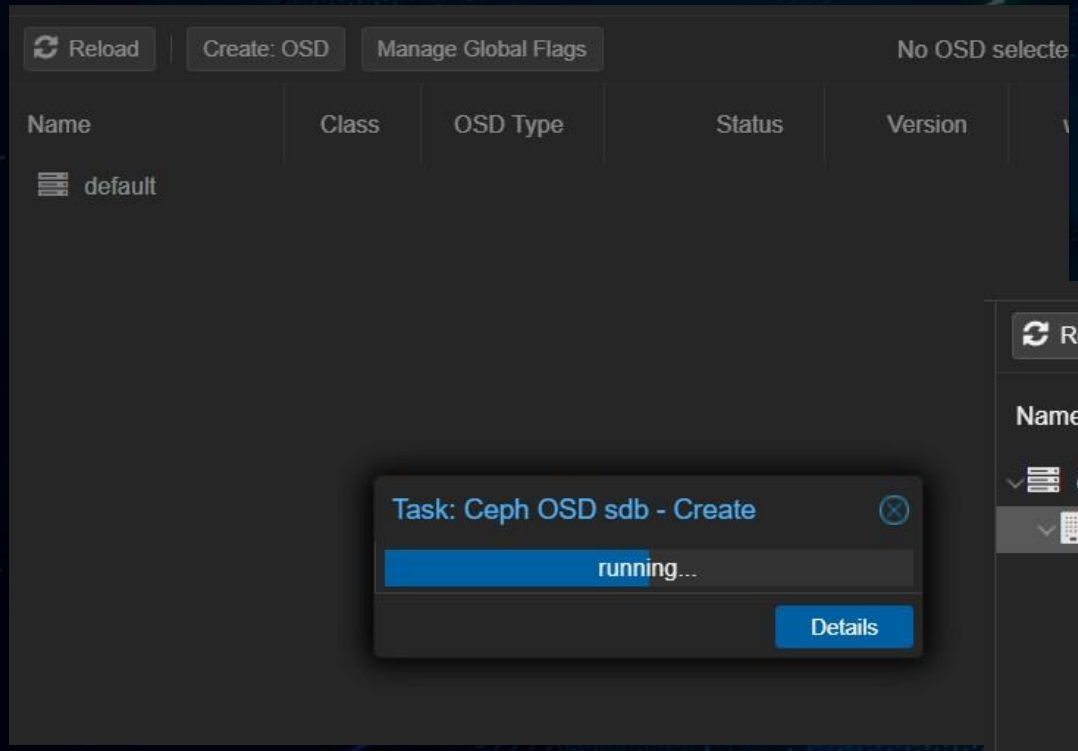
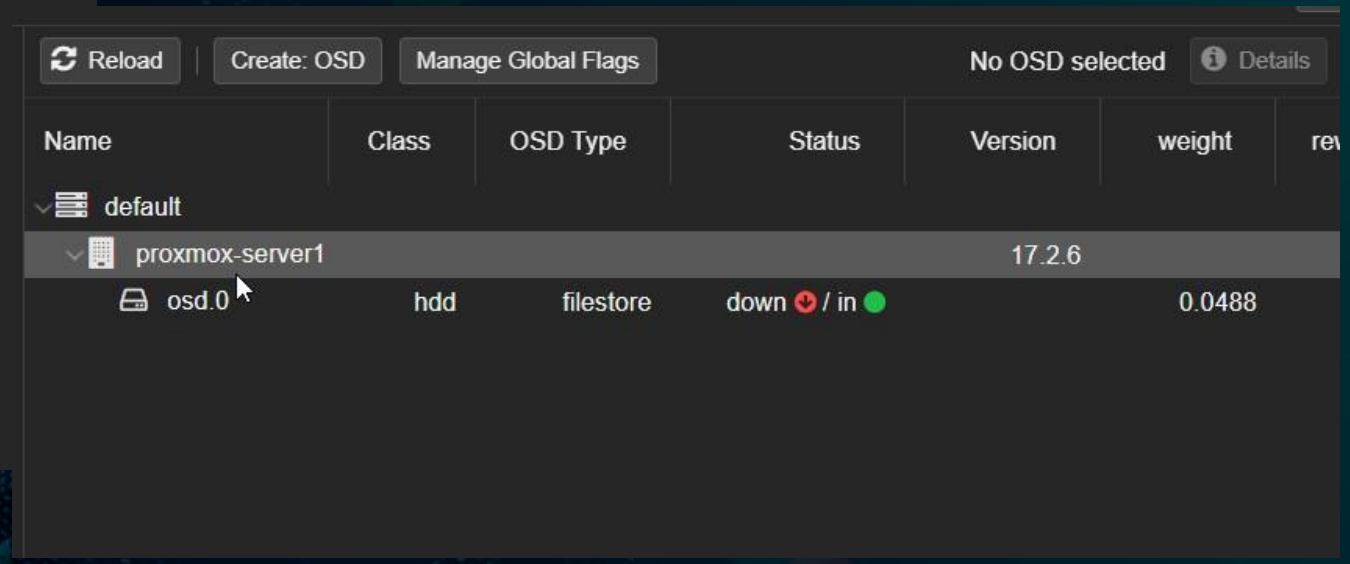
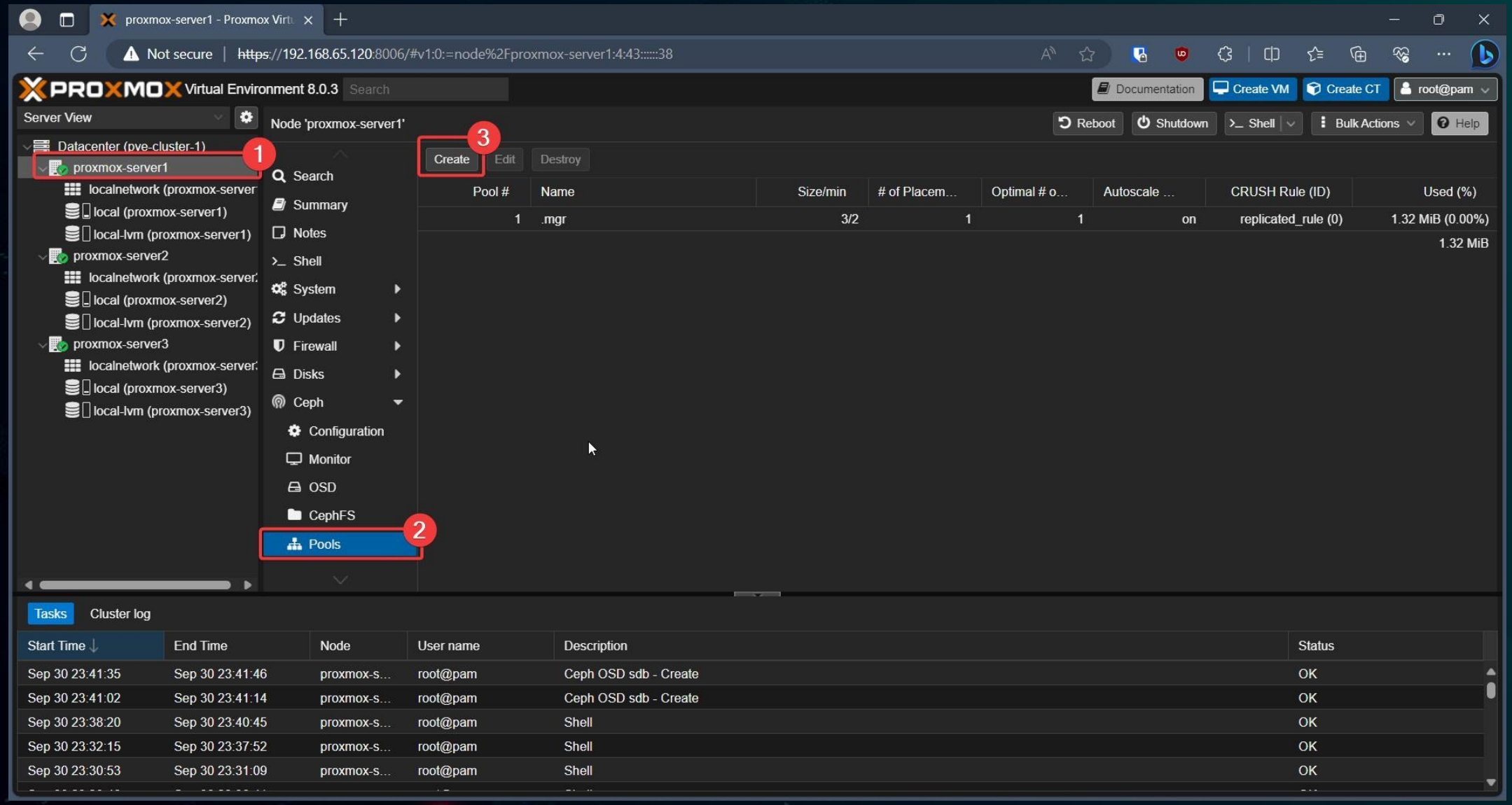




Create Ceph Pool



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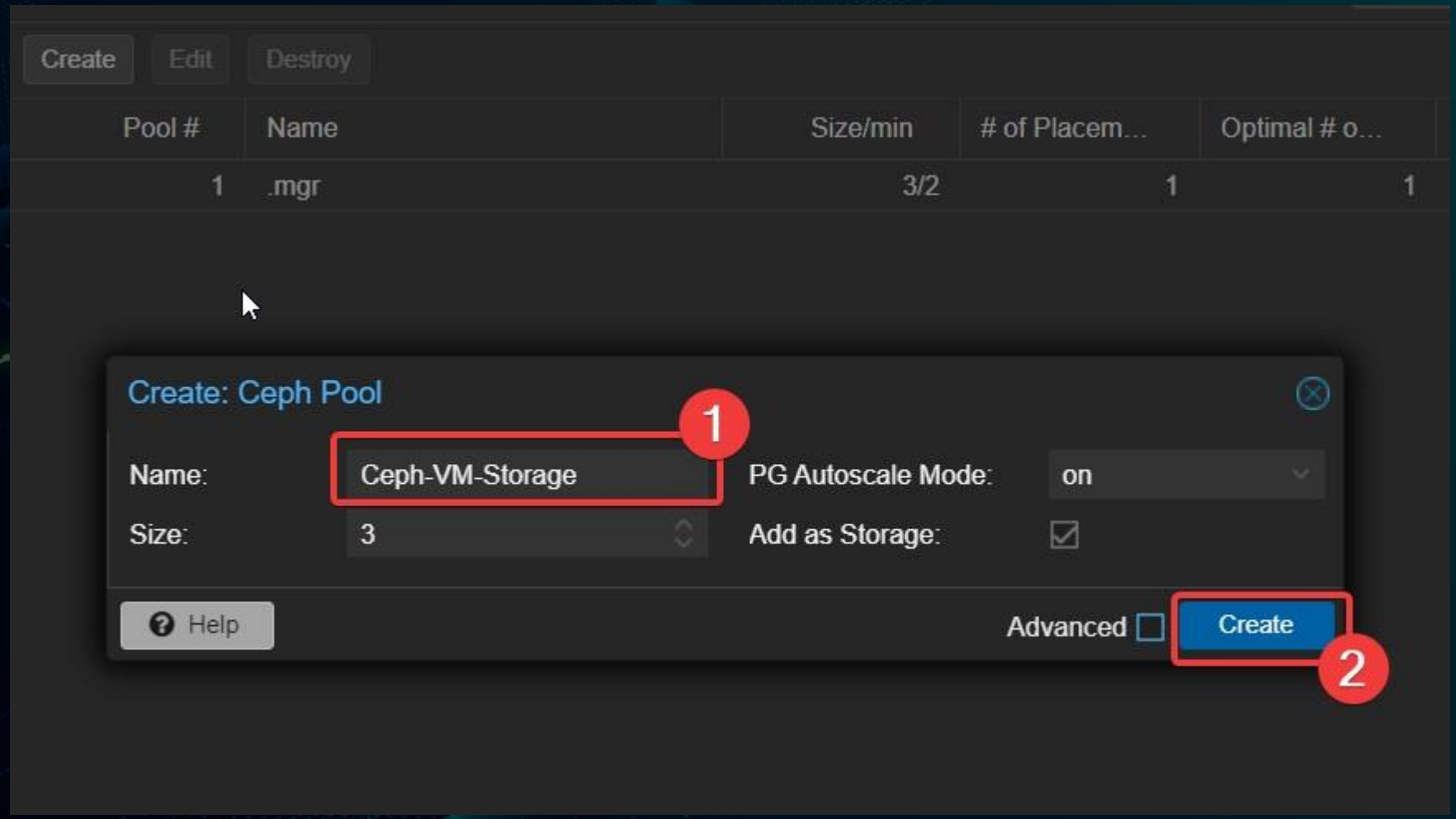
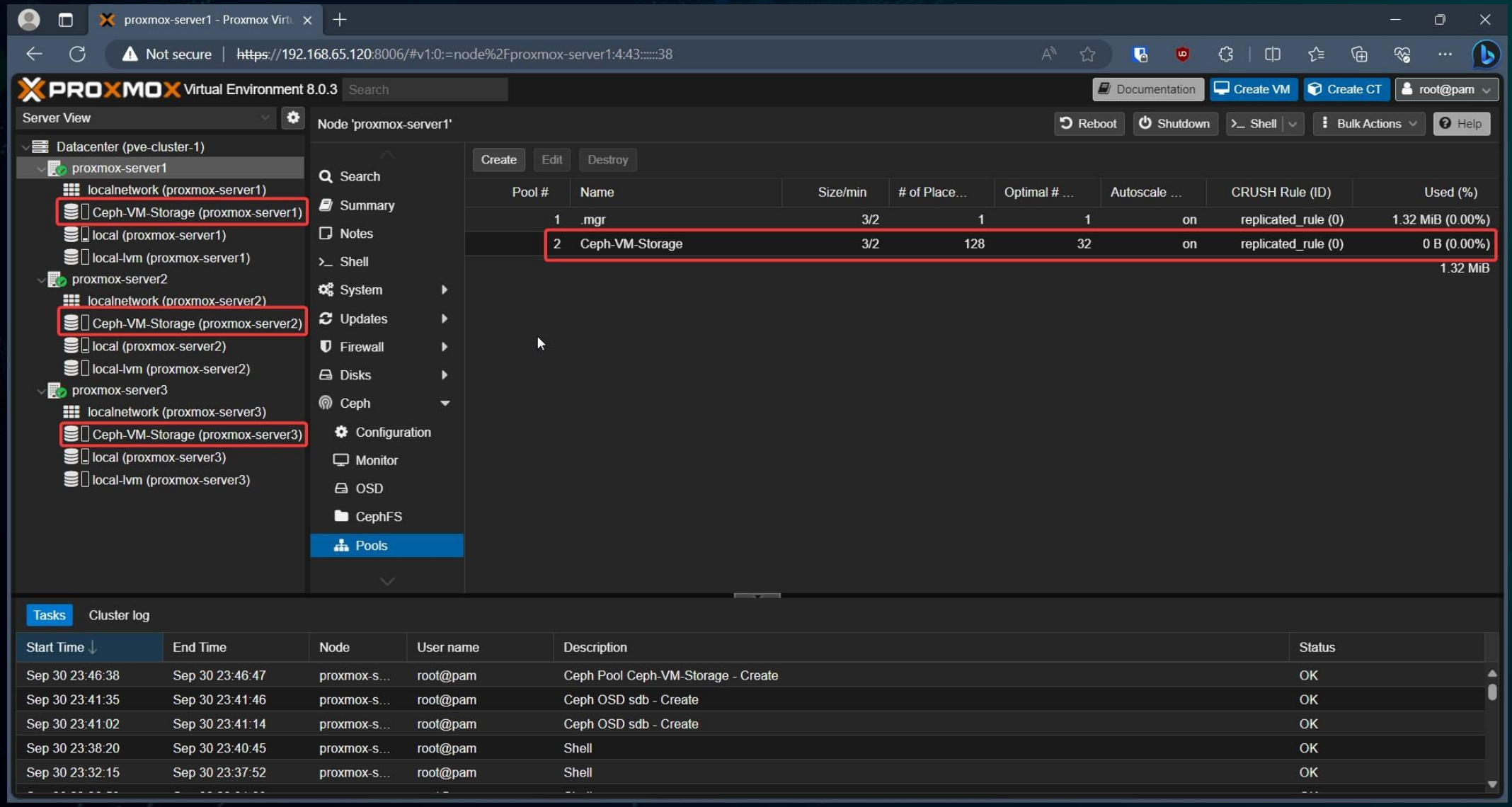


Create Ceph Pool

- Pool is ready and available in all servers to store VMs:



Live demo

- ✓ **Live Demo from test lab (Max 5mins) / Recorded Video**

Thank You

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