# Gold-Tier Hardware Servicing Guide for Qumulo

# Table of Contents

# Getting Started

## Safety Recommendations for Gold-Tier Hardware Platforms

This section gives safety recommendations for Gold-Tier hardware platforms.

> **Caution**
> Read these recommendations carefully. Failure to follow these recommendations can potentially cause damage to your equipment or injure the person who maintains it.

- **Operating Ambient Temperature:** When you install nodes in a closed or multi-unit rack assembly, the operating ambient temperature of the rack or cabinet environment can be greater than the ambient temperature of the room.

  Install your equipment in an environment where the maximum ambient temperature (Tma) doesn't exceed 40° C (104° F).

- **Sufficient Airflow:** Install your equipment in a way that avoids compromising the amount of airflow required for the equipment's safe operation.
- **Even Mechanical Loading:** Ensure your equipment is level when you mount it.
- **Circuit Load:** Determine the load your equipment can place on your supply circuit and refer to nameplate ratings to determine potential circuit overload scenarios.
- **Reliable Earthing:** Maintain earthing (by connecting to the part of the equipment that doesn't carry current).

  Give particular attention to supply connections other than direct connections to the branch circuit (for example, power strips).

- **Redundant Power Supplies (PSU):** When you receive multiple PSUs with your equipment, connect each PSU to a separate circuit.
- **Equipment Under Maintenance:** Ensure that all equipment under maintenance has all of its PSUs disconnected.
- **Battery Replacement:** Use compatible battery types to avoid a potential explosion. Dispose of depleted batteries according to provided instructions.

# Identifying NICs and Choosing Transceivers and Cables for Your Qumulo Node

This section explains how to identify the NICs in your nodes and choose the correct transceivers and cables.

## Step 1: Identify the NICs in Your Nodes

Most Qumulo-certified nodes are compatible with multiple NIC models. The NIC model determines transceiver compatibility.

1. Use SSH to connect to your node.
2. Run the `lspci | grep "Ethernet controller"` command.

   > **Note**
   > This command might return information about unused NICs that have interfaces with speeds of 10 Gbps (or slower).

   A list of NICs appears. In the following example, we ran the command on a Supermicro 1114S node, which has two ConnectX-6 NICs.

   ```
   45:00.0 Ethernet controller: Broadcom Inc. and subsidiaries BCM57416 NetXtrem
   e-E Dual-Media 10G RDMA Ethernet Controller (rev 01)
   45:00.1 Ethernet controller: Broadcom Inc. and subsidiaries BCM57416 NetXtrem
   e-E Dual-Media 10G RDMA Ethernet Controller (rev 01)
   81:00.0 Ethernet controller: Mellanox Technologies MT28908 Family [ConnectX-6]
   81:00.1 Ethernet controller: Mellanox Technologies MT28908 Family [ConnectX-6]
   c5:00.0 Ethernet controller: Mellanox Technologies MT28908 Family [ConnectX-6]
   c5:00.1 Ethernet controller: Mellanox Technologies MT28908 Family [ConnectX-6]
   ```

3. To determine the speed and firmware compatibility information for the NICs in your node, refer to the following table.

| NIC Model | Speed | Firmware Compatibility Information |
|---|---|---|
| 82599ES | 10 Gbps | Intel 82599ES 10 Gigabit Ethernet Controller |

| NIC Model | Speed | Firmware Compatibility Information |
|---|---|---|
| AOC-S100G-b2C | 100 Gbps | • Supermicro Networking Cables and Transceivers Compatibility Matrix<br>• Broadcom Optical Transceivers<br>• Supported Cables for Broadcom Ethernet Network Adapters in the Broadcom Ethernet Network Adapter User Guide |
| AOC-S25G-b2S | 25 Gbps | |
| ConnectX-3 | 10 Gbps | Supported Cables and Modules in the Mellanox ConnectX-3 Firmware Release Notes |
| ConnectX-3 Pro | 40 Gbps | Supported Cables and Modules in the Mellanox ConnectX-3 Pro Firmware Release Notes |
| ConnectX-4 | 40 Gbps | Firmware Compatible Products in the NVIDIA Mellanox ConnectX-4 Adapter Cards Firmware Release Notes |
| ConnectX-4 Lx | 25 Gbps | Firmware Compatible Products in the NVIDIA ConnectX-4 Lx Adapter Cards Firmware Release Notes |
| ConnectX-5 | 100 Gbps | Firmware Compatible Products in the NVIDIA ConnectX-5 Adapter Cards Firmware Release Notes |
| ConnectX-6 | 100 Gbps | Firmware Compatible Products in the NVIDIA ConnectX-6 Adapter Cards Firmware Release Notes |
| ConnectX-6 Dx | 100 Gbps | Firmware Compatible Products in the NVIDIA ConnectX-6 Dx Adapter Cards Firmware Release Notes |
| E810-CQDA2 | 100 Gbps | Intel Ethernet Network Adapter E810-2CQDA2<br>**Note**<br>Intel might support, but doesn't verify, third-party transceiver compatibility. |

| NIC Model | Speed | Firmware Compatibility Information |
|---|---|---|
| E810-XXVDA2 | 25 Gbps | Intel Ethernet Network Adapter E810-XXVDA2<br><br>**Note**<br>Intel might support, but doesn't verify, third-party transceiver compatibility. |
| P2100G | 100 Gbps | • Broadcom Optical Transceivers<br>• Supported Cables for Broadcom Ethernet Network Adapters in the Broadcom Ethernet Network Adapter User Guide |
| P225P | 25 Gbps | |

## Step 2: Choose Transceivers for Your Nodes

This section lists and explains the differences between the types of transceivers available for your nodes.

- **Lucent Connector (LC):** The LC with two fibers is very common for 10 Gbps and 25 Gbps connections.

  **Note**
  Although there are transceivers that can use LC fiber optic cables for 40 Gbps and 100 Gbps connections, these transceivers are generally more expensive, consume more power, and are mainly intended for reusing LC cabling, or for long-distance applications.

- **Lucent Connector Duplex (LC Duplex):** The LC duplex with two fibers is the most common standard for 25 Gbps connections. The maximum short-range connection is 100 m and long-range connection is 10 km. There is also an extended-range standard with a maximum of 40 km.
- **Multi-Fiber Push On (MPO):** The MPO connector with eight fibers is a common connector for 40 Gbps connections.
- **PAM4:** Some newer switches can establish 100 Gbps connections by using double 50 Gbps PAM4 connections instead of the more common four 25 Gbps connections. For information about configuring Pulse Amplitude Modulation 4-level (PAM4), see Auto-Negotiation on Ethernet NIC Controllers in the Broadcom documentation.

- **SR4:** The SR4, with four QSFP28 connections over an eight-fiber cable, is the most common and cost-efficient standard for 100 Gbps connections. The maximum range for SR4 is 100 m.

## Step 3: Choose Cables for Your Transceivers

This section lists and explains the differences between the types of cables available for your transceivers.

> **Note**
> If you use DAC or AOC cables, ensure that the manufacturers of your NIC and network switch both support your cables.

- **Optical Cables:** We recommend using optical cables and optical transceivers that both the NIC and the switch support.
- **Direct Attach Cables (DACs):** Although these cables are significantly cheaper than optical cables and are less prone to compatibility and thermal issues, they are limited in length (2-3 m, up to 5 m maximum).
- **Active Optical Cables (AOCs):** Although these cables are cheaper than dedicated transceivers and fiber optic cables, they might cause compatibility issues, or your NIC or switch might not support them.

# Creating a Qumulo Core USB Drive Installer

This section explains how to create a Qumulo Core USB Drive Installer on macOS or Windows.

## How is the Qumulo Core Product Package Different from the Qumulo USB Installer?

Whereas the Qumulo USB Installer is designed for specific models of third-party hardware bundled with Qumulo Core, the Qumulo Core Product Package is designed for installation on your own hardware.

Because Qumulo has no control over the host operating system (OS), the following are the main differences in functionality between the two.

- **Web UI:** The Qumulo Core Product Package has no kiosk mode. The Qumulo Core Web UI runs directly on your node.
- **Well-Known `admin` User:** When you use the Qumulo Core Product Package, changing the `admin` user's password has no effect on the host OS. You must create your own users on the host OS.
- **Automatic SSH Configuration:** Any SSH configuration set by using `multitenancy` REST APIs have no effect on the host OS. You must configure SSH on the host OS.
- **System Partitions and Directories:** The Qumulo Core Product Package has no `/config` partition for storing logs and container images or `/history` partitions for storing configuration files.
  The Qumulo Core container stores logs and container images in the `/var/opt/qumulo/history` directory and configuration files in the `/etc/qumulo` directory. You can also configure your own mounts and partitions on the host OS.
- **Core Dump Handler:** You must configure the core dump handler on the host OS. For more information, see `core` Linux Manual Page.

For more information, see Installing the Qumulo Core Product Package in the Qumulo On-Premises Administrator Guide.

## Prerequisites

- USB 3.0 (or higher) drive (8 GB minimum)
- Qumulo Core USB installer image (to get the image, contact the Qumulo Care team)

## To Create a USB Drive Installer on macOS

1. Open Terminal and log in as `root` by using the `sudo -s` command.
2. Insert your USB drive and then find its disk label by using the `diskutil list` command.

In the following example, the USB drive's device label is `disk2`.

```
/dev/disk2 (external, physical):
   #:                       TYPE NAME                    SIZE       IDENTIFIER
   0:             Windows_FAT_32 MY_USB_DRIVE            *32.0 GB    disk2
```

3. To unmount the USB drive, use your USB drive's device label. For example:

```
diskutil unmountDisk /dev/disk2
```

4. To write the Qumulo Core USB installer image to your USB drive, specify the path to your image file and the USB drive's device label. For example:

```
dd if=/path-to-image-file/ of=/dev/rdisk2 bs=2m
```

> **Note**
> If you encounter an **Operation not permitted** error in macOS, do the following.
>
> a. Navigate to **System Preferences > Security & Privacy**.
>
> b. On the **Privacy** tab, grant **Full Disk Access** to Terminal.
>
> c. Restart Terminal and try the command again.
>
> d. When finished, remove **Full Disk Access** from Terminal.

5. Eject your Qumulo Core USB Drive Installer. For example:

```
diskutil eject disk2
```

## To Create a USB Drive Installer on Windows

To create a USB Drive Installer on Windows, you must use a third-party application such as Rufus. We recommend Rufus because it can detect many USB storage devices (rather than only Windows-compatible ones).

⚠ Important

- We don't recommend using other tools (such as Win32 Disk Imager) because they might encounter errors when unable to recognize the USB drive after writing data to it.
- When the operation concludes, you might not be able to view the contents of the USB drive on Windows because the drive will be formatted by using a different file system.

1. Insert your USB drive and run Rufus.
2. Under **Drive Properties**, select a device and the path to the Qumulo Core USB installer image.
3. For **Partition scheme**, select **MBR** and for **Target System**, select **BIOS or UEFI**.
4. Under **Format Options**, ensure that the **File system** is set to **FAT32 (Default)**.
5. Click **Start**.
6. If prompted to download a new version of `GRUB` or `vesamenu.c32`, click **No**.
7. When the **ISOHybrid image detected** dialog box appears, click **Write in DD Image mode** and then click **OK**.

   ⚠ Important
   For this operation to succeed, you must use DD Image mode.
8. To confirm the operation, destroy all data on the USB drive, and image the drive click **OK**.

# Creating and Configuring a Qumulo Cluster with Your Nodes

This section explains how to prepare your platform nodes for creating a Qumulo cluster.

## Step 1: Boot by Using the Qumulo Core USB Drive Installer

1. Insert a USB drive with the Qumulo Core installer (page 7) into an available port and power on the node.
2. When the node begins to boot, enter the boot menu.

   > **Note**
   > The boot setting is persistent: When you boot from a USB drive once, the node continues to boot from the USB drive. After you finish installing Qumulo Core, remove the USB drive from the node.

3. On the boot drive selection screen, select your USB drive (usually labeled with `UEFI OS`) and boot into it.

   The Qumulo Core installation begins.

## Step 2: Create and Configure Your Cluster

1. Review the **End User Agreement**, click **I agree to the End User Agreement**, and then click **Submit**.
2. Name your cluster.
3. On the **1. Set up cluster** page, select the nodes to add to your cluster.

   As you select nodes, the installer updates the total capacity of your cluster at the bottom of the page.

   > **Note**
   > If any nodes are missing, confirm that they are powered on and connected to the same network.

4. Confirm that the individual nodes have the expected capacity.
5. On the **2. Confirm cluster protection level** page, Qumulo Core selects the recommended 2, 3, or 4-drive protection level based on your cluster size and node type.
6. If the **Customize Protection Level** option appears, you can increase your system resilience by selecting 3- or 4-drive protection.

> ⚠ Important
>
> - Qumulo Core 6.1.0.1 and 6.1.1 support Adaptive Data Protection by letting you reconfigure your cluster's fault tolerance level and storage efficiency only when you add nodes to your cluster.
>
>  Depending on your cluster, Qumulo Core shows configuration options that offer better fault tolerance levels, better storage efficiency, or both benefits. To enable Adaptive Data Protection for your cluster, you must contact the Qumulo Care team .
> - In Qumulo Core 6.1.2 (and higher), you can change your cluster's data protection configuration when you add or replace nodes by using the `qq` CLI.
> - Using 3- or 4-drive protection reduces the total capacity of your cluster.

7. Enter a password for the administrative account and click **Create Cluster**.
8. To access the Qumulo Core Web UI, connect to any node by entering its IP address into a browser.

# Configuring Cluster Networking

## Networking a Qumulo Cluster with a Unified Networking Configuration

This section explains how to network a cluster with platforms that use a unified networking configuration.

**Tip**
To identify the `eth` port, run the following command:

```
for i in /sys/class/net/eth*; \
  do echo $i; \
  cat $i/device/uevent | \
  grep -i pci_slot; \
  done
```

### Prerequisites

**Note**
Before you create your Qumulo cluster, if your client environment requires Jumbo Frames (9,000 MTU), configure your switch to support a higher MTU.

Your node requires the following resources.

- A network switch with the following specifications:
    - Ethernet
    - Fully non-blocking architecture
    - IPv6 capability
- Compatible networking cables
- A sufficient number of ports for connecting all nodes to the same switch fabric
- One static IP for each node, for each defined VLAN

## Recommended Configuration

This platform uses a *unified networking configuration* in which the same NIC handles back-end and front-end traffic. In this configuration, each networking port provides communication with clients and between nodes. You can connect the NIC's ports to the same switch or to different switches. However, for greater reliability, we recommend connecting both ports on every node to each switch.

We recommend the following configuration for your node.

- Your Qumulo MTU configured to match your client environment
- Two physical connections for each node, one connection for each redundant switch
- One Link Aggregation Control Protocol (LACP) port-channel for each network on each node, with the following configuration
    - Active mode
    - Slow transmit rate
    - Access port or trunk port with a native VLAN
- DNS servers
- A Network Time Protocol (NTP) server
- Firewall protocols or ports allowed for proactive monitoring
- Where `N` is the number of nodes, `N-1` floating IP addresses for each node, for each client-facing VLAN

## Connecting to Redundant Switches

For redundancy, we recommend connecting your cluster to dual switches. If either switch becomes inoperative, the cluster is still be accessible from the remaining switch.

- Connect the two NIC ports on your nodes to separate switches.
- The uplinks to the client network must equal the bandwidth from the cluster to the switch.
- The two ports form an LACP port channel by using a multi-chassis link aggregation group.
- Use an appropriate inter-switch link or virtual port channel.

## Connecting to a Single Switch

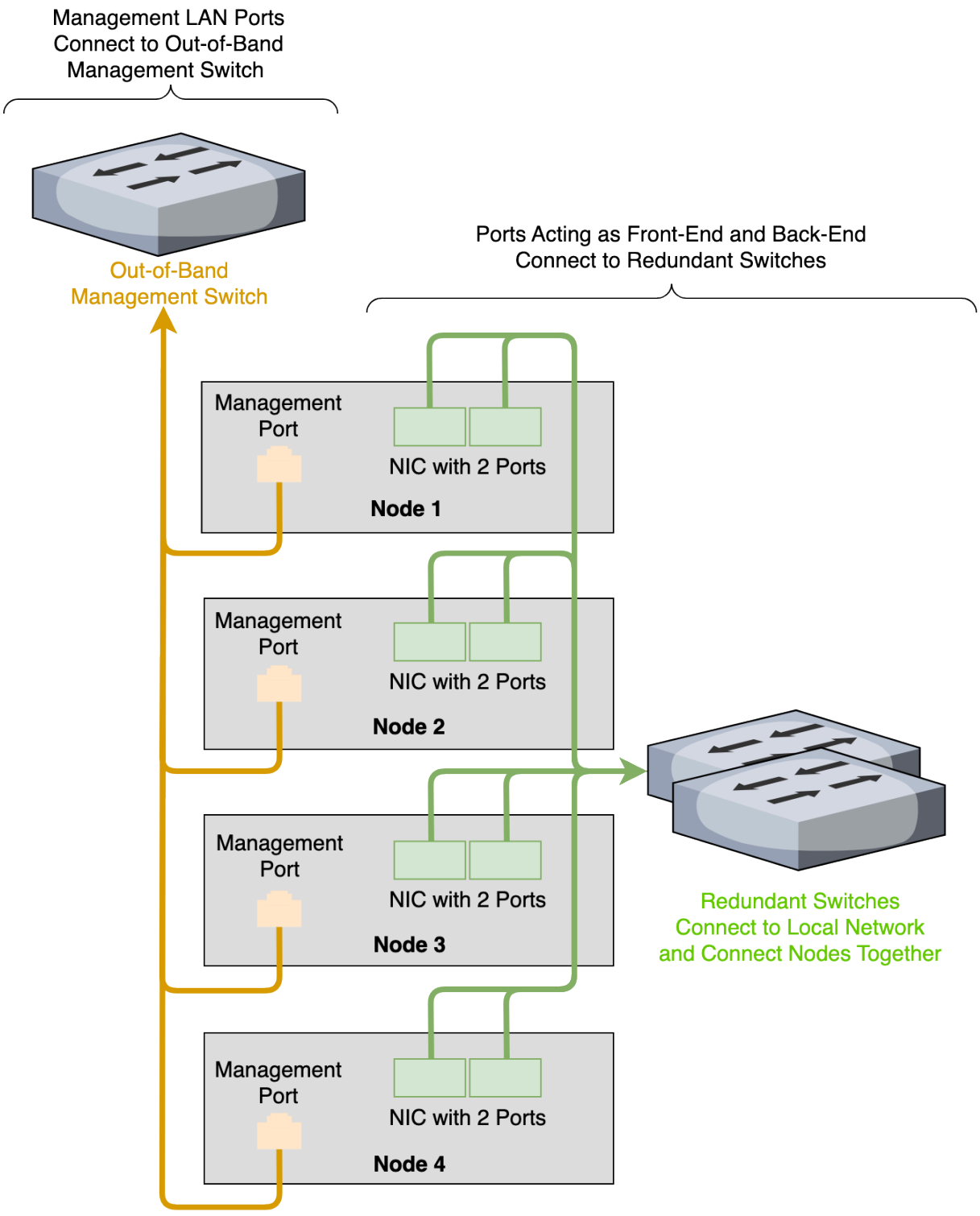
You can connect a your cluster to a single switch. If this switch becomes inoperative, the entire cluster becomes inaccessible.

- Connect the two NIC ports on your nodes to a single switch.

- The uplinks to the client network must equal the bandwidth from the cluster to the switch.
- The two ports form an LACP port channel.

## Four-Node Cluster Architecture Diagram

The following is the recommended configuration for a four-node cluster connected to an out-of-band management switch and redundant switches.


Management LAN Ports
Connect to Out-of-Band
Management Switch
Out-of-Band
Management Switch
Ports Acting as Front-End and Back-End
Connect to Redundant Switches
Management
Port
NIC with 2 Ports
Node 1
Management
Port
NIC with 2 Ports
Node 2
Management
Port
NIC with 2 Ports
Node 3
Management
Port
NIC with 2 Ports
Node 4
Redundant Switches
Connect to Local Network
and Connect Nodes Together

# Networking a Qumulo Cluster with a Split Networking Configuration

This section explains how to network a cluster with platforms that use a split networking configuration.

**Tip**
To identify the `eth` port, run the following command:

```
for i in /sys/class/net/eth*; \
  do echo $i; \
  cat $i/device/uevent | \
  grep -i pci_slot; \
  done
```

## Prerequisites

**Note**
Before you create your Qumulo cluster, if your client environment requires Jumbo Frames (9,000 MTU), configure your switch to support a higher MTU.

Your node requires the following resources.

- A network switch with the following specifications:
    - Ethernet
    - Fully non-blocking architecture
    - IPv6 capability
- Compatible networking cables
- A sufficient number of ports for connecting all nodes to the same switch fabric
- One static IP for each node, for each defined VLAN

## Recommended Configuration

> **Important**
> We don't recommend connecting to a single back-end NIC port because the node becomes unavailable if the single connection fails.

This platform uses a *split networking configuration* in which different NICs handle back-end and front-end traffic. You can connect the front-end and back-end NICs to the same switch or to different switches. However, for greater reliability, we recommend connecting all four ports on every node: Connect both front-end NIC ports to the front-end switch and both back-end NIC ports to the back-end switch.

We recommend the following configuration for your node.

- Your Qumulo front-end MTU configured to match your client environment
- One set of redundant switches for the back-end network (9,000 MTU minimum)

  > **Note**
  > You can configure front-end and back-end traffic on the same switch.

- One physical connection for each node, for each redundant switch
- One Link Aggregation Control Protocol (LACP) port-channel for each network (front-end and back-end) on each node, with the following configuration
  - Active mode
  - Slow transmit
  - Access port or trunk port with a native VLAN
- DNS servers
- A Network Time Protocol (NTP) server
- Firewall protocols or ports allowed for proactive monitoring
- Where `N` is the number of nodes, `N-1` floating IP addresses for each node, for each client-facing VLAN

## Connecting to Redundant Switches

For redundancy, we recommend connecting your cluster to dual switches. If either switch becomes inoperative, the cluster is still be accessible from the remaining switch.

- Front End
  - Connect the two front-end NIC ports on your nodes to separate switches.

    - The uplinks to the client network must equal the bandwidth from the cluster to the switch.
    - The two ports form an LACP port channel by using a multi-chassis link aggregation group.
- Back End
    - Connect the two back-end NIC ports on your nodes to separate switches.
    - Use an appropriate inter-switch link or virtual port channel.
- Link Aggregation Control Protocol (LACP)
    - For all connection speeds, the default behavior is that of an LACP with 1,500 MTU for the front-end and 9,000 MTU for the back-end interfaces.

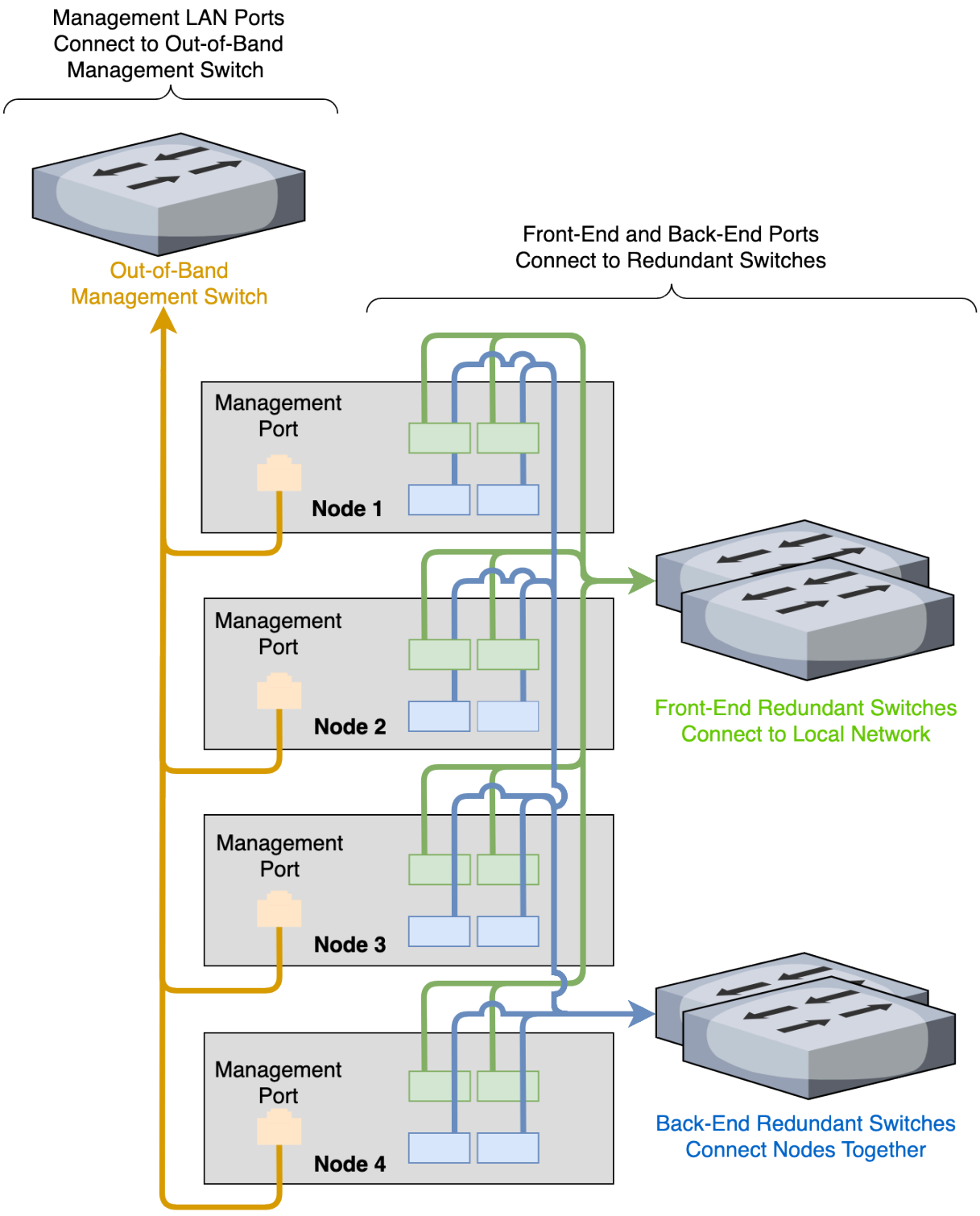
## Connecting to a Single Switch

You can connect your cluster to a single switch. If this switch becomes inoperative, the entire cluster becomes inaccessible.

- Front End
    - Connect the two front-end NIC ports to a single switch.
    - The uplinks to the client network must equal the bandwidth from the cluster to the switch.
    - The two ports form an LACP port channel.
- Back End
    - Connect the two band-end ports to a single switch.
- Link Aggregation Control Protocol (LACP)
    - For all connection speeds, the default behavior is that of an LACP with 1,500 MTU for the front-end and 9,000 MTU for the back-end interfaces.

## Four-Node Cluster Architecture Diagram

The following is the recommended configuration for a four-node cluster connected to an out-of-band management switch and redundant switches.


Management LAN Ports
Connect to Out-of-Band
Management Switch
Out-of-Band
Management Switch
Front-End and Back-End Ports
Connect to Redundant Switches
Management
Port
Node 1
Management
Port
Node 2
Management
Port
Node 3
Management
Port
Node 4
Front-End Redundant Switches
Connect to Local Network
Back-End Redundant Switches
Connect Nodes Together

# Replacing Hardware Components in Your Nodes

This section explains how to replace hardware components in your platform's nodes.

For detailed instructions, see the documentation from your hardware vendor.

## Locating a Failed Drive

Gold-Tier hardware doesn't use predefined drive mapping or panel LEDs to indicate drive health.

### To Locate a Failed Drive by using the Web UI

1. Log in to Qumulo Core.
2. Click **Cluster** > **Overview** and then click the name of the node with a failed drive.
3. On the page for the node, under **Drive Details**, the serial number for the failed drive is listed.
4. Use the failed drive's serial number and a server management tool to determine the physical location of the failed drive.

## Initializing a Replacement Boot Drive

After you replace the boot drive, you must initialize the replacement boot drive by using the Qumulo Core Installer.

### To Initialize the Replacement Boot Drive

1. To get the correct version of the Qumulo Core Installer for the node in your cluster, contact the Qumulo Care team.
2. Create a Qumulo Core USB Drive Installer (page 0).
3. Power on your node, enter the boot menu, and select your USB drive.

   The Qumulo Core Installer begins to run automatically.
4. When prompted, take the following steps:
   a. Select `[x] Perform maintenance`.
   b. Select `[1] Boot drive reset`.

   The Qumulo Core Installer initializes the boot drive.
5. After the process is complete reboot your node.

   Your node rejoins the cluster automatically.