Abstract
This guide provides information for the planning of a VMware vSAN 2-node cluster infrastructure on a VxRail platform. This guide focuses on the VxRail implementation of the vSAN 2-node cluster, including minimum requirements and recommendations.

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Revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
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<tr>
<td>June 2019</td>
<td>Removed Remote or Branch Office (ROBO) licensing requirement</td>
</tr>
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<td>March 2020</td>
<td>Updated to support switch changes made in VxRail v4.7.410</td>
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1 Overview

VMware vSAN 2-node cluster is a configuration that is implemented in environments where a minimal configuration is a key requirement.

VxRail v4.7.100 was the first release to support the vSAN 2-node cluster with direct-connect configuration. Starting with VxRail v4.7.410, vSAN 2-node cluster with switch configuration is also supported.

Note: A minimum of 4 ports are required for both configurations.

This guide provides information for the planning of a vSAN 2-node cluster infrastructure on a VxRail platform. This guide focuses on the VxRail implementation of the vSAN 2-node cluster, including minimum requirements and recommendations.

For detailed information about VMware vSAN 2-node cluster architecture and concepts, see the VMware vSAN 2-Node Guide.

1.1 Introduction

A VMware vSAN 2-node cluster on VxRail consists of a cluster with two VxRail nodes, and a Witness host deployed as a virtual appliance. The VxRail cluster is deployed and managed by VxRail Manager and VMware vCenter Server.

A vSAN 2-node configuration is very similar to a stretched-cluster configuration. If there is a failure, the Witness host is the component that provides quorum for the two data nodes. As in a stretched-cluster configuration, the requirement for one Witness per cluster still applies.

Unlike a stretched cluster, the vCenter Server and the Witness host are typically located in a main data center, as shown in Figure 1. The two vSAN data nodes are in a remote location. Even though the Witness host can be deployed at the same site as the data nodes, the most common deployment for multiple 2-node clusters is to have multiple Witnesses hosted in the same management cluster as the vCenter Server. This deployment optimizes the infrastructure cost by sharing the vSphere licenses and the management hosts.

This design is facilitated by the low bandwidth that is required for the communication between data nodes and the Witness.
A vSAN 2-node configuration maintains the same high availability characteristics as a regular cluster. Each physical node is configured as a vSAN fault domain. This means that the virtual machines can have one copy of data on each fault domain. If a node or a device fails, the virtual machine remains accessible through the alternate replica and Witness components.

When the failed node is restored, the Distributed Resource Scheduler (DRS) automatically rebalances the virtual machines between the two nodes. DRS is highly recommended and requires a vSphere Enterprise edition license or higher.
2 Requirements, Recommendations, and Restrictions

2.1 VxRail hardware
The vSAN 2-node configuration is supported using the VxRail E, P, V, or S series appliances. The systems can be configured with the following Network Daughter Cards:

- 4 x 10 GbE
- 2 x 1 GbE + 2 x 10 GbE

![Figure 2 Front and back views of the VxRail Appliance](image)

2.2 VxRail software version
VxRail v4.7.100 or later supports the vSAN 2-node cluster with direct-connect configuration.

VxRail v4.7.410 or later supports the vSAN 2-node cluster with switch configuration.

2.3 VMware vCenter Server
The vSAN 2-node cluster must be connected to an external vCenter Server at the time of its deployment.

- VMware vCenter Server version requirements:
  - Version 6.7u1 or later is required for 2-node cluster with direct-connect configuration.
  - Version 6.7u3 or later is required for switch configurations.
- The vCenter Server must be deployed before the deployment of the 2-node cluster.
- vCenter Server cannot be deployed on the 2-node cluster.

2.4 Witness virtual appliance
VMware supports both physical ESXi hosts and a virtual appliance as a vSAN Witness host. VxRail v4.7.100 only supports using the vSAN Witness virtual appliance as a vSAN Witness host. The Witness virtual appliance does not consume extra vSphere licenses and does not require a dedicated physical host.

Note: The Witness ESXi OVA host deploys a Virtual Standard witness Switch (vSS). See the VMware documentation for more details.

2.4.1 Software version

- vSAN Witness appliance version 6.7u1 or later is required.
- Witness appliance must be at the same vSAN version as the ESXi hosts.
- The vSphere license is included and hard-coded in the Witness virtual appliance.
2.4.2 Installation

- The Witness appliance must be installed, configured, and added to vCenter inventory before the vSAN 2-node cluster on VxRail deployment.
- The Witness appliance must have connectivity to both vSAN nodes.
- The Witness appliance must be managed by the same vCenter Server that is managing the 2-node cluster.
- A Witness appliance can only be connected to one vSAN 2-node cluster.
- The general recommendation is to place the vSAN Witness host in a different data center, such as a main data center or a cloud provider.
- The Witness can run in the same physical site as the vSAN data nodes. However, it cannot be placed in the 2-node cluster to which it provides quorum.
- It is possible to deploy the Witness appliance on another 2-node cluster, but it is not recommended. A VMware RPQ is required for this solution design.
- Direct-connect configurations require Ports 1 and 2 to be directly connected to the switches. Ports 3 and 4 from Node 1 are directly connected to Ports 3 and 4 of Node 2 respectively.
- Switched configurations require all four ports to be connected to the switches.

2.4.3 Sizing

- There are three typical sizes for a witness appliance that can be selected during deployment: Tiny, normal, and large. Each option has different requirements for compute, memory, and storage. Select the appropriate size from the deployment drop-down menu.
- The general recommendation is to use the normal size. However, 2-node clusters with up to 25 VMs are good candidates for the “Tiny” option because they are less likely to reach or exceed 750 components.
  - Each storage object is deployed on vSAN as a RAID tree and each leaf of the tree is said to be a component. For instance, when we deploy a VMDK with a RAID-1 mirror, we will have a replica component in one host and another replica component in another host. The number of stripes that are used has an effect. For example, if using two stripes we will have two replica components in each host.

2.5 Physical network

In releases earlier than 4.7.410, the two vSAN data nodes must be directly connected using SFP+ or Cat6 cables. Starting with VxRail 4.7.410, the two vSAN data nodes can be connected through the switch.

The following physical layout is enforced:

- Either a 1 GbE or a 10 GbE switch is supported. 1 GbE switch is only supported in a directly connected configuration.
- Ports 1 and 2 of the VxRail Appliances are connected to a switch and used for the management and witness traffic. If the ports are connected to a 1 GbE switch, port speed auto-negotiates down to 1 Gb.
- If direct-connect is desired, Ports 3 and 4 from Node 1 are directly connected to Ports 3 and 4 of Node 2 respectively and are used for vSAN and vMotion traffic.
- If switched configuration is desired, all four ports must be connected to the switches.
2.6 Port requirements

The following table lists the services that are needed. The incoming and outgoing firewall ports for these services should be opened. See the https://ports.vmware.com/home/vSphere for the latest list of firewall ports.

<table>
<thead>
<tr>
<th>Table 1 Service ports on VxRail Appliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services</td>
</tr>
</tbody>
</table>

Figure 3 Direct-connect port configuration

Figure 4 ToR switch port configuration single switch (left) dual switch (right)
### 2.7 Witness and Management network topology

VMware recommends that the vSAN communications between vSAN nodes and the vSAN Witness host be:

- Layer 2 (same subnet) for configurations with the Witness host in the same location
- Layer 3 (routed) for configurations with the Witness host in an alternate location such as at the main data center
  - A static route is required.

The maximum supported roundtrip time (RTT) between the vSAN 2-node cluster and the Witness is 500 milliseconds (250 milliseconds each way).

In the VxRail implementation of the vSAN 2-node cluster, a VMkernel interface is designated to carry traffic destined for the Witness host.

![Diagram](image)

**Figure 5** Direct-connect port configuration for traffic between 2-node cluster and Witness host

Each vSAN host’s vmk5 VMkernel interface is tagged with “witness” traffic. When using Layer 3, each vSAN host must have a static route configured for vmk5 and be able to properly access the vmk1 on the vSAN Witness host, which is tagged with “vSAN” traffic.

Likewise, the vmk1 interface on the Witness host must have a static route configured to properly communicate with vmk5 on each vSAN host.
2.8 Network layout

The following chart illustrates the network layout that is used by VxRail in the configuration of a vSAN 2-node cluster. One additional VLAN is needed for Witness traffic separation. This layout is specific to the VxRail vSAN 2-node cluster. The configuration of the management cluster is slightly different as described in the VxRail Networking Guide.

![Network layout of a VxRail vSAN 2-node cluster](image)

2.9 Capacity planning considerations

In this section, we offer general recommendations for storage, CPU, memory, and link bandwidth sizing.

2.9.1 Storage capacity

- A minimum of 25% to 30% of spare storage capacity is required for a 2-node cluster.
- Note that in a 2-node cluster, the protection method will be RAID-1 and if a node fails, the surviving node will continue to operate with a single object’s component.

2.9.2 CPU and memory capacity

- When defining CPU and memory capacity, consider the minimum capacity required to satisfy the VM requirements while in a failed state.
- The general recommendation is to size a cluster to operate below 50% of the max CPU required, taking in consideration the projected growth in consumption.
2.9.3 Network Bandwidth

Our measurements indicate that a regular T1 link can satisfy the network bandwidth requirements for the communications between Data Nodes <> vCenter Server and Data Nodes <> Witness Appliances. However, for the purpose of adapting the solution to different service level requirements, it is important to understand in more details the requirements for:

- Normal cluster operations
- Witness contingencies
- Services, such as maintenance, lifecycle management, and troubleshooting

![Network Bandwidth Diagram](image)

**Figure 8**  Network bandwidth planning considerations

2.9.3.1 Normal cluster operations

- Normal cluster operations include the traffic between data nodes, vCenter Server, and the Witness appliance.
• During normal operations, the bulk of the traffic is between data nodes and vCenter Server. This traffic is affected primarily by number of VMs and number of components but, is typically very light load.
• Our measurements of a cluster with 25 VMs and near 1,000 components indicated a bandwidth consumption lower than 0.3 Mbps.

2.9.3.2 Witness contingencies
• The Witness appliance does not maintain any data, only metadata component.
• The Witness traffic can be influenced by the I/O workload running in the cluster, but in general, this is very small traffic while the cluster is in a normal state.
• In the event the master node fails or is partitioned, the following occurs:
  o vSAN powers off the VMs in the failed host.
  o The secondary node is elected as the HA master. The Witness host sends updates to the new master, followed by the acknowledgment from the master that the ownership is updated.
  o 1,138 bytes is required for each component update.
  o When the update is completed, quorum is formed between the secondary host and the Witness host, allowing the VMs to have access to their data and be powered on.
• The failover procedure requires enough bandwidth to allow for the ownership of components to change within a short interval of time.
• Our recommendation for a 2-node cluster with up to 25 VMs is that at least 0.8 Mbps be available to ensure a successful failover operation.

2.9.3.3 Maintenance, lifecycle management and troubleshooting
• The amount of bandwidth reserved for maintenance, lifecycle management and troubleshooting are determined primarily by the desired transfer times for large files.
• The log files that are used in troubleshooting are compressed and typically can be transferred in a reasonable time.
• The composite files that are used for software and firmware upgrades can be up to 4.0 GB and can take a long time to be transferred when using a T1 link. The bandwidth requirements should be evaluated in case you have specific maintenance window requirements.
  o As a reference, if using a T1 link, we expect that at least 1 Mb/s of bandwidth is available for the transfer of the composite file. We estimate that this transfer will take about nine hours.

2.10 Upgrade options
VxRail supports two options for node upgrades:

1) Fully automated
   a. All components including Witness nodes are upgraded using VxRail LCM.
2) Manual Witness node upgrade
   a. Users manually upgrade witness nodes
   b. All other components are automatically upgraded using VxRail LCM.

2.11 Licensing
The vSAN licensing editions that are listed in the following table can be used on a vSAN 2-node cluster.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Standard</th>
<th>Advanced</th>
<th>Enterprise</th>
<th>Enterprise Plus</th>
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<td>✓</td>
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<td>Virtual Distributed Switch</td>
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<td>All-Flash Hardware</td>
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<td>✓</td>
<td></td>
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<tr>
<td>QoS – IOPS Limit</td>
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<tr>
<td>Cloud Native Storage</td>
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<tr>
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<tr>
<td>RAID-5/6 Erasure Coding</td>
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<td>✓</td>
<td></td>
</tr>
<tr>
<td>Stretched Cluster with Local Failure Protection</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9  vSAN licensing options

**Note:** VxRail 2-node cluster does not support expansion to more than two nodes.

While vSAN ROBO licenses are supported for VxRail vSAN 2-node clusters, these licenses are not orderable through VxRail. Witness Appliance license is not required but the host where the Witness resides needs the appropriate vSphere license. For more information, see the VMware vSAN Licensing guide.
3 Deployment Types

3.1 Centralized management (Option 1)
In this scenario, the vCenter Servers and Witness virtual appliances are deployed at the same management cluster located at a main data center. One vCenter Server instance can manage multiple VxRail vSAN 2-node clusters but each VxRail vSAN 2-node cluster must have its own Witness.

Network bandwidth must meet the requirements stated earlier. Enhanced link mode is recommended.

![Diagram of centralized management of vCenter Server and Witness appliances](image)

Figure 10  Centralized management of vCenter Server and Witness appliances

3.2 Centralized management, localized Witness (Option 2)
In this deployment option, the vCenter server is located at the main data center, but the vSAN Witness appliance and the two VxRail nodes are at the same location. An additional ESXi host is required to host the vSAN Witness appliance. vSAN Witness appliance cannot be hosted in the VxRail 2-node cluster.

![Diagram of centralized vCenter with local Witness Appliances](image)

Figure 11  Centralized vCenter with local Witness Appliances
3.3 Localized management and Witness (Option 3)

In this option, the three fault domains are at the same location; the vCenter Server, vSAN Witness appliance, and the VxRail nodes. An additional ESXi host is required to host vSAN Witness appliance and customer-supplied vCenter Server. vSAN Witness appliance, and customer-supplied vCenter cannot be hosted in the VxRail vSAN 2-node cluster.

Figure 12  Localized vCenter and Witness Appliance

**Deployment options considerations**

<table>
<thead>
<tr>
<th>Option</th>
<th>Pros</th>
<th>Cons</th>
</tr>
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<td>Single pane of glass for the management of multiple 2-node clusters</td>
<td>Network costs for vCenter and Witness communications</td>
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<tr>
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<td>Centralization of Witness appliances reduces licensing and hardware costs.</td>
<td></td>
</tr>
<tr>
<td>Centralized Management, localized Witness</td>
<td>Single pane of glass for the management of multiple 2-node clusters</td>
<td>Network costs for vCenter communications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Software and hardware costs for deployment of witness appliances</td>
</tr>
<tr>
<td>Localized management and witness</td>
<td>Reduces network cost that is associated to normal operations and witness contingency</td>
<td>Software and hardware costs for deployment of multiple vCenter Servers and witness appliances</td>
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<tr>
<td></td>
<td></td>
<td>Network Bandwidth that is still needed for maintenance and troubleshooting which is the larger bandwidth requirement</td>
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</table>
4 Conclusion

Starting with VxRail 4.7.100, VMware vSAN 2-node cluster direct connect is supported. Switch configuration is supported in v4.7.410 or later. A VMware vSAN 2-node cluster is a minimal configuration consisting of two vSAN data nodes and a Witness virtual appliance.

vSAN 2-node cluster can easily be deployed anywhere. Many vSAN 2-node clusters can be managed by a single vCenter instance. This minimal configuration continues to provide the same functional benefits of vSphere and vSAN. It enables an efficient centralized management with reduced hardware and software costs, while meeting the needs of environments with limited space, budget and/or IT personnel constraints.
References