Hitachi Vantara

Configuring Device Mapper Multipath on Red Hat and SUSE Linux with VSP One Block 20 Storage Systems

v1.0

Configuration Guide

This guide shows how to configure Device Mapper Multipath on Red Hat Enterprise Linux 9.2 and SUSE Linux Enterprise Server 15 SP5 with Hitachi Virtual Storage Platform One Block 20 (VSP One Block 20) storage systems. The same procedure is applicable to other Red Hat and SUSE Linux versions as well.

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Hitachi Vantara

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Preface

About this document

This document shows how to configure Device Mapper Multipath (DM Multipath) for Red Hat Enterprise Linux (RHEL) 9.2 and SUSE Linux Enterprise Server (SLES) 15 SP5 with Hitachi Virtual Storage Platform One Block 20 (VSP One Block 20) storage systems.

DM Multipath manages multiple I/O paths between server nodes and storage systems into a single device. These storage LUN I/O paths are physical SAN connections that include separate cables, switches, and storage controllers. Multipathing aggregates these I/O paths and creates a new device that consists of the combined paths.

Multipathing enables load balancing across multiple paths, ensuring optimal resource utilization. In the event of a path failure, it automatically switches to an active path, improving system availability and reliability.

DM Multipath is available as an installable software package across various Linux operating systems (OS) and server virtualization products such as RHEL, SLES, Oracle Linux, Ubuntu, and Citrix Hypervisor.

Revision History

Revision	Changes	Date
v1.0	Initial release	March 2025

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Introduction

Hitachi Virtual Storage Platform One Block 20 (VSP One B20) is a new 2U all-NVMe storage appliance with three dedicated models. All models have the same capacity (72 NVMe flash drives, the appliance, + 2x media trays) and support FC, iSCSI, and NVMe TCP connectivity. The new capabilities remove complexities such as data reduction data reduction always being on, Dynamic Drive Protection (DDP) removing complicated RAID setups, and Dynamic Carbon Reduction delivering real-world reductions in power consumption.

- VSP One Block 24 – 256GB Cache + SW Advanced Data Reduction (ADR) + 24 cores
- VSP One Block 26 – 768GB Cache + 2x Compression Accelerator Module (CAM) + 24 cores
- VSP One Block 28 – 1TB Cache + 4x CAM + 64 cores

Purpose

This document shows how to configure Device Mapper Multipath (DM Multipath) on RHEL and SLES systems for both local and SAN boot processes with VSP One Block 20 storage systems.

Connectivity Diagram

The following diagram shows the connectivity of Port 1C and 2C of a VSP One Block 28 storage system through two FC switches:

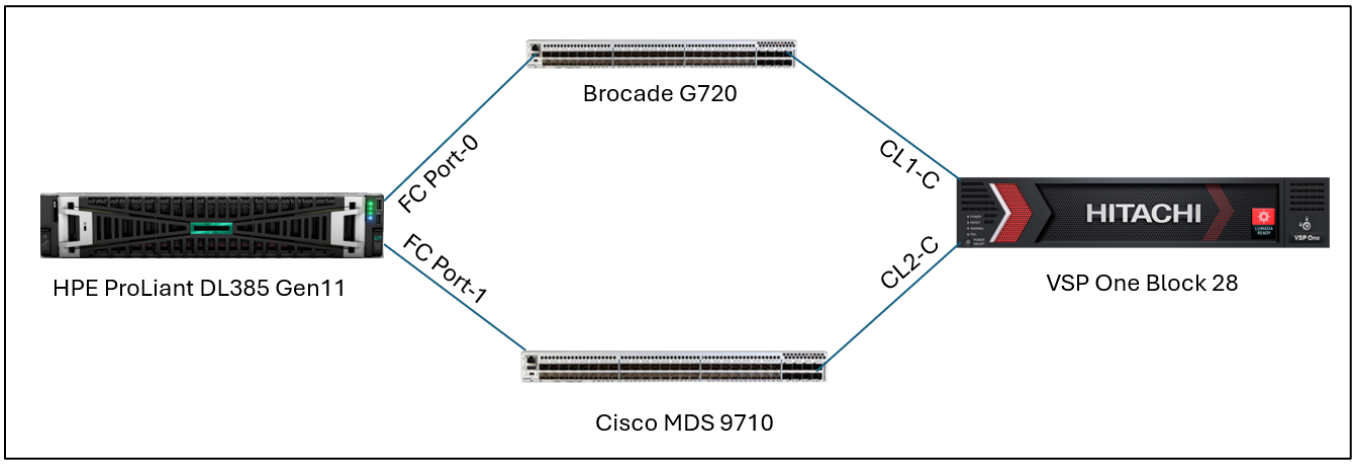


Figure 1: Port 1C and 2C of a VSP One Block 28 storage system connected through two FC switches

Hardware Requirements

The following lists the hardware requirements:

- Linux server: HPE ProLiant DL385 Gen11

- FC HBA: QLogic QLE2872
- CCI server: HPE ProLiant DL380 Gen10
- FC switch: Cisco MDS 9710, Brocade G720
- Storage system: VSP One Block 28

Note: In this scenario, a QLogic QLE2872 HBA is used for demonstration. However, the configuration procedures apply to any supported FC HBA.

Software Requirements

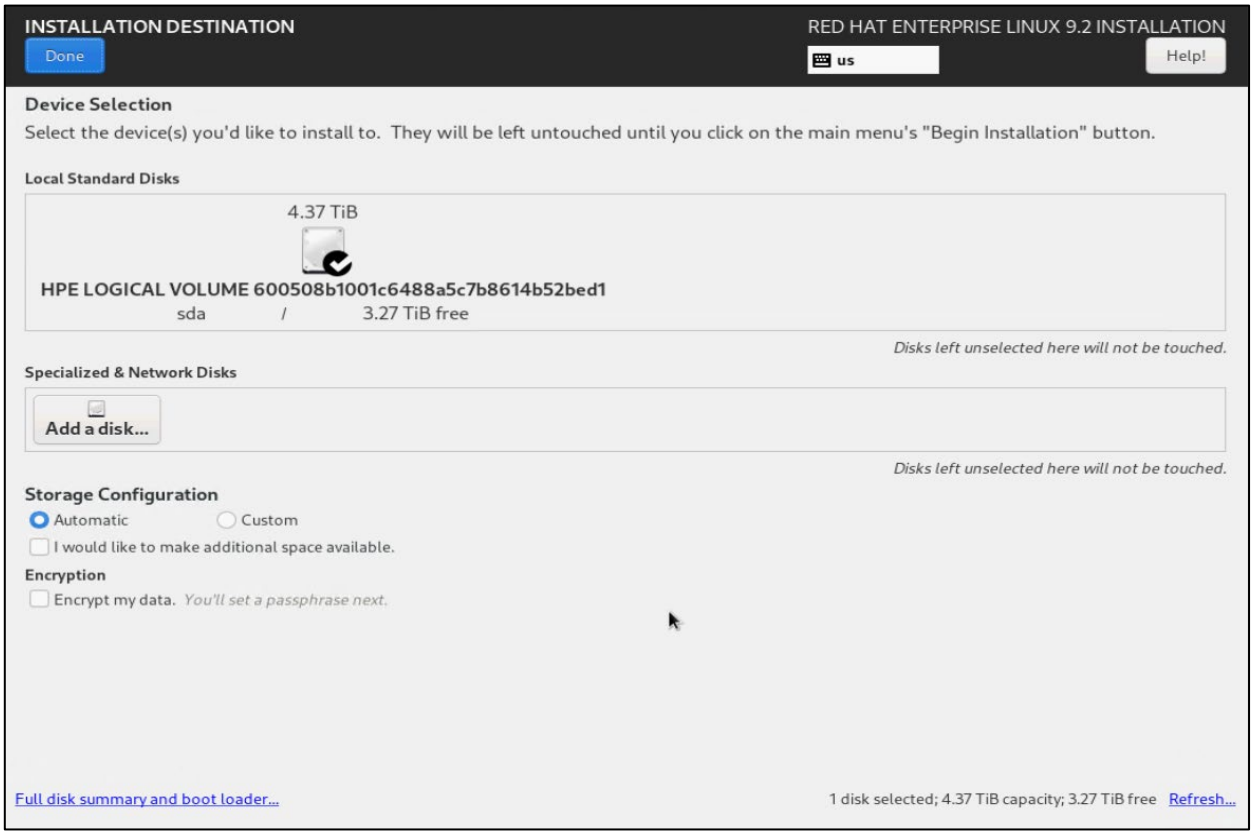
The following lists the software requirements:

- OS installation media: RHEL 9.2 and SLES 15 SP5
- Command Control Interface (CCI)

Red Hat Enterprise Linux 9.2 (Local Boot)

To install and configure DM Multipath on a RHEL 9.2 local boot system, complete the following steps:

1. Select a local disk for installing RHEL 9.2, as shown in the following example:



   For more details, see the RHEL 9 Installation Guide.

2. Select the OS disk partitioning as recommended by Red Hat and customize it according to your requirements.

3. Complete the OS installation by selecting the required packages and then restart the server.

4. Complete the SAN configuration and assign additional LDEVs from the VSP One Block 20 storage system with multiple I/O paths.

5. To discover the mapped LUNs from the VSP One Block 20 storage system, rescan the FC HBA.

   For host group configuration and port topology settings, see the Red Hat Linux configuration and attachment section of the Open-Systems Host Attachment Guide for Virtual Storage Platform Family Guide.

For switch zone configuration details, see the SAN switch vendors configuration documents; for additional storage configuration details, see the VSP One Block Storage Provisioning Guide.

6. Log in to the server running RHEL 9.2 and configure multipathing.
   - The DM Multipath configuration file is typically not created during a local boot OS installation.
   - The DM Multipath configuration file, `multipath.conf`, is located in the /etc directory and overwrites the built-in multipathd configuration table.
7. Verify that the multipath service is running after the installation. If the multipath service is not enabled, enable it using the following commands:

```
# mpathconf --h

usage: /usr/sbin/mpathconf <command>

Commands:

Enable: --enable

Disable: --disable

Only allow certain wwids (instead of enable): --allow <WWID>

Set user_friendly_names (Default y): --user_friendly_names <y|n>

Set find_multipaths (Default y): --find_multipaths
<yes|no|strict|greedy|smart>

Set default property blacklist (Default n): --property_blacklist <y|n>

Set enable_foreign to show foreign devices (Default n): --
enable_foreign <y|n>

Set recheck_wwid (Defaut n): --recheck_wwid <y|n>

Add/Change/Remove option in defaults section: --option
<option_name>:<value>

Load the dm-multipath modules on enable (Default y): --with_module
<y|n>

start/stop/reload multipathd (Default n): --with_multipathd <y|n>

select output file (Default /etc/multipath.conf): --outfile <FILE>

#
```

   - To create an initial configuration file, run the following command:

     ```
     /usr/sbin/mpathconf
     ```

   - To check the available command options, run the following help command:

     ```
     mpathconf --h
     ```

- To create a multipath configuration file, run the following command:

  ```
  # mpathconf --enable
  ```

- To enable and start the multipathd service, run the following commands:

  ```
  # systemctl enable multipathd
  # systemctl start multipathd
  ```

8. Verify the status of the multipathd service by running the following command:

   ```
   # systemctl status multipathd
   ● multipathd.service - Device-Mapper Multipath Device Controller
   Loaded: loaded (/usr/lib/systemd/system/multipathd.service; enabled;
   preset: enabled)
   Active: active (running) since Tue 2024-06-18 05:55:36 UTC; 2min 23s
   ago
   TriggeredBy: ○ multipathd.socket
      Main PID: 12786 (multipathd)
        Status: "up"
         Tasks: 7
        Memory: 18.7M
           CPU: 61ms
        CGroup: /system.slice/multipathd.service
                └─12786 /sbin/multipathd -d -s

   Jun 18 05:55:36 RHEL92-TestServer systemd[1]: Starting Device-Mapper
   Multipath Device Controller...
   Jun 18 05:55:36 RHEL92-TestServer multipathd[12786]: --------start up--
   ------
   Jun 18 05:55:36 RHEL92-TestServer multipathd[12786]: read
   /etc/multipath.conf
   Jun 18 05:55:36 RHEL92-TestServer multipathd[12786]: path checkers
   start up
   Jun 18 05:55:36 RHEL92-TestServer systemd[1]: Started Device-Mapper
   Multipath Device Controller.

   #
   ```

9. Verify the `/etc/multipath.conf` file and customize it according to your requirements.

10. Verify the default values for various DM Multipath parameters by running the following commands:

    ```
    multipath -t
    ```

    or

    ```
    multipathd -k'show config'
    ```

11. Change the `defaults, devices, blacklist, blacklist_exceptions` and `multipaths` sections for VSP One Block 20 storage systems as follows:

    The devices section of the DM Multipath configuration file must contain the vendor and product information to identify the storage system:

```
vendor "HITACHI"
product "OPEN-.*"
```

The following is an example of the `multipath.conf` file, which includes different sections:

```
defaults {
        user_friendly_names "yes"
}

blacklist {
        devnode "!^(sd[a-z]|dasd[a-z]|nvme[0-9])"
        device {
                vendor "....."
                product "......."
        }
}

blacklist_exceptions {
}

devices {
        device {
                vendor "HITACHI"
                product "OPEN-.*"
                path_grouping_policy "multibus"
                path_checker "tur"
                features "0"
                hardware_handler "0"
                prio "const"
                rr_weight "uniform"
                no_path_retry 10
        }
}

multipaths {
       multipath {
              wwid                  360060e80282718005080271800000002
              alias                 mpath_lun0
       }
       multipath {
              wwid                  360060e80282718005080271800000000b
              alias                 mpath_lun1
       }
}

overrides {
}
```

The following example shows a multipath configuration file for VSP One Block 20:

```
# cat /etc/multipath.conf
      .......
defaults {
        find_multipaths yes
        user_friendly_names yes
}
```

```
blacklist {
}
devices {
        device {
                vendor "HITACHI"
                product "OPEN-.*"
                path_grouping_policy "multibus"
                path_checker "tur"
                features "0"
                no_path_retry 10
                hardware_handler "0"
                prio "const"
                rr_weight "uniform"
        }
}
#
```

12. To apply any changes made in the configuration file, restart the multipathd service or reconfigure it:

```
# systemctl restart multipathd.service
```

or

```
# systemctl reload multipathd.service
```

or

```
# multipathd -k
multipathd> reconfigure
ok
multipathd> exit
```

13. Verify the multipath status of the LUNs from the VSP One Block 20 storage system by running the following command:

```
# multipath -ll
mpathb (360060e80282718005080271800000002) dm-4 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 5:0:0:1   sdc 8:32  active ready running
  `- 8:0:0:1   sdn 8:208 active ready running

mpathc (360060e80282718005080271800000000b) dm-9 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 5:0:0:10  sdl 8:176 active ready running
  `- 8:0:0:10  sdw 65:96 active ready running
```

Red Hat Enterprise Linux 9.2 (SAN Boot)

This section shows how to install and configure DM Multipath on a RHEL 9.2 SAN Boot system.

Before installing Red Hat Enterprise Linux, you must complete several storage configuration steps. For detailed instructions, see the VSP One Block Storage Provisioning Guide.

1. Establish connectivity to the VSP One Block 20 storage system either directly or through a SAN switch, using multiple I/O paths through an FC HBA.
2. Install a supported FC HBA and connect it to the FC ports of the VSP One Block 20 storage system.

   HBA ports can be connected directly to the FC ports of the VSP One Block 20 storage system or through intermediate SAN FC switches.
3. Create host groups in the storage ports and assign the same set of LUNs to all host groups.
4. Configure port topology and LUN security.
5. Configure the HBA BIOS. Follow the recommendations provided by the HBA vendor and ensure that boot from SAN is enabled.
6. Verify that the designated SAN Boot LUN from the VSP One Block 20 storage system is detected in the HBA BIOS. For more information, see the HBA vendor configuration guides.
7. Set the FC port topology on the VSP One Block 20 storage system by issuing the following raidcom CCI command:

   ```
   raidcom modify port -port
   ```

   - Fabric: ON when connected through a SAN Switch.
   - Fabric: OFF when connected directly with HBA.
   - Connection Type: P-to-P for both direct and Fabric connections.

   For configuration information, see the VSP One Block Storage Provisioning Guide.

   Example:

   ```
   raidcom modify port -port CL1-C -topology n_port -I6811
   raidcom modify port -port CL2-C -topology f_port -I6811
   ```

   `n_port`: For direct connection between FC HBA and VSP One Block 20.
   `f_port`: For connection between FC HBA and VSP One Block 20 through an FC Switch.
8. Create host groups on the storage ports and assign the HBA WWPN to the host groups as follows:

```
# raidcom add host_grp -port CL1-C-3 -host_grp_name RHEL9u2-SANBoot
-I6811

# raidcom add host_grp -port CL2-C-3 -host_grp_name RHEL9u2-SANBoot
-I6811

# raidcom add hba_wwn -port CL1-C-3 -hba_wwn 2100f4c7aa0ceba6 -I6811
# raidcom add hba_wwn -port CL2-C-3 -hba_wwn 2100f4c7aa0ceba7 -I6811

# raidcom get hba_wwn -port CL1-C-3 -I6811
PORT   GID GROUP_NAME                    HWWN  Serial# NICK_NAME
CL1-C    3 RHEL9u2-SANBoot    2100f4c7aa0ceba6   810008 -
#

# raidcom get hba_wwn -port CL2-C-3 -I6811
PORT   GID GROUP_NAME                    HWWN  Serial# NICK_NAME
CL2-C    3 RHEL9u2-SANBoot    2100f4c7aa0ceba7   810008 -
#
```

9. Set the Host Mode to 00 (Standard) on the host group in the Linux environment as follows:

```
# raidcom modify host_grp -port CL1-C-3 -host_mode 0x00 -I6811
```

10. Create and assign the same set of LUNs to both host groups. Ensure that the Boot LUN size meets the OS installation requirements.

    In the following example, one 100G LDEV is created from the VSP One Block 20 storage system and mapped to both the host groups.

    LDEV creation:

```
# raidcom add ldev -parity_grp_id 1-1 -ldev_id 00:1D -capacity 100G

-I6811
```

    LDEV format:

```
# raidcom initialize ldev -ldev_id 00:1D -operation fmt -I6811
```

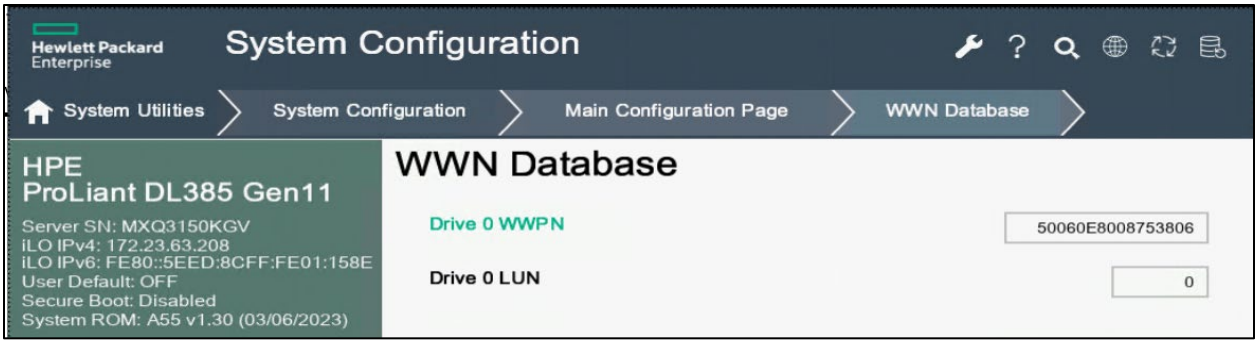
    LDEV mapping to both host groups:

```
# raidcom add lun -port CL1-C-3 -lun_id 0 -ldev_id 00:1D -I6811

# raidcom add lun -port CL2-C-3 -lun_id 0 -ldev_id 00:1D -I6811
```

    Note: Assign LDEV ID 0 while mapping a SAN Boot LUN to host groups.

11. Enter the WWPN of the VSP One Block 20 storage system FC port in the WWN Database of the QLogic HBA as follows:



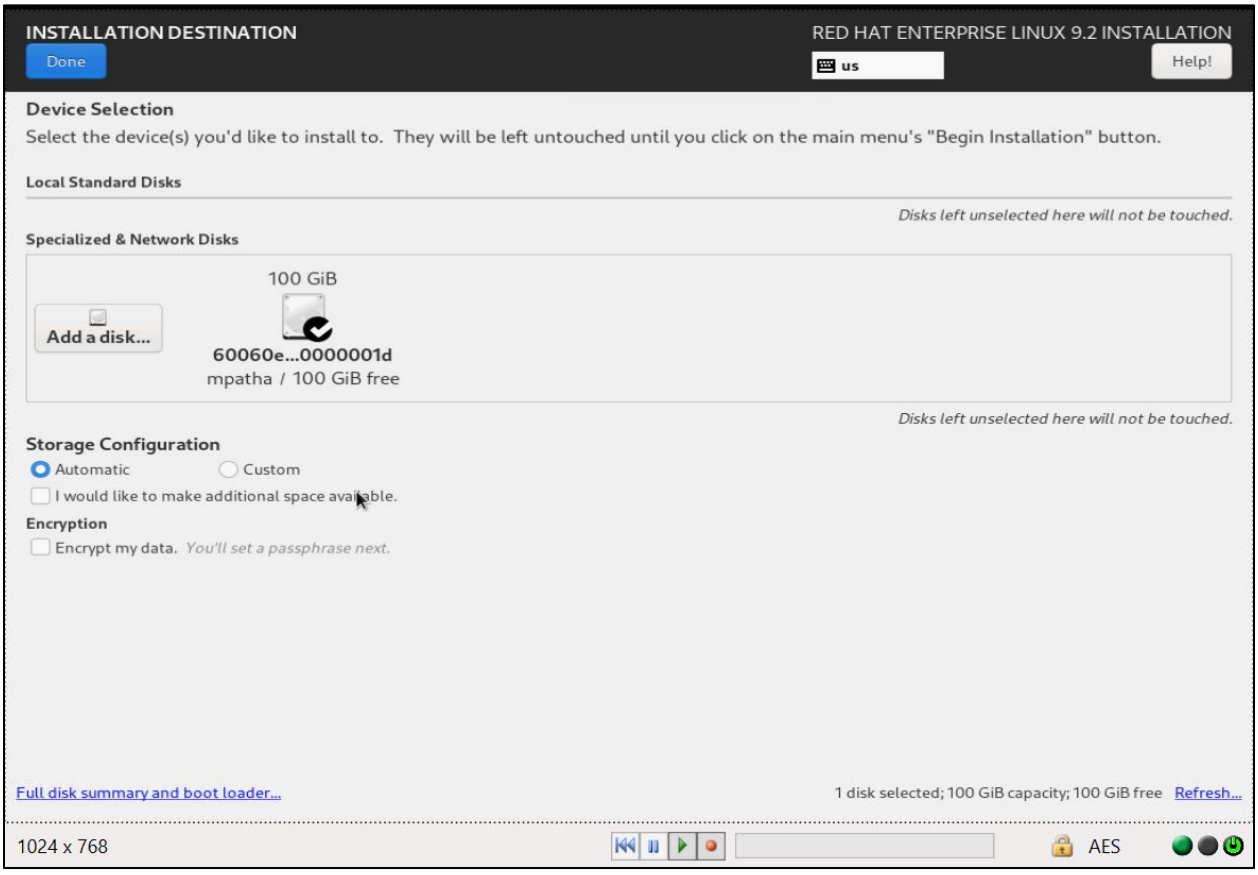
This configuration can vary from HBA vendor to vendor. See the adapter configuration manuals of the respective HBA vendor during configuration.

12. Install RHEL 9.2 on a LUN (LUN ID 0) provisioned from the VSP One Block 20 storage system.

    For a detailed installation process, see the RHEL 9 Installation Guide.

13. Select a SAN disk.

14. Verify that the storage LUN is detected as a `multipath` enabled device as follows:



The DM Multipath configuration file is created during SAN Boot installation as shown in the following example:

```
# cat /etc/multipath.conf
defaults {
        find_multipaths yes
        user_friendly_names yes
}


blacklist {
}
#

# multipath -ll
mpatha (360060e80282718005080271800000001d) dm-0 HITACHI,OPEN-V
size=100G features='0' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:0 sda 8:0  active ready running
  `- 7:0:0:0 sdb 8:16 active ready running
#
```

15. Update the `multipath.conf` configuration file for the VSP One Block 20 storage system as shown in the following example:

```
# cat /etc/multipath.conf
defaults {
        find_multipaths yes
        user_friendly_names yes
}


blacklist {
}
devices {
        device {
                vendor "HITACHI"
                product "OPEN-.*"
                path_grouping_policy "multibus"
                path_checker "tur"
                features "0"
                no_path_retry 10
                hardware_handler "0"
                prio "const"
                rr_weight "uniform"
        }
}
#
```

16. Rebuild the `initramfs` file system using the `dracut` command as follows:

```
# dracut -v -f
```

17. To setup multi-pathing in the `initramfs` file system, use the `dracut` command as follows:

```
# dracut -v -f --add multipath
```

18. Restart the server after the DM Multipath configuration is updated and `initramfs` is rebuilt.

    The following example shows the DM Multipath status:

```
# multipath -ll
mpatha (360060e80282718005080271800000001d) dm-0 HITACHI,OPEN-V
size=100G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:0 sda 8:0  active ready running
  `- 7:0:0:0 sdb 8:16 active ready running
#
```

    The following example shows the DM Multipath status after additional storage LUNs were added and detected as `multipathd` devices:

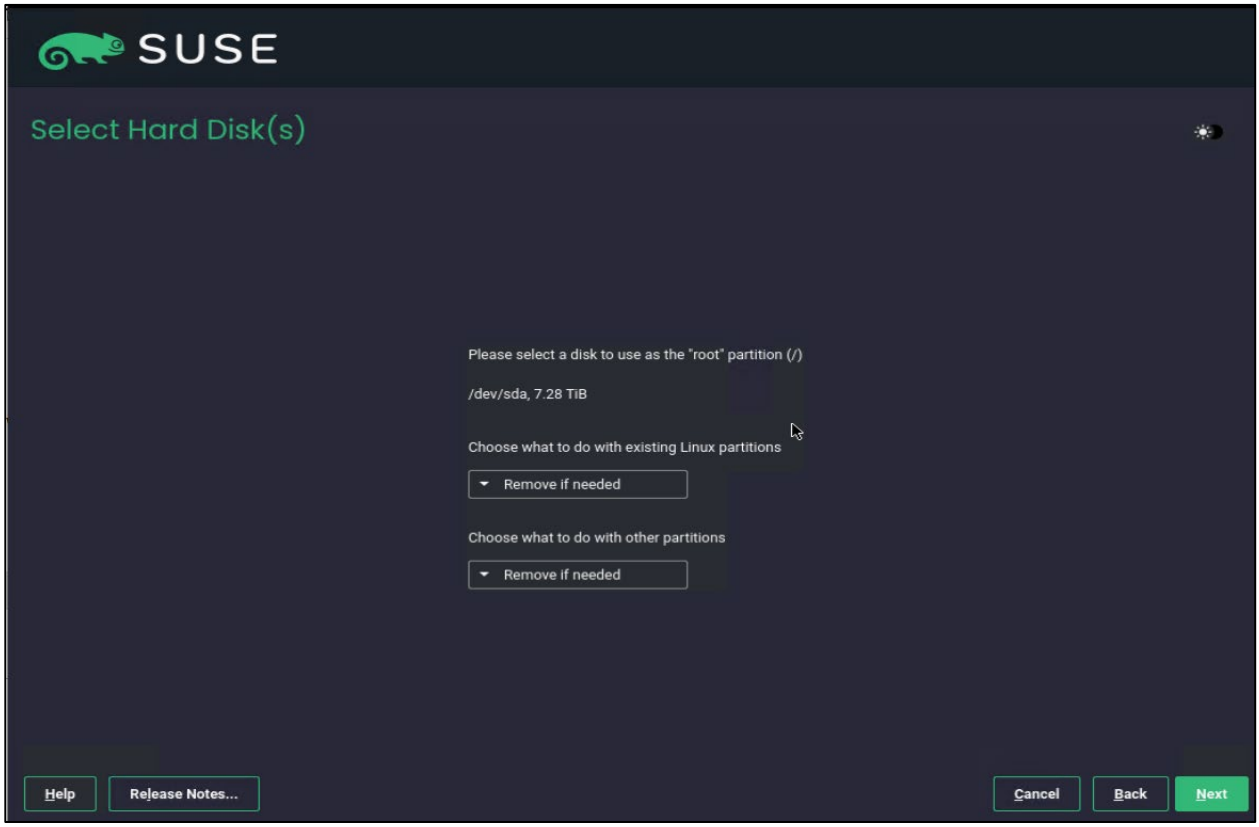
```
# multipath -ll
mpatha (360060e80282718005080271800000001d) dm-0 HITACHI,OPEN-V
size=100G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:0 sda 8:0  active ready running
  `- 7:0:0:0 sdb 8:16 active ready running
mpathb (360060e80282718005080271800000002) dm-7 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:1 sdc 8:32 active ready running
  `- 7:0:0:1 sde 8:64 active ready running
mpathc (360060e80282718005080271800000000b) dm-8 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:2 sdd 8:48 active ready running
  `- 7:0:0:2 sdf 8:80 active ready running
#
```

SUSE Linux Enterprise Server 15 SP5 (Local Boot)

This section shows how to install and configure DM Multipath on a SLES 15 SP5 Local Boot system.

1. Install SUSE Linux on a local disk.
2. Select the local disk and click **Next**.

   For details, see SUSE 15 SP5 Installation Guide.



Configuring SAN and Assigning Additional LUNs from VSP One Block 20 with Multiple I/O Paths

1. To detect the storage LUNs, rescan the FC HBA.

   For host group configuration and port topology settings, see the SUSE Linux configuration and attachment section of the Open-Systems Host Attachment Guide for Virtual Storage Platform Family Guide.

   For additional storage configuration details, see the SAN switch vendors configuration documents; for switch zone configuration details, see the VSP One Block Storage Provisioning Guide.

2. After completing the OS installation and restarting the server, verify that the DM Multipath service is enabled as follows:

```
# systemctl list-unit-files | grep multipathd
   multipathd.service             disabled       disabled
   multipathd.socket              disabled       disabled
#
```

3. Enable and start the multipathd service (because it is not enabled by default after restarting the server) as follows:

```
# systemctl enable multipathd
  Created
symlink/etc/systemd/system/sysinit.target.wants/multipathd.service →
/usr/lib/systemd/system/multipathd.service.
   Created symlink
/etc/systemd/system/sockets.target.wants/multipathd.socket→
/usr/lib/systemd/system/multipathd.socket.
# systemctl start multipathd
```

4. Verify that the DM Multipath service is enabled as follows:

```
# systemctl list-unit-files | grep multipathd
   multipathd.service                enabled         disabled
   multipathd.socket                 enabled         disabled
#

# multipath -ll
  360060e80282718005080271800000000b dm-2 HITACHI,OPEN-V
  size=10G features='0' hwhandler='0' wp=rw
  `-+- policy='service-time 0' prio=1 status=active
    |- 8:0:0:1 sdc 8:32 active ready running
    `- 9:0:0:1 sdf 8:80 active ready running
  360060e80282718005080271800000002 dm-0 HITACHI,OPEN-V
  size=10G features='0' hwhandler='0' wp=rw
  `-+- policy='service-time 0' prio=1 status=active
    |- 8:0:0:2 sdd 8:48 active ready running
    `- 9:0:0:2 sdg 8:96 active ready running

#
```

5. Identify the local boot disk that will be blacklisted from the DM Multipath configuration, as shown in the following example:

```
# fdisk -l | grep Disk | sort
  Disk /dev/sda: 7.28 TiB, 7999376588800 bytes, 15623782400 sectors
   Disk identifier: 5051DBBD-07C4-45E1-AD59-3B726911D8CF
   Disk model: MR416i-o Gen11
   Disklabel type: gpt
#

#/usr/lib/udev/scsi_id --whitelisted --replace-whitespace --
device=/dev/sda
3600062b212ee3d002e3defcb9b8f337d
#
```

6. Create a `multipath.conf` file under the `/etc` directory, because it is not automatically created during OS installation. Update the `/etc/multipath.conf` file with the VSP One Block 20 storage configuration, as shown in the following example:

```
# cat /etc/multipath.conf
 blacklist{
        wwid 3600062b212ee3d002e3defcb9b8f337d
}

devices {
      device {
            vendor "(HITACHI|HP)"
            product "OPEN-.*"
            path_grouping_policy "multibus"
            path_checker "tur"
            features "0"
            hardware_handler "0"
            prio "const"
            rr_weight "uniform"
            no_path_retry 10
            }
}
```

7. After making changes to the configuration file, run the following command to recreate the initrd image file, and then restart the server:

```
dracut -f -v
```

8. Verify the current configuration and ensure that it reflects the updated configuration.

```
# multipathd -k
multipathd> show config
............
............
devices {
      device {
            vendor "(HITACHI|HP)"
            product "OPEN-.*"
            path_grouping_policy "multibus"
            path_checker "tur"
            features "0"
            hardware_handler "0"
            prio "const"
            rr_weight "uniform"
            no_path_retry 10
      }
}
.......
#
```

The following is an example of the DM Multipath status after updating the `/etc/multipath.conf` file:

```
# multipath -ll
360060e80282718005080271800000002 dm-1 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
```

```
`-+- policy='service-time 0' prio=1 status=active
  |- 9:0:0:1 sdf 8:80 active ready running
  `- 5:0:0:1 sdc 8:32 active ready running
360060e80282718005080271800000000b dm-2 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 9:0:0:2 sdg 8:96 active ready running
  `- 5:0:0:2 sdd 8:48 active ready running
```

SUSE Linux Enterprise Server 15 SP5 (SAN Boot)

This section shows how to install and configure Device Mapper Multipath for a SLES 15 SP5 SAN Boot system.

Before installing SUSE Linux, several storage configuration steps must be completed. For detailed instructions, see the VSP One Block Storage Provisioning Guide.

1. Establish connectivity with the VSP One Block 20 storage system either directly or through a SAN switch using multiple I/O paths through FC HBA.
2. Install a supported FC HBA and connect it to the FC ports of the VSP One Block 20 storage system. You can connect the HBA ports directly to the FC ports of the VSP One Block 20 storage system or through intermediate SAN FC switches.
3. Create host groups on the storage ports and assign the same set of LUNs to all host groups.
4. Configure port topology and LUN security.
5. Set up the HBA BIOS according to the HBA vendor recommendations, ensuring that boot from SAN is enabled. Verify that the designated SAN Boot LUN from the VSP One Block 20 storage system is detected in the HBA BIOS. For more information, see the respective HBA configuration guide.
6. Set the FC port topology on the VSP One Block 20 storage system by issuing the following `raidcom CCI` command:

   ```
   raidcom modify port -port
   ```

   - Fabric: ON when connected through a SAN Switch.
   - Fabric: OFF when connected directly with HBA.
   - Connection type: P-to-P for both direct and Fabric connections.

   For configuration information, see the VSP One Block Storage Provisioning Guide.

   Example:

   ```
   raidcom modify port -port CL1-C -topology n_port -I6811
   raidcom modify port -port CL2-C -topology f_port -I6811
   ```

   `n_port`: For direct connection between FC HBA and VSP One Block 20.
   `f_port`: For connection between FC HBA and VSP One Block 20 through an FC Switch.
7. Create host groups on the storage ports and assign the HBA WWPN to the host groups as follows:

   ```
   # raidcom add host_grp -port CL1-C-3 -host_grp_name SLES15SP5-SANBoot
   -I6811
   ```

```
# raidcom add host_grp -port CL2-C-3 -host_grp_name SLES15SP5-SANBoot
-I6811

# raidcom add hba_wwn -port CL1-C-3 -hba_wwn 2100f4c7aa0ceba6 -I6811
# raidcom add hba_wwn -port CL2-C-3 -hba_wwn 2100f4c7aa0ceba7 -I6811


# raidcom get hba_wwn -port CL1-C-3 -I6811
  PORT   GID GROUP_NAME                  HWWN  Serial# NICK_NAME
  CL1-C    3 SLES15SP5-SANBoot      2100f4c7aa0ceba6   810008 -
#

# raidcom get hba_wwn -port CL2-C-3 -I6811
  PORT   GID GROUP_NAME                  HWWN  Serial# NICK_NAME
  CL2-C    3 SLES15SP5-SANBoot    2100f4c7aa0ceba7   810008 -
#
```

8. Set the Host Mode to 00 (Standard) on the host group in the Linux environment as follows:

   ```
   # raidcom modify host_grp -port CL1-C-3 -host_mode 0x00 -I6811
   ```

9. Assign the same set of LUNs to all host groups. Ensure that the Boot LUN size meets the OS installation requirements.

   In the following example, one 100G LDEV is created from the VSP One Block 20 storage system and mapped to both the host groups.

   LDEV creation:

   ```
   # raidcom add ldev -parity_grp_id 1-1 -ldev_id 00:1D -capacity 100G
   -I6811
   ```

   LDEV format:

   ```
   # raidcom initialize ldev -ldev_id 00:1D -operation fmt -I6811
   ```

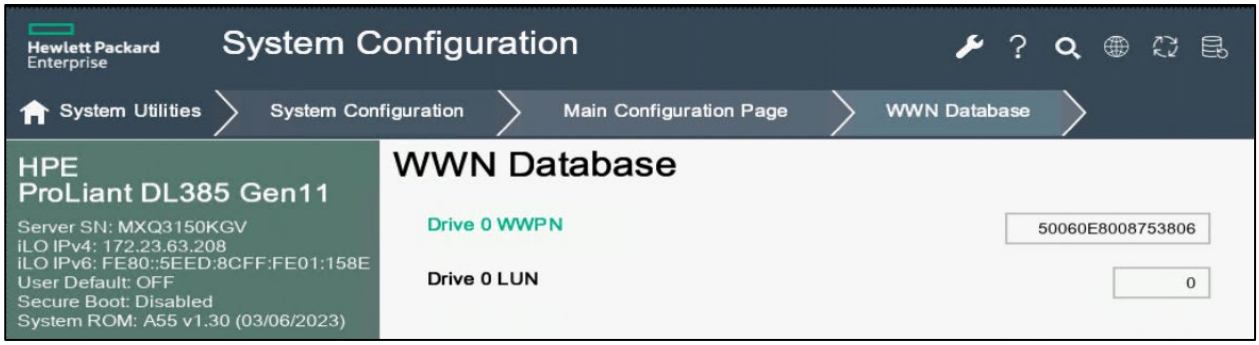
   LDEV mapping to both host groups:

   ```
   # raidcom add lun -port CL1-C-3 -lun_id 0 -ldev_id 00:1D -I6811

   # raidcom add lun -port CL2-C-3 -lun_id 0 -ldev_id 00:1D -I6811
   ```

   Note: Assign LDEV ID 0 while mapping a SAN Boot LUN to host groups.

10. Enter the WWPN of the VSP One Block 20 storage system in the WWN database of the QLogic HBA as follows:

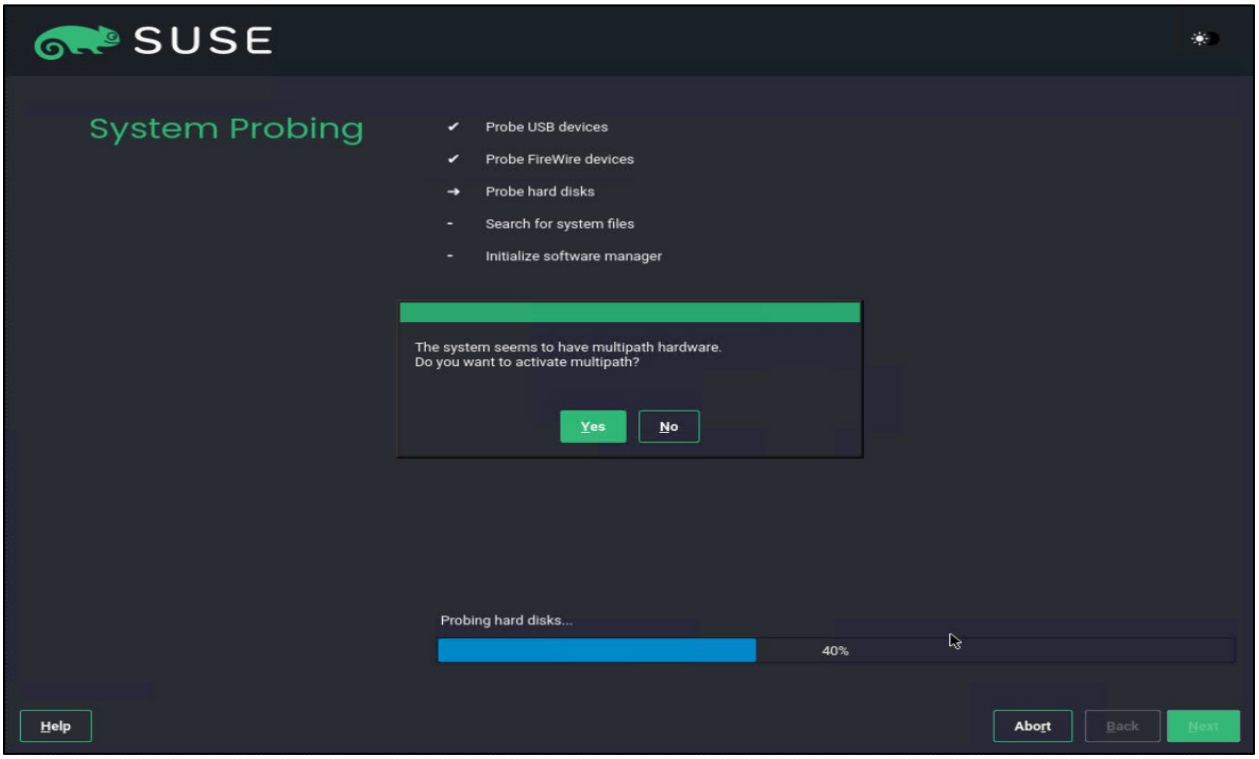


Note: This configuration can vary from HBA vendor to vendor. See the adapter configuration manuals of the respective HBA vendor during configuration.

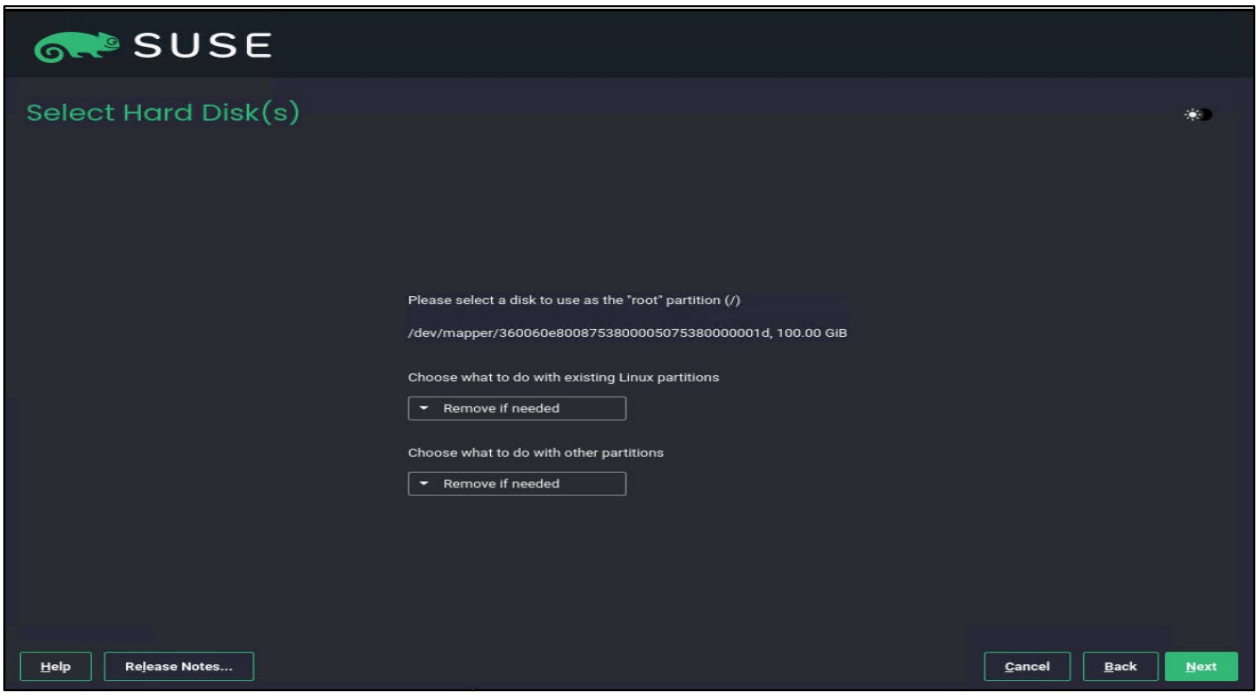
11. Install SUSE Linux 15 SP5 on a LUN (LUN ID 0) provisioned from the VSP One Block 20 storage system.

    For a detailed installation process, see the SUSE Linux Installation Guide.

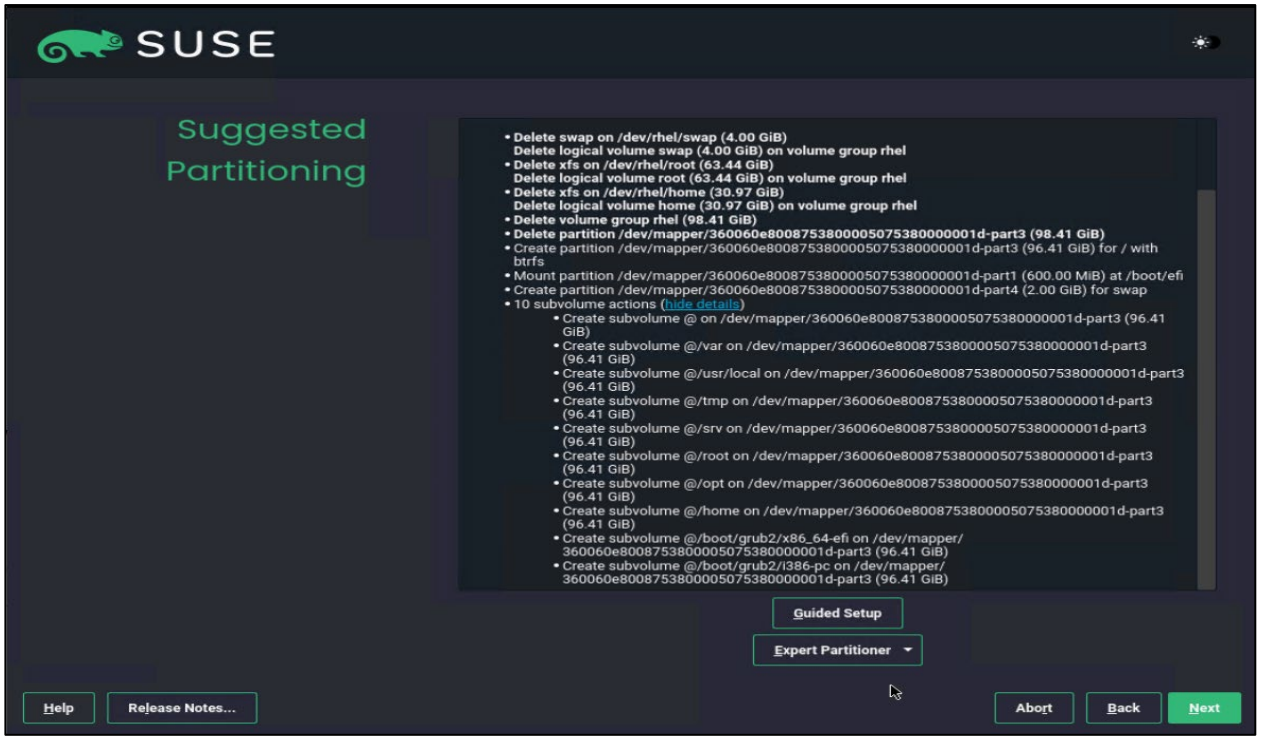
12. Select a SAN disk.
13. Verify that the storage LUN is detected as a `multipath` enabled device as follows:



14. Select the `multipath enabled` storage device as shown in the following installation screen:



15. Create disk partitioning and complete the installation.



16. After the OS installation is completed and the system is running, verify that the boot disk is claimed by multipathd as follows:

```
# multipath -ll
360060e80282718005080271800000001d dm-0 HITACHI,OPEN-V
size=100G features='0' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:0 sda 8:0  active ready running
  `- 8:0:0:0 sdb 8:16 active ready running
#
```

17. Verify the current multipathd configuration as follows:

```
#multipathd -k
multipathd> show config
..........
..........
devices {
device {
             vendor "(HITACHI|HP)"
             product "^OPEN-"
             path_grouping_policy "multibus"
       }
   }
...........
```

18. Create and update the DM Multipath configuration file.

    The following example shows the devices section of the `/etc/multipath.conf` configuration file for the VSP One Block 20 storage system:

```
devices {
      device {
                vendor "HITACHI"
                product "OPEN-.*"
                path_grouping_policy "multibus"
                path_checker "tur"
                features "0"
                hardware_handler "0"
                prio "const"
                rr_weight "uniform"
                no_path_retry 10
             }
       }
```

19. To update the initrd image file based on the updated DM Multipath configuration, use the `dracut -f -v` command and restart the server. Verify that the configuration accurately reflects the updates.

```
# multipathd -k
multipathd> show config
........
devices {
      device {
                vendor "HITACHI"
```

```
                product "OPEN-.*"
                path_grouping_policy "multibus"
                path_checker "tur"
                features "0"
                hardware_handler "0"
                prio "const"
                rr_weight "uniform"
                no_path_retry 10
        }
}
.......
```

The following example shows the DM Multipath status:

```
# multipath -ll
360060e80282718005080271800000001d dm-0 HITACHI,OPEN-V
size=100G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:0 sda 8:0  active ready running
  `- 8:0:0:0 sdb 8:16 active ready running
#
```

The following example shows the DM Multipath status after additional storage LUNs were added and detected as multipathd devices:

```
# multipath -ll
360060e80282718005080271800000002 dm-5 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:1 sdc 8:32 active ready running
  `- 8:0:0:1 sde 8:64 active ready running
360060e80282718005080271800000000b dm-6 HITACHI,OPEN-V
size=10G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=1 status=active
  |- 4:0:0:2 sdd 8:48 active ready running
  `- 8:0:0:2 sdf 8:80 active ready running
#
```

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