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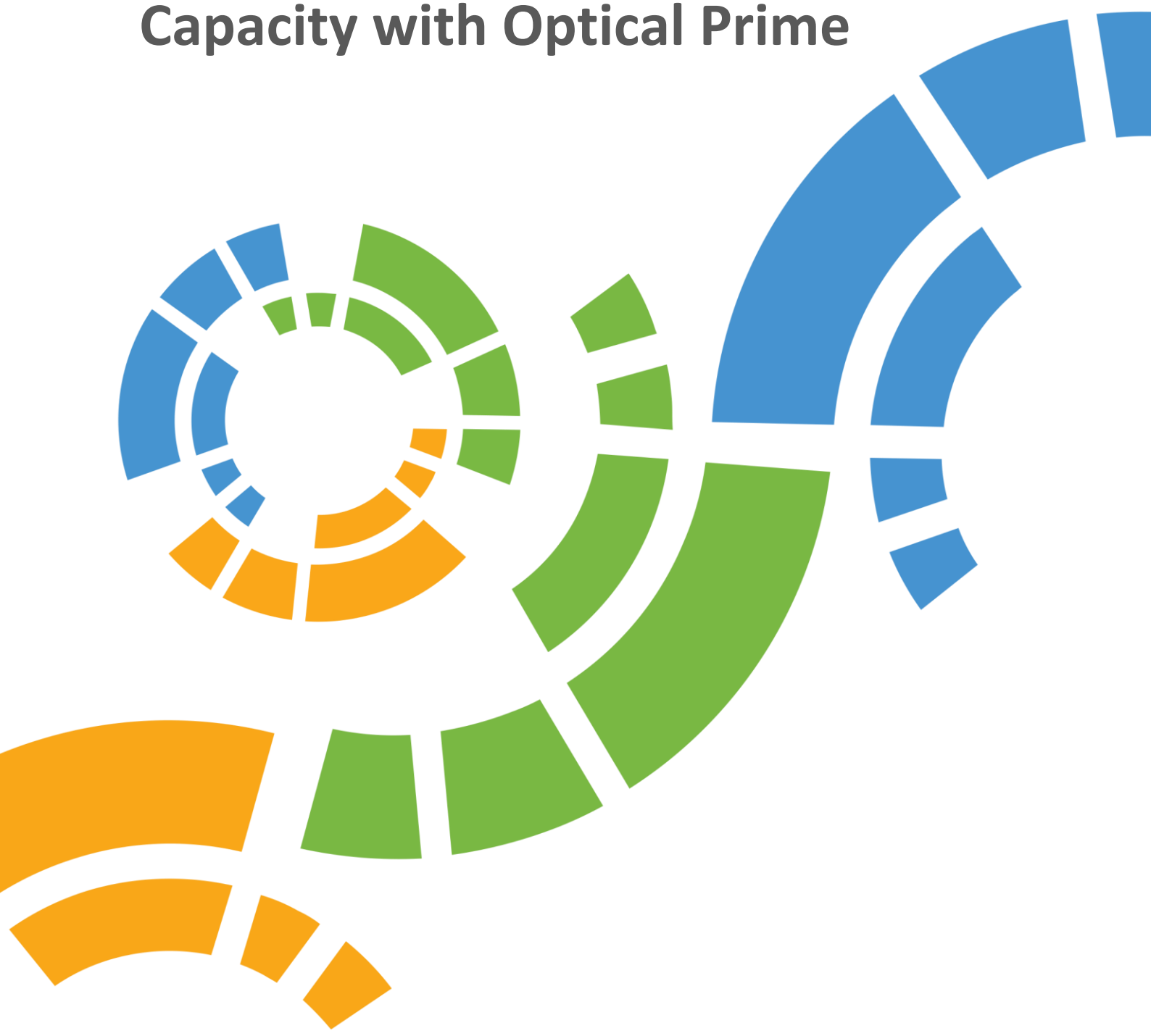
Interpret Live Optics Virtual Capacity with Optical Prime



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Revision History

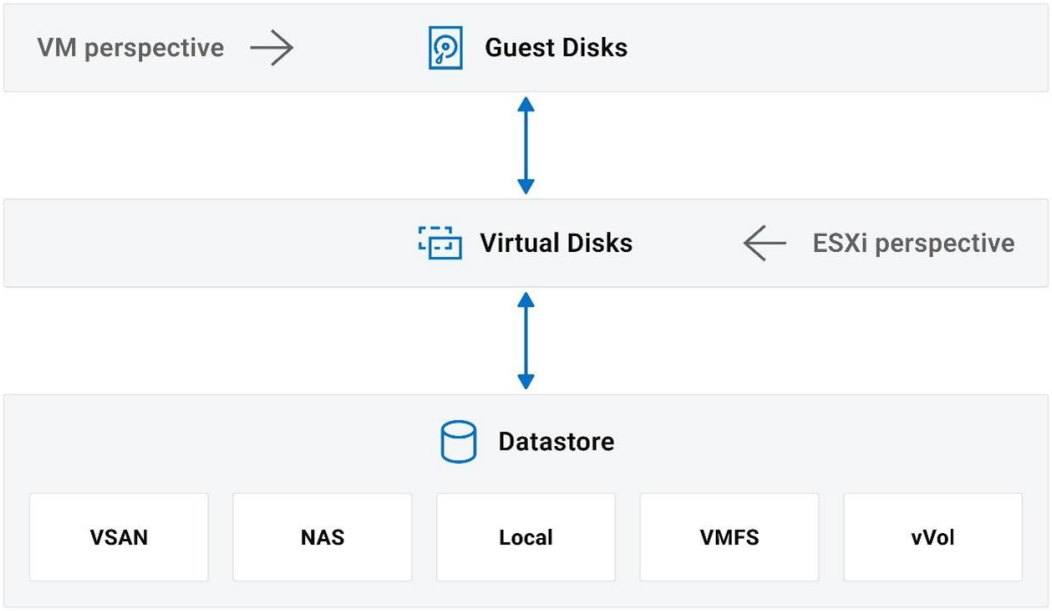
Date	Document Revision	Description of Changes
October 2024	1.1	Updated the *FAQ* section
June 2024	1.0	Initial version

About This Document

This document describes how to use Optical Prime reports to interpret capacity figures to size a new platform for hosting existing and future virtual machine (VM) workloads.

Basic VMware Concepts

Let's start with an overview of VMware storage terms and concepts.



Datastores

A VMware **cluster** of ESXi hosts contains one or more **datastores**. A datastore is a virtual concept representing a pool of usable storage accessible by VMs running in a cluster. VMware defines a datastore as a storage container used to store VM files, templates, and ISO images.

The physical layer that backs a datastore depends on the type of datastore:

- VSAN
- NAS
- Local
- VMFS
- vVol

Generally, when sizing for a tech refresh, the details of the underlying datastore type are not relevant, but let's cover them here:

VSAN: Commonly used in HCI solutions such as VxRail, VSAN leverages disks attached to the ESXi hosts in the cluster to form a highly available and redundant storage pool for a datastore. Only one VSAN datastore may exist per cluster.

> **NOTE:** VSAN datastores report their capacities differently to all other datastore types. See VSAN Datastore Storage for more information.

NAS: The datastore is hosted on a network file share, typically an appliance, although in some HCI solutions such as Nutanix, the file share is supported by the underlying HCI platform.

Local: Common in smaller or lab deployments, the local datastore uses disks in the ESXi host and is inaccessible to other nodes in the cluster. Because local datastores cannot be used in highly available configurations, or shared across nodes in the cluster, they are typically not used in production environments. Often, storage associated with local datastores is ignored.

VMFS: The traditional VMware distributed filesystem that leverages local disks in the ESXi hosts, directed attached storage (DAS), or storage area network (SAN) LUNs, VMFS is the most common datastore type.

vVol: Less frequently used, vVol datastores have a direct integration with storage arrays using a SAN connection. vVols were designed to bypass limits restricting the number of SAN LUNs that can be connected to an ESXi host. The presence of vVols requires an external SAN.

Virtual Disks

Regardless of the **datastore** type, all datastores are a file system visible to ESXi hosts. These file systems store all files for VMs, templates, and ISO images. Every VM has several files stored in the datastore. One type of file is known as the virtual disk file. For every virtual disk attached to the VM, there is a virtual disk file.

The ESXi host knows the size of the virtual disk file. Some virtual disk files are thin provisioned, and some are thick provisioned.

- **Thin provisioned** virtual disk files start small and grow over time as data is written to the disk. An upper limit is placed on the maximum size that the file can grow.
- **Thick provisioned** virtual disk files are created at a static size representing the total capacity of the virtual disk.

All virtual disk files have two basic properties:

- **Virtual Disk Used Capacity** is the data that has been written to a thin provisioned virtual disk file or is the total size of a thick provisioned virtual disk file.
- **Virtual Disk Size** is the maximum size that a thin provisioned virtual disk file can reach, or the size of the thick provisioned virtual disk file. For thick provisioned virtual disks, the **Used Capacity** and **Size** properties are the same.

Guest Disks

The **Guest Disk** is the perspective of the disk from the operating system (OS) running on the guest VM.

Guest Disks have two basic properties:

- **Guest Disk Used Capacity** is the space currently in use from the perspective of the OS running on the guest VM.
- **Guest Disk Size** is the provisioned size of the disk from the perspective of the OS running on the guest VM.

EXAMPLE

Let's take a VM running Microsoft Windows that has two drives: C and D. On the **datastore**, two virtual disk files exist, one for the C drive and one for the D drive.

Now, let's say the C drive is 100 GiB and the D drive is 1000 GiB in size. In this case the **Guest Disk Size** of the C drive is 100 GiB, and the D drive is 1000 GiB.

If the virtual disk files for these drives were thick provisioned, the sizes of the files would be approximately 100 GiB and 1000 GiB respectively. Virtual disk files are slightly larger than the OS perspective as some overhead is applied.

Now, you log into the guest VM and examine the two filesystems on the C drive and D drive. The C drive shows 56 GiB used, and the D drive shows 750 GiB used. The **Guest Disk Used Capacity** for the two drives is 56 and 750 respectively.

Assuming again that the virtual disks are both **thick provisioned**, the **Virtual Disk Used Capacity** and **Virtual Disk Size** are still 100 GiB and 1000 GiB.

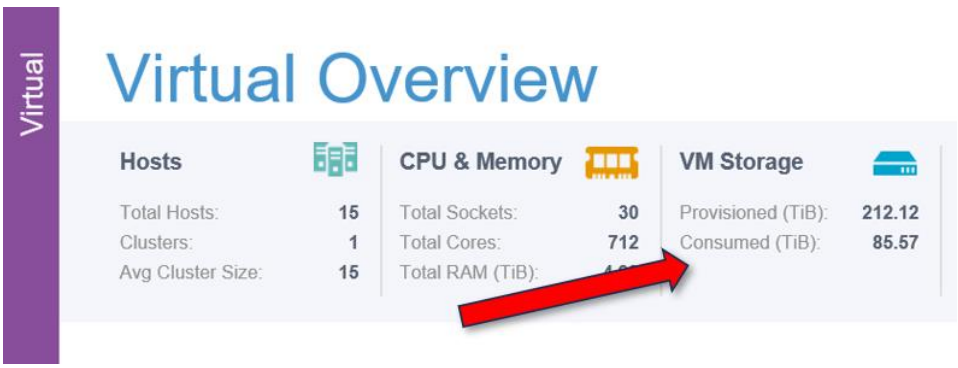
However, if both disks were **thin provisioned**, the **Virtual Disk Used Capacity** for the C drive would be at least 56 GiB. Usually, the Virtual Disk Used Capacity is larger than the Guest Disk Used Capacity. This is because the virtual disk continues to grow as data is written to it. However, the virtual disk file never shrinks when data is freed. (Reclamation operations can be completed by an administrator to shrink the disk, but these are rarely used).

Interpreting Optical Prime Capacity

Every deployment is different. Despite software services such as Live Optics that can help provide an in depth overview of your current environment, you must still research details that are not captured by the Live Optics collector. Let's discuss some considerations when sizing storage capacity for a virtualization refresh.

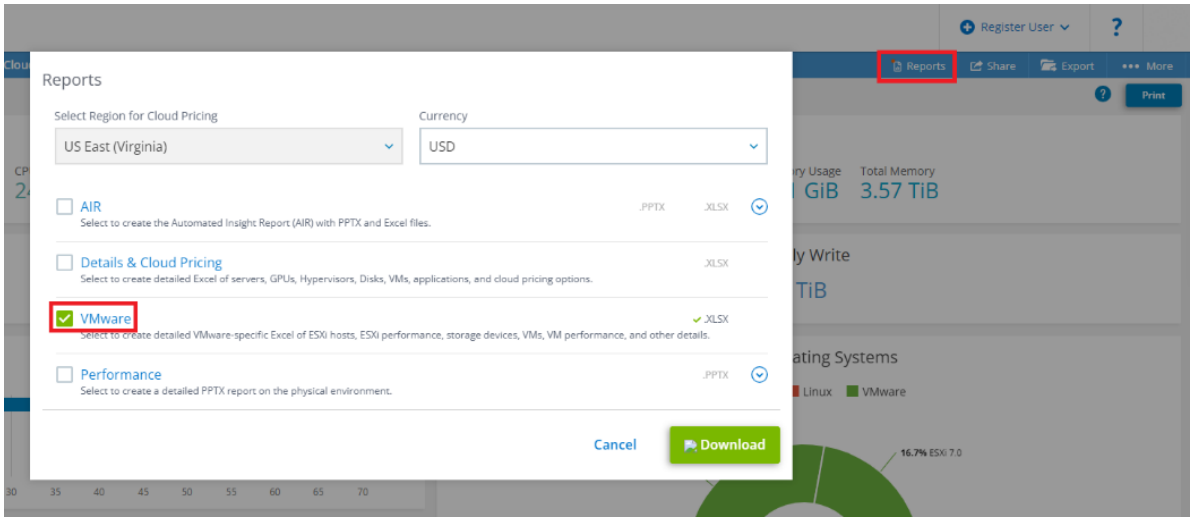
Most sizers base their calculations on the current **Guest Used Disk Capacity** of VMs plus an annual future growth percentage. The best place to find this is from an Optical Prime AIR Report.

On the **Virtual Overview** slide, locate the **Consumed (TiB)** value.

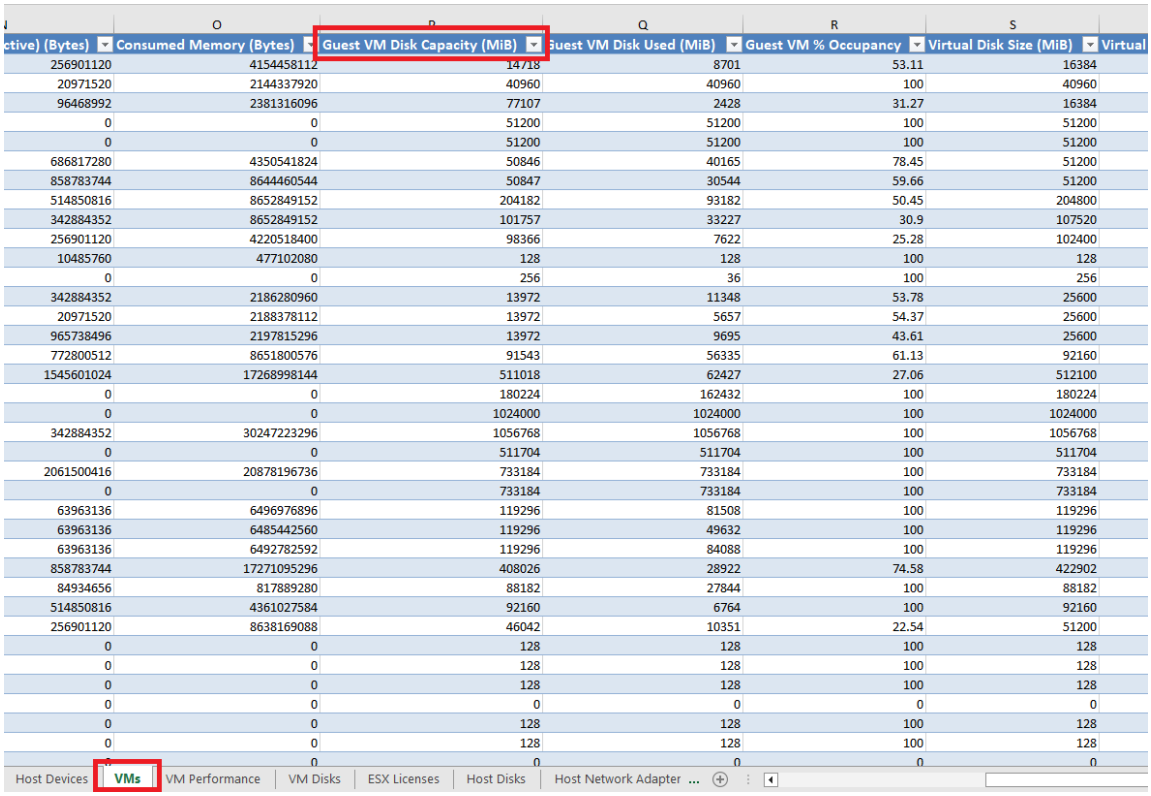


This value includes VMs that were idle during a collection. If you do not wish to size for idle VMs, or if you wish to select a subset of VMs to include in your calculation, download the VMware Microsoft

Excel spreadsheet report. This can be found by accessing the Live Optics dashboard and selecting an Optical Prime project. Click **Reports** in the top right corner of the screen and select **VMware** from the available reports.



Select the **VMs** tab and total the **Guest VM Disk Capacity (MiB)** for the VMs you wish to include for sizing.



ctive) (Bytes)	Consumed Memory (Bytes)	Guest VM Disk Capacity (MiB)	Guest VM Disk Used (MiB)	Guest VM % Occupancy	Virtual Disk Size (MiB)	Virtual
256901120	4154458112	14718	8701	53.11	16384	
20971520	2144337920	40960	40960	100	40960	
96468992	2381316096	77107	2428	31.27	16384	
0	0	51200	51200	100	51200	
0	0	51200	51200	100	51200	
686817280	4350541824	50846	40165	78.45	51200	
858783744	8644460544	50847	30544	59.66	51200	
514850816	8652849152	204182	93182	50.45	204800	
342884352	8652849152	101757	33227	30.9	107520	
256901120	4220518400	98366	7622	25.28	102400	
10485760	477102080	128	128	100	128	
0	0	256	36	100	256	
342884352	2186280960	13972	11348	53.78	25600	
20971520	2188378112	13972	5657	54.37	25600	
965738496	2197815296	13972	9695	43.61	25600	
772800512	8651800576	91543	56335	61.13	92160	
1545601024	17268998144	511018	62427	27.06	512100	
0	0	180224	162432	100	180224	
0	0	1024000	1024000	100	1024000	
342884352	30247223296	1056768	1056768	100	1056768	
0	0	511704	511704	100	511704	
2061500416	20878196736	733184	733184	100	733184	
0	0	733184	733184	100	733184	
63963136	6496976896	119296	81508	100	119296	
63963136	6485442560	119296	49632	100	119296	
63963136	6492782592	119296	84088	100	119296	
858783744	17271095296	408026	28922	74.58	422902	
84934656	817889280	88182	27844	100	88182	
514850816	4361027584	92160	6764	100	92160	
256901120	8638169088	46042	10351	22.54	51200	
0	0	128	128	100	128	
0	0	128	128	100	128	
0	0	128	128	100	128	
0	0	0	0	0	0	
0	0	128	128	100	128	
0	0	128	128	100	128	

Host Devices | VMs | VM Performance | VM Disks | ESX Licenses | Host Disks | Host Network Adapter ...

Other sizing considerations

The previous section does not consider snapshot policies, ISO storage, or templates. ISO storage and templates do not use much datastore space, but snapshots can use large quantities amount of

space. It is important that you research the snapshot policies of your environment to understand and calculate your storage needs.

Additionally, if **Guest iSCSI Present** appears, total the storage for VMs with iSCSI. If a significant amount of storage is used, you must decide if this will be replaced in a new environment or carried over from the current.

Advanced Storage Concepts

Here we'll examine some advanced storage concepts which might apply to your virtualized environment.

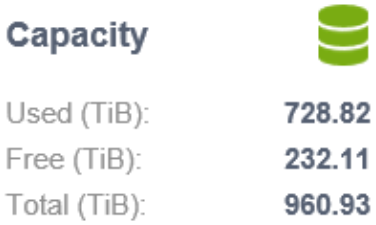
VSAN Datastore Storage

Unlike all other datastores, VSANs do not report used and free storage at the logical level. Instead, VSAN storage is reported at the *raw* level. The used capacity includes the capacity required for processes such as data protection and stretch cluster mirroring. For example, if the used capacity is 20 TiB, and the configuration includes a stretch cluster with RAID 1 dual site mirroring, 15 TiB is used for data protection and redundancy, with only 5 TiB of logical usage.

ESXi Non-Datastore Storage

When viewing the total storage capacities in the online viewer or the AIR report, remember that the totals displayed are based not only on the datastores in the project, but also any LUNs attached to the ESXi hosts which are not participating in the datastores.

Online Viewer – Optical Prime Environment Tab



AIR Report – Physical Overview Tab

These LUNs are either Raw Device Mappings (RDMs) or LUNs used in disk-to-disk backups by data protection software installed on the ESXi hosts.

These days, RDMs are rare, but backup LUNs are more common. Often backup LUNs are thin provisioned on the storage infrastructure hosting them and are not recognized by the ESXi hosts. In these cases, Optical Prime can vastly overestimate the usable capacity, because it is unaware the LUN is thin-provisioned.

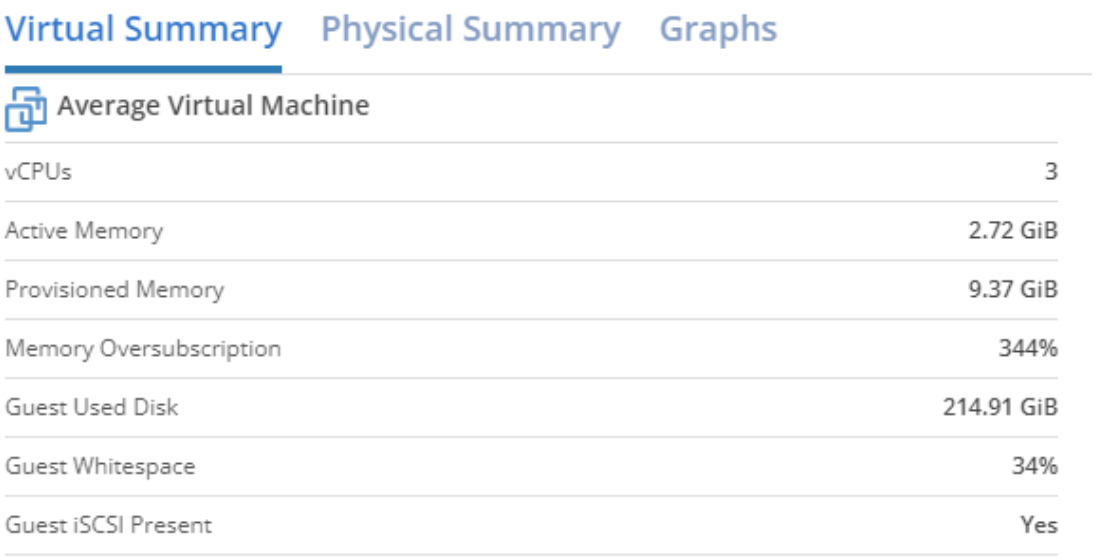
A good indicator of a LUN that is not part of a datastore is any local disk with a name that begins with the prefix "*naa-*" followed by a long series of alphanumeric characters.

In general, when migrating to a new virtual environment, the non-datastore storage is not relevant in future sizing.

iSCSI Storage and Virtual Machines

Using the Optical Prime online viewer, locate the **Virtual** tab. Under **Virtual Summary**, check the **Guest iSCSI Present** property.

If **Yes** appears in this field, Optical Prime believes that some of your VMs are connected to external storage using iSCSI.



Some information on iSCSI:

- An iSCSI disk can be mounted by a VM using a software initiator.
- iSCSI uses the Ethernet network to connect to the remote storage array hosting the iSCSI LUNs. An ESXi host will be unaware of this iSCSI disk.

The key indicator that iSCSI is present is when the **Guest Used Disk Capacity** is larger than the **Virtual Disk Used Capacity** for a VM.

If iSCSI is in use, the storage capacity represented by iSCSI is accounted for in the **Guest Used Disk Capacity** figures. This is another reason to use the Guest Used Disk Capacity totals for the purpose of sizing.

Hyper-V, Xen, and KVM Storage

Optical Prime supports collections for Hyper-V, Xen, and KVM hypervisors. However, for these non-VMware hypervisors, the **Guest Used Disk Capacity,** and the **Virtual Disk Used Capacity** for VMs are not visible to Optical Prime. Instead, Optical Prime substitutes the **Virtual Disk Size** values for the **Guest Used Disk Capacity** and **Guest Disk Size**.

FAQ

Why is the Used Capacity in the Optical Prime Environment Tab so much larger than the Guest Used Disk Capacity?

The **Used Capacity** shown in the Environment Tab is the sum of the used capacity reported by datastores and any LUNs attached to the ESXi hosts that are not contributing to any datastores.

First, if you have deselected any ESXi hosts from the project, your datastore capacity might be misleading. By deselecting an ESXi host, you are excluding its VMs from the **Guest Used Disk Capacity**, but you are not necessarily altering the reported capacity at the datastore level. If the datastore is attached to any other ESXi host in the cluster, Live Optics reports the full used capacity of that datastore.

Second, check for snapshot policies, ISO, and templates. Generous snapshot policies can consume a large amount of datastore space.

Finally, check for any disks attached to the ESXi hosts that are not part of any datastores. Often, especially in HCI appliances like VxRail, large, thin provisioned LUNs used for disk-to-disk backup are present. These LUNs can inflate the physical capacity of the system and should not be considered when sizing the VMs for a platform tech refresh.

Why is the Virtual Disk Used (MiB) less than the Guest VM Disk Used (MiB)?

The sizes of the **Guest VM Disk Capacity** and/or **Guest VM Disk Used** can be significantly larger than the sizes of the **Virtual Disk Capacity** and **Virtual Disk Used** numbers. When this happens, in the Optical Prime *Virtual Tab*, the **Reclaimable** capacity shown can be negative. The following scenarios can cause this:

- If a VM is connected to external storage with iSCSI, this can cause the **Guest VM Disk Capacity** to be much larger than the **Virtual Disk Capacity** as seen by the ESXi hosts.
- If a VM is derived from a template VM, and the template VM has a large amount of disk data, then the **Guest VM Disk Capacity** can be larger than the **Virtual Disk Capacity**.

Why is the Guest VM Disk Capacity (MiB) the same as the Guest VM Disk Used (MiB) and Virtual Disk Used (MiB)?

VMware only can report from the perspective of the OS running on the guest VM when VMware Tools is installed and running correctly on a VM. In almost every large VMware environment, there are VMs where VMware Tools is either not installed or running as expected.

In these cases, Optical Prime copies over the virtual disk file sizes to the guest disk capacity fields. This will slightly overestimate the necessary capacity but is the only available datapoint.

Why do the capacities in the Virtual tab of the Optical Prime online viewer not match up with those in the AIR Report?

The capacities displayed in the Virtual tab of the Optical Prime online viewer include running VMs only. Generally, you should also consider idle VMs when sizing for capacity.