VMware Virtual SAN Cookbook

VMware Virtual SAN is a radically simple, hypervisor-converged storage system designed and optimized for vSphere virtual infrastructure. Traditional storage solutions such as monolithic storage arrays and complex management tools are often ill-suited to the needs of the modern data center. Software-defined storage solutions, such as VMware Virtual SAN, integrate the storage side of the infrastructure with the server side and can simplify management and improve flexibility.

You will start with an introduction to VSAN and object storage, before moving on to hardware selection. Later, you will go through the preparation that must be performed in your existing infrastructure to support the pending VSAN deployment. Next, you will touch base with Storage Policy-based Management and also cover policy changes, maintenance, validation, and troubleshooting VSAN. Finally, you will move on to recipes which will help expedite the problem resolution process that will provide you with all the information required to find a rapid resolution.

Who this book is written for
If you are an administrator of a VMware vSphere infrastructure who wants to simplify storage delivery by integrating storage into vSphere, Virtual SAN is for you. No extensive storage background is needed as VMware Virtual SAN integrates into the existing vSphere solutions with which you are already familiar.

What you will learn from this book
- Prepare your infrastructure for VMware Virtual SAN
- Plan and build a solution that will suit your needs
- Implement VMware Virtual SAN
- Harness the power of policy-based management
- Increase or decrease the scale of your Virtual SAN as needs change
- Monitor your Virtual SAN infrastructure effectively
- Respond to and troubleshoot problems
- Understand the technical underpinnings of VMware Virtual SAN

In this package, you will find:

- The author biography
- A preview chapter from the book, Chapter 1 'Hardware Selection for Your VSAN Cluster'
- A synopsis of the book’s content
- More information on VMware Virtual SAN Cookbook
Jeffrey Taylor is an IT professional with deep knowledge of VMware vSphere and storage infrastructures. He has been working with VMware's global support services for nearly 5 years and is currently a staff engineer with a focus on Virtual SAN and storage infrastructure. Before his current role, he worked on a variety of software platforms for a global financial processor, with an emphasis on Unix/Linux midrange systems and mission-critical distributed applications.
VMware Virtual SAN (VSAN) is the converged storage solution for VMware vSphere.

Integrated directly into the hypervisor, this is a native solution with no VM-based intermediaries for storage delivery. As a result, VSAN is fast, simple to deploy and manage, and integrates tightly with the existing VMware vSphere product suite.

As the solution is native to ESXi and runs on the hypervisor itself, its architecture is simplified and the storage-delivery mechanism is tightly integrated and uniquely suited to the needs of vSphere infrastructures. VSAN is an object-oriented storage solution, where each VM is comprised of a number of objects physically distributed across the ESXi cluster. This object-oriented nature means that access to your data happens natively, without the need for traditional intermediate storage protocols like iSCSI or Fibre Channel.

VSAN’s object-oriented nature also means that your VMs exist as a series of distributed objects rather than a series of monolithic files. Whereas, with traditional storage, you have a series of files (configuration files, virtual disks, swap, snapshots, and so on), with VSAN you have a coordinated and related series of objects. These objects are a container for small configuration files (the namespace object, also called VM Home), objects for each virtual disk, objects for each snapshot, and an object for the VM swap space.

The key point when discussing VSAN’s architecture, is how it integrates into the existing hypervisor infrastructure to deliver the final service of any hypervisor: production virtual machines. Behind this integration of the storage and compute virtualization layers is the notion of hyper-converged infrastructure. VSAN is one element of converged infrastructure. The goal of hyper-converged infrastructure is to abstract the traditional demarcations within the environment (compute, network, and storage) by converging all aspects of the datacenter into a software-defined model with a centralized control plane and a distributed data/IO plane.
VSAN is the storage element of the software-defined datacenter. User data (VMs) is abstracted and distributed across the compute cluster. Each VM exists as a collection of related objects, distributed optimally within the compute resources. VSAN natively integrates with vCenter and its associated management tools. As a result, VSAN brings truly native, truly integrated management of the storage system into the existing and familiar vSphere operating structure.

A major benefit to this new operating model of the storage system is its simplicity and centralized management. VSAN obviates the need for traditional monolithic storage arrays connected via traditional protocols. It also significantly improves on existing virtualization-centric distributed storage solutions, typically delivered as virtual storage appliances (VSAs). Embedding the distributed storage system into the hypervisor allows for gains in performance and management. Native management through the vCenter Server means that storage for the virtual infrastructure can now be deployed and managed by the virtualization engineer.

What this book covers

Chapter 1, *Hardware Selection for Your VSAN Cluster*, provides guidance on how to build your own VSAN cluster hardware, or how to select from a VSAN Ready Node.

Chapter 2, *Initial Configuration and Validation of Your VSAN Cluster*, provides the step-by-step procedure to configure your new VSAN cluster and ensure that it is working properly.

Chapter 3, *Storage Policy-based Management*, introduces the concept of policy-based management, outlines how and why it is useful, and shows how to implement and use storage policies.

Chapter 4, *Monitoring VSAN*, outlines how to monitor the VSAN cluster following deployment and into production.

Chapter 5, *VSAN Maintenance Operations*, describes how VSAN maintenance is performed, from cluster expansion to patching to modifying virtual machines.

Chapter 6, *Ruby vSphere Console*, covers the VSAN-related aspects of the powerful RVC utility that is bundled with the vCenter Server.

Chapter 7, *Troubleshooting VSAN*, discusses how to identify and resolve various problems that may occur in the Virtual SAN environment.

Chapter 8, *Support Success*, should you need to contact VMware Support to pursue issue resolution, this chapter sets you up for success by outlining the steps you should take to ensure a smooth and rapid support engagement.

Chapter 9, *VSAN 6.0*, covers specific changes in VSAN 6.0 and calls out procedural differences between VSAN 6.0 and VSAN 5.5.
Appendix A, Chapter-specific Expansion, highlights a number of VSAN concepts that we discussed throughout this book, which can be expanded with supplementary information to improve comprehension. This information is presented on a chapter-by-chapter basis.

Appendix B, Additional VSAN Information, highlights additional technical details about Virtual SAN and provides information about useful third-party tools.
Hardware Selection for Your VSAN Cluster

In this chapter, we will discuss the following topics, with a recipe for each:

- Using the VMware Compatibility Guides
- Selecting a server platform
- Selecting a storage controller
- Selecting a solid-state drive (SSD) for the cache tier
- Selecting hard disk drives/magnetic disks
- Deciding on a network standard
- Choosing a VSAN Ready Node (an alternative option)

Introduction

VSAN can only be as good as the hardware on which it runs. VSAN has special requirements for its hardware, and so elements of your VSAN hardware will need to be selected against a stricter subset of the overall VMware Compatibility Guide. Each element of your future VSAN node will need to be compliant with the vSphere and VSAN Compatibility Guides to be production-ready and ensure that the configuration will be supported by VMware.

Depending on your specific needs, you may find that the VSAN Ready Node will better fit your needs. VSAN Ready Nodes are preconfigured systems built by the VMware hardware partners to be VSAN ready, so the machines can simply be purchased and deployed.

You will need to decide whether specifying your own system configuration, or selecting a VSAN Ready Node, is the best choice for your infrastructure. This chapter will prepare you for either choice. VSAN Ready Nodes are covered in the last recipe in this chapter.
Hardware Selection for Your VSAN Cluster

Using the VMware Compatibility Guides

While most system vendors offer hardware that is compatible with VMware vSphere, only a subset of the hardware in the VMware Compatibility Guide is applicable for use for VSAN. It is important to make sure that all applicable hardware exists in both guides. The storage-specific components like hard-disk controllers and disks must meet the more-exhaustive performance and reliability requirements for VSAN.

Getting ready

You should have some idea of your hardware requirements. This includes an estimate of your needs for system memory (RAM), along with processor power, networking needs, and storage requirements in terms of capacity and performance.

How to do it...


The first link will take you to the standard VMware Compatibility Guide, and the second will take you to the VSAN sub-guide. By default, you will land on the system/server page, to help you select a server platform.

Selecting a server platform

For VSAN, the only requirement in terms of the server platform is that it needs to appear in the regular VMware Compatibility Guide for vSphere 5.5 or 6.0, as applicable to your deployment. Any compatible/certified server is acceptable for use with VSAN.

Getting ready

You should be on the VMware Compatibility Guide Systems/Server page.

How to do it...

You will need to filter your selection to restrict output to only the relevant results. To do this, carry out the following steps:

1. Within Product Release Version, select the most recent vSphere ESXi 5.5 or ESXi 6.0 update release.
2. If you have a brand preference, select it within Partner Name.
3. While most systems in the Compatibility Guide are rack mount systems, if you have other form-factor needs, select those within System Type.
4. If you need dedicated or expanded functionality (such as graphics acceleration for VMware Horizon View or I/O redirection), make that selection within Features.
5. Select your CPU socket/core and/or brand needs within the Sockets, Max Cores per Socket, and CPU Series sections.
6. VSAN requires at least two CPU cores across one or more sockets. Any field left blank assumes an inclusive search and all subcategories will be included.
7. Once you have selected all of your requirements, click on Update and View Results to see a list of all the compatible systems meeting your criteria.

Example of the compatibility guide once filters are applied:

![Compatibility Guide Example](image-url)

Click here to Read Important Support Information.

Server Device and Model Information

The detailed lists show actual vendor devices that are either physically tested or are similar to the devices tested by VMware or VMware partners. VMware provides support only for the devices that are listed in this document. Click on the "Model" to view more details and to subscribe to RSS feeds.
Hardware Selection for Your VSAN Cluster

There's more...

VSAN does also impose additional resource needs. Depending on the size of the disks you choose and how many, VSAN will consume additional compute and memory resources. If you typically run your systems close to the margins, in terms of compute/memory resources (or if you are planning to with your new cluster), consider specifying a modest amount of additional CPU and memory in the configuration. VSAN is capped at 10 percent resource utilization for CPU and memory as a maximum, so adding at least 10 percent to your assumed consumption should leave you with comfortable operating margins.

Additionally, VSAN requires a local boot device, either an SD card, or other low-performance solid-state memory, or a dedicated hard disk drive, or SSD. The boot device should be at least 16GB, in accordance with standard VMware recommendations. If your server configuration equals/exceeds 512 GB of system RAM, then you must use a hard disk drive or SSD as your boot device to ensure supportability, otherwise, a core dump cannot be written in the event of a system crash.

Selecting a storage controller

Selecting an appropriate storage controller is one of the most important decisions you will make when creating a VSAN server configuration. The storage controller has tremendous weight in terms of I/O performance and reliability. Because of the importance of the storage controller on the overall performance and reliability of your VSAN cluster the storage controller must be selected from the VSAN-specific subset of the overall VMware Compatibility Guide.

Getting ready

You should be on the VMware VSAN Compatibility Guide page.

How to do it...

The initial landing page for the VSAN Compatibility Guide will allow you to browse through VSAN Ready Node configurations. As we will be discussing the case of VSAN Ready Nodes later in this chapter, for now please click the "Build Your Own based on Certified Components" link from the main page of the VSAN Compatibility Guide:
Unlike the regular VMware Compatibility Guide, the VSAN-specific component guide is laid out as a branching tree that you can use to drill down to your desired configuration, after which time hardware choices will be displayed.

1. In the leftmost pane, select I/O Controller.
2. In the next pane, select the most-recent vSphere 5.5 or 6.0 update release.
3. In the next pane, select a brand name if desired.
4. In the next pane, specify whether you wish to view the SAS, SAS-RAID, or SAS/SATA RAID controller types.

Some controllers for VSAN support the pass-through (JBOD) mode, and some require you to create single-disk RAID-0 sets. Pass-through controllers tend to be easier to configure and make drive-replacement simpler. RAID-0 controllers are more common and typically have larger queue depths. When selecting controllers and disks, please keep in mind the performance and reliability differences between drive technologies. Generally speaking, SAS and Nearline SAS (NL-SAS) disks have deeper queue depths and are higher-performance. SAS disks are typically more reliable than their SATA and NL-SAS counterparts.
Hardware Selection for Your VSAN Cluster

After making your selections, choose **Update and View Results** to get a list of hardware that matches your specifications.

There's more...

Aside from simply ensuring that you select a supported storage controller, the VSAN-specific Compatibility Guide also provides you with additional detail that will be crucial to selecting your storage controller.

This view will tell you whether or not the controller supports the pass-through/JBOD mode and, vitally, it will tell you the controller's command queue depth. The controller's queue depth is a vital consideration. If each node is relatively small with one disk group, any queue depth above 256 commands is acceptable. If you have two disk groups, please consider 512 commands to be the minimum queue depth.

For large or high-performance configurations with several disk groups and extremely large capacities, and/or very high-performance SSDs, you should choose the highest queue depth you can. Standard controllers with maximum queue depths usually have around 1000 commands, like in the preceding example.

Queue depth can have a tremendous effect on the performance of streaming data. Opting for controllers and disks with deeper queues will provide better overall performance, particularly when VSAN is reconfiguring or resynchronizing data.
Selecting a solid-state drive (SSD) for the cache tier

In combination with the storage controller, the SSD for the cache tier is the most important choice you can make in terms of the long-term reliability and performance of your VSAN deployment. The cache-tier SSD is used for caching reads and writes in VSAN hybrid configurations, and for caching writes only in all-flash configurations. SSDs are graded in many ways, and these grades for performance, write resiliency, and fabrication technology will all affect your selection. The VSAN Compatibility Guide gives you an overview of all of these factors to help you make the best choice.

For the SSD:
- The write-performance class is on a scale of A-F, with the F class being the fastest (class A is technically deprecated).
- Write-resiliency is on a scale of A-D, with D being the most resilient.
- Fabrication technology is either multi-layer cell (MLC), or single-layer cell (SLC). SLC is usually more performant and resilient, at the cost of lower capacities and higher price.

SSDs come in either SATA, SAS, or PCIe connections. PCIe SSD cards are usually at the top end in terms of performance. Given that SAS and PCIe interfaces permit significantly higher device command queues, it is a good idea to use SAS or PCIe type SSDs, especially if you are using a pass-through/JBOD controller that directly leverages device-level command queues.

Getting ready

You should be on the VMware VSAN Compatibility Guide component page.

How to do it...

The Compatibility Guide for SSD is navigated in the same way as for the I/O controller.

1. In the leftmost pane, select SSD.
2. In the next pane, select the most recent vSphere 5.5 or 6.0 update release.
3. In the next pane, select a brand name if desired.
4. Specify whether are searching for All Flash or Hybrid cache tier.
5. In the various other fields and drop-down menus, you can select the interface type, manufacturer, performance class, capacity, and form-factor.
6. After making your selections, choose **Update and View Results** to get a list of hardware that matches your specifications:

There's more...

Determining the size of your capacity-tier (magnetic or SSD) storage will directly affect the sizing decision for your cache-tier SSD. In general, the SSD should be 10 percent of the size of the magnetic disks in the underlying disk group, for example, if your disk group will consist of four 1.5 TB capacity-tier disks, you will have 6 TB of bulk storage. To accommodate this, the SSD should be about 600 GB. Alternatively, you may choose to opt for two disk groups consisting of three 1TB capacity disks each. In this case, each disk group should have a cache-tier SSD of 300GB. The ratio of cache-tier SSD to capacity-tier disks or SSDs should be approximately 1:10.
Selecting capacity tier disks

The magnetic disks or SSDs you choose will be used for storage capacity and persistent data that is destaged from cache. This is the capacity tier within VSAN, whereas the caching tier SSD will act as the performance caching layer.

In general, you will want to select magnetic disks or SSDs that have adequate capacity to fit your needs. For highly dynamic workloads where data will be frequently destaged from the SSD write buffer and fetched into the SSD read cache, HDD performance is important and you may wish to go with faster disks and/or SAS disks. Only SAS and SATA disks are supported for use with VSAN.

Getting ready

You should be on the VMware VSAN Compatibility Guide component page.

How to do it...

The Compatibility Guide for SSD is navigated in the same way as for the I/O controller

1. In the leftmost pane, select HDD or SSD.
2. In the next pane, select the most recent vSphere 5.5 or 6.0 update release.
3. In the next pane, select a brand name if desired.
4. In the various other fields and drop-down menus, you can select the interface type, manufacturer, disk speed (RPM), capacity, and form-factor.

   - If we are pursuing an all-flash VSAN configuration, ensure that we select Virtual SAN All Flash Capacity Tier from the Tier: pane.
5. After making your selections, choose **Update and View Results** to get a list of hardware that matches your specifications.

![Hardware Selection UI](image)

There's more...

In general, SAS disks outperform SATA disks of equivalent capacities and/or rotational speeds because SAS drives use more robust recording technique, deeper queues or both. When cost is a concern, slower SAS drives (typically 7200 RPM; also called near-line SAS or NL-SAS) are usually built on cheaper SATA platforms but include enterprise-grade features like deeper command queues, error-correction, dual-channel connections and native SCSI support. Low-end SAS drives are typically better than high-end SATA drives despite the shared technology platform and costs are usually not significantly higher. NL-SAS is a great alternative to SATA for building out a cost-conscious capacity tier when HDD performance is a factor.
See also

Before settling on a Cache + Capacity disk combination, please review the Chapter 1 – VSAN Capacity Planning section of Appendix A, Chapter-specific Expansions for a verbose description of the capacity expectations and recommended maximums to help you build your VSAN cluster to an appropriate scale.

Deciding on a network standard

For smaller clusters, network speed is typically only a forefront concern during times of data reconstruction in the event of a node/disk failure, rebalancing, or user-invoked configuration changes. These are generally fairly rare operations and, for the most part, 1GbE networking will be adequate for clusters with fewer than 5 nodes. 10GbE networking is recommended as a VMware best practice for all clusters. 10GbE networking should be considered mandatory for larger clusters, especially clusters of >8 nodes. If 1GbE network interfaces are being used for VSAN, those interfaces need to be dedicated to use by VSAN. 10GbE interfaces can be shared between VSAN and other workloads.

Unlike disks and storage controllers, there is no special compatibility guide for network controllers. Any vSphere-compatible network controller is acceptable for use with VSAN.

Getting ready

You should be on the VMware Compatibility Guide IO Devices page.

How to do it...

1. Within Product Release Version:, select the most recent vSphere 5.5 or 6.0 update release.
2. If you have a brand preference, select it within Brand Name.
3. Select Network, within I/O Device Type.
4. After making your selections, choose **Update and View Results** to get a list of hardware that matches your specifications.

See also

Before settling on a networking standard, please take a look at a detailed description of the VSAN networking options and recommendations in the VSAN Network Considerations section of Appendix B, Additional VSAN Information.

Choosing a VSAN Ready Node (an alternative option)

To help simplify the hardware selection process, numerous VMware partners have preconfigured "VSAN Ready Nodes" that are compliant with the various aspects of the vSphere and VSAN compatibility guides. With VSAN Ready Nodes, the sizing decisions, disk/SSD technology, network standards, and so on, have already been determined by the systems vendor. You may find that a VSAN Ready Node will simplify your purchasing and designing decisions for new VSAN build-outs and/or if you have a preferred system vendor.
### Getting ready

You should be on the VMware VSAN Compatibility Guide landing page.

### How to do it...

VSAN Ready Nodes are configured by the manufacturer and are designed to target specific infrastructure scales, or for specific use cases, such as virtual desktops (VDI). These scales are known as Ready Node Profiles. A matrix that defines these profiles can be found by clicking on the Virtual SAN Hardware Quick Reference Guide link at the top of the VSAN Compatibility Guide page.

1. The VSAN Compatibility Guide for VSAN Ready Nodes is navigated in a similar manner to the component-oriented Compatibility Guide. The guide is presented as a series of drill-down categories.
2. Select the parameters that fit your needs from the Ready Node type (All Flash or Hybrid), preferred manufacturer, performance/scale profile, form-factor, etc.
3. Once your choices have been selected, click the "Update and View Results" button to populate a list of compliant ready-node configurations:

<table>
<thead>
<tr>
<th>Ready Node Types:</th>
<th>Ready Node Vendors:</th>
<th>Ready Node Profile:</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Cisco</td>
<td>HY2 Series</td>
<td>HY2 Series</td>
</tr>
<tr>
<td>Dell</td>
<td>HY4 Series</td>
<td>HY4 Series</td>
</tr>
<tr>
<td>ESX 5.5 U2</td>
<td>Ultra Series</td>
<td>Ultra Series</td>
</tr>
<tr>
<td>ESW 5.5 U1</td>
<td>Gen 1 - 60</td>
<td>Gen 1 - 60</td>
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<td>Gen2 - 120</td>
<td>Gen2 - 120</td>
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<td>Gen4 - 480</td>
<td>Gen4 - 480</td>
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<td>Gen5 - 960</td>
<td>Gen5 - 960</td>
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<td></td>
<td>Gen6 - 1920</td>
<td>Gen6 - 1920</td>
</tr>
<tr>
<td></td>
<td>Gen7 - 3840</td>
<td>Gen7 - 3840</td>
</tr>
</tbody>
</table>

Click here to Read Important Support Information.

Click on the 'Model' to view more details and to subscribe to RSS feeds.

Search Results: Your search for "Virtual SAN Ready Nodes" returned one result. Back to Top Turn Off Auto Scroll Display: 10
4. The initial output will be a collapsed list of the various Ready Node configurations that are compliant with your selected filters. The output is initially grouped by vendor.

5. To get additional information about the specific Ready Node configuration, twirl down the arrow next to the vendor that you wish to use and then you can expand configuration information about the specific server platform that is recommended:

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Model</th>
<th>Profile &amp; Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELL</td>
<td>HY-6 Series: 152 Server Platform Up to 8TB raw capacity, 30 Virtual Machines</td>
<td>Ready Node Generation: Gen2 - 12G Profile: HY-6 Series Raw Storage Capacity: 8 TB</td>
</tr>
</tbody>
</table>

6. You can then use the SKU number (pictured above) when you contact your preferred vendor to get pricing and ordering information for the Ready Node.

**See also**

As with user-specified build-outs, please review the Chapter 1 - VSAN Capacity Planning section of Appendix A, Chapter-specific Expansions for a verbose description of the capacity expectations and recommended maximums, to help you select an appropriate VSAN Ready Node.
Where to buy this book

You can buy VMware Virtual SAN Cookbook from the Packt Publishing website.

Alternatively, you can buy the book from Amazon, BN.com, Computer Manuals and most internet book retailers.

Click here for ordering and shipping details.