VMware GuestReclaim V.1.0

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1. GuestReclaim

GuestReclaim reclaims dead space from a NTFS volumes hosted on a thin provisioned SCSI disk. It can also reclaim space from full partitions and disks there by wiping clean all file systems on them.

What is a Thin provisioned (TP) SCSI disk ?

In a thin provisioned LUN/Disk, physical storage space is allocated on demand. That is the storage system allocates space as and when a client (example a file system/database) writes data to the storage medium. One primary goal for thin provisioning is to allow for storage overcommit. For more information on this please refer http://en.wikipedia.org/wiki/Thin_provisioning.

What is Dead Space Reclamation ?

Deleting files frees up space on the file system volume. This freed space sticks with the LUN/Disk, until it is released and reclaimed by the underlying storage layer. Free space reclamation allows the lower level storage layer (for example a storage array, or any hypervisor) to repurpose the freed space for some other storage allocation request. For example

- A storage array that supports thin provisioning can repurpose the reclaimed space to satisfy allocation requests for some other thin provisioned LUN within the same array

- A hypervisor file system can repurpose the reclaimed freed space from one virtual disk for satisfying allocation needs of some other virtual disk within the same data store.

 GuestReclaim allows transparent reclamation of dead space from NTFS volumes.

2. Installation

The tool is provided as a standalone binary executable. Unzip the package and it will contain a program GuestReclaim.exe. Run GuestReclaim.exe from the command prompt. Use the –list option to list the thin provisioned disks on the system. If no disks show up it means that the first 16 disks are not thin provisioned.

Export an environment variable [c:\> set RECLAIM_DEBUG=1] to get the verbose output for TP querying process. To shut off the debug log unset the variable by assigning it a NULL string [c:\> set RECLAIM_DEBBUG=] i.e. nothing followed by the equal to sign.

For help on invocation see "Invocation/Command line help" and "FAQ" sections

3. Requirements:

Thin provisioned (TP) SCSI disk.

Space can be reclaimed on SCSI disks that advertise themselves as thin provisioned devices. GuestReclaim queries the device for its TP status using standard SCSI primitives like reading the vital product data page (B0 vpd). GuestReclaim will issue SCSI Unmap commands to the underlying storage for reclaiming dead space.

Supported Operating systems

Desktop: Windows XP, Windows Vista, Windows 7.

Server: Windows Server 2003, Windows Server 2008.

Windows 8 is not supported in this version (tested for Initial Builds of Window 8 [as of May 31]).

Administrative Privileges

The tool needs to be executed with Administrator privileges.

4. Modes of operation:

GuestReclaim can reclaim dead space from

Listing thin provisioned devices

GuestReclaim has a list option that queries the first 16 disks on the system for TP status. If a TP device is found it listed along with the drives/volumes it is hosting. Dead space can reclaimed from these volume and full devices and partitions can also be unmapped.

Reclaiming dead space from simple NTFS volumes

A simple NTFS volume is a volume that is NOT raided/stripped/mirrored across physical disk using software RAID. A simple volume is thus composed of only 1 disk. GuestReclaim release dead space from such volume to the underlying storage device.

Reclaiming dead space Raw Partition and Disks

Full partition or a disk can be reclaimed using GuestReclaim. Use this option when you are repurposing a disk with an existing volume, and want reclaim all the space from the existing volume.

IMPORTANT: If you unmap a disk/partition that is hosting an NTFS (or any file system) volume, all data on the volume will be wiped clean. This includes all file system metadata. **PLEASE REBOOT THE MACHINE AFTER SUCH AN OPERATION**

5. Suggested Space reclamation workflow

Dead space accumulates as the guest file system deletes files over time. The amount of dead space available for reclamation at a given point in time can be estimated by subtracting the NTFS volume's used space from reported physical space allocation for the Thin provisioned disk. For example you may have a 10GB *thin* virtual disk, formatted with a NTFS volume. If the used space from NTFS point of view is 5GB and the allocated space for the virtual disk in 8GB, then dead space is 8GB-5GB=3GB. **Suggested threshold for reclaiming dead space is 1GB. As the reclamation itself takes up some space (reclamation overhead), one must have more space to reclaim than the process overhead to actually get any space savings. The representative overhead is anywhere between 16M to 100M.**

Once sizeable amount of dead space has accumulated, one can run GuestReclaim tool to reclaim this dead space. Automated Periodic running of this tool keep dead space under check.

Defragmenting the guest file system prior to dead space reclamation

Underlying storage can only reclaim space in terms of a certain minimum block size (minimum granularity). Sample granularity for TP devices can be as low as 4K and as high as 1MB. Each device advertises its minimum unmap granularity.

If the guest file system is highly fragmented, then free/dead space may be scattered in small runs. These small runs cannot be reclaimed when they are smaller than the minimum unmap granularity supported by the underlying device.

Defragmenting the guest file system can coalesce smaller dead space runs into larger runs that can be reclaimed. Defragmenting **is not required**, but may maximize the reclaimed space in some cases. Recent releases of Windows like (Windows 7) defragment the volume in the background so additional defragmentation may not be required.

6. Space reclamation from Virtual disks on hypervisors.

The tool transparently operates on virtual disk *if the hypervisor emulation layer* reports virtual disks as thin provisioned. End to End reporting of thin provisioning status in a virtual storage stack is required to fully leverage Thin Provisioning in a virtualized environment.

This tool is not related to any VMWare ESX or any other Hypervisor Release. **If ever** ESX supports unmaps on virtual disk in the future, it will be tied to "Virtual Hardware Version Upgrade" and will mostly be in a release after vSphere 5.0.

For the authoritative word on ESX virtual disk unmap support, please check official updates about features in VSphere 5.x releases.

Until then you can use tools on RDMs.

7. Invocation/Command line help

Tool prints command line help when invoked without parameters. It will list program options available.

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Storage space reclamation agent for thin provisioned SCSI disks

Supported Operating systems: WinXP to Windows7

Unmap targets: Simple NTFS and FAT Volume, raw disks and partitions

Usage: guestReclaim.exe [--list | --volumefreespace | --fullvolume | --disk] [command specific options]

 --list   : List available drives and their volume/partition mapping

 --volumefreespace   : Unmap free space on a NTFS/FAT volume. Expects drive letter

 --fullvolume   : Unmaps entire volume. Destroys filesystems that exists on the partition. Expects partition drive letter

 --disk   : Unmaps full disk. Destroys all volumes/partitions/data on disk. Expects partition diskname

 NOTE: For the --disk and --fullvolume commands make sure that the partition or disk being unmapped

is not hosting any active filesystems volumes. Existing filesystem volumes can be deleted using disk

 manager run [diskmgmt.msc]

Example1: guestReclaim.exe --list

     List drive options and volume mappings to be used

Example2: guestReclaim.exe --volumefreespace D:\

     Reclaims space for NTFS volume D:\

Example3: guestReclaim.exe --fullvolume D:\

     Reclaims space for entire partition D:\

     [CAUTION All data on the partition will be unmapped/swiped]

Example4: guestReclaim.exe --disk \\.\PhysicalDrive0

     Reclaims space for entire PhyscialDrive0

     [CAUTION All volumes/partitions on the disk will be unmapped/swiped]

FAQ

Q. Does unmap work on a VMware linked clone ?

A. NO, VMware linked clones are based of redo-log technology. GuestUnmap only works for thin provisioned disks.

Q. Does unmap work with Disk with snapshots?

A. NO

Q. How much space savings can I expect?

A. A large fraction of the dead space is reclaimable given

   - there is enough dead space to reclaim. (Order of few hundred megabytes)

   - the dead space is not fragmented (See workflow section)

Q. I see no saving but instead I see some space bloat ?

A. There might not be enough dead space to reclaim, to offset the reclamation overhead. The net result may be an overhead. (See workflow section). If you are sure that enough dead space is available, please run defrag to compact the dead space.

Q. Does the –list option reclaim any space ?

A. NO, --list option only PROBES the first 16 disk and the volumes on those disk for thin provisioning status.

Q. Can I unmap dead space on ALL disks, in a single invocation ?

 A. NO, one can only operate on one disk/volume in a single invocation of the command. Scripting such that all volumes on the systems are covered can be done using WMI or other scripting tools.

Q. What do I do if I have more than 16 disk and they are thin provisioned ?

A. Checking of thin provisioning status is done via probing. One could probe the first 100 or first 16 devices, 16 was chosen as it seems sufficient for the common case.

In case you have more than 16 devices and you are sure one of them is thin provisioned, you can directly unmap it by referencing it by its number.

For example for unmapping disk18.
guestReclaim --disk \\.\PhysicalDrive18

Q.VMWare thick disks show up as thin provisioned, but no space is reclaimed ?

A. VMware ESX wrongly reports thick disks as thin provisioned and unmap capable. This will be fixed in future releases.

NOTES Relates to VMFS releasing dead space to backend array on ESXi

Vsphere5.0 does have some level of support for releasing space from VMFS to the backend array http://www.yellow-bricks.com/2011/07/15/vsphere-5-0-unmap-vaai-feature/. This feature had issues with some array and was recalled, please consult array vendor

http://virtualgeek.typepad.com/virtual_geek/2011/10/urgent-vaaithin-provision-reclaim-on-hold-workaround.html