Functional IOPS in VDI with Dell Compellent

A Dell White Paper

Dell Compellent

May 2011

Contents

Figures

Introduction

Virtual Desktop Infrastructures (VDI) require several components to deliver efficient and reliable desktops to the end user. As with any project, planning is key to a successful VDI deployment. Many factors need to be considered to provide the end user an experience as good as or better than a traditional desktop solution. One area that requires significant attention in the planning process is the storage requirements for VDI.

VDI planning

When planning storage requirements for VDI, capacity is only part of the equation. The number of input/output operations per second (IOPS) must also be taken into consideration. This paper will outline the special requirements for calculating IOPS for a VDI deployment and demonstrate the advantages of Dell Compellent storage in a VDI environment.

In storage, the number of IOPS represents the maximum amount of input/output operations a storage device can perform. Not all IOPS are created equal, however. Raw IOPS represent the maximum amount of IOPS a single disk can perform multiplied by the total number of disks. For example, we can use the chart below to find the total raw IOPS of six 146GB 15K drives.

6 disks x 180 IOPS = 1080 Raw IOPS

Disk Type	IOPS
7200 SATA	90
10k SAS	140
15k SAS	180

Raw IOPS are a theoretical maximum that will change once disks are placed into production. There are a couple factors that need to be taken into consideration when calculating usable IOPS. Because writes take more IOPS to complete, the percent of writes the workload requires have to be known. The other consideration is the RAID level used to protect data on the disk. These are factored to calculate the Functional IOPS of a storage system. In a VDI environment, functional IOPS give a better performance profile by taking into account the demands placed on the storage.

Calculating Functional IOPS

Functional IOPS are important with VDI due of the high write requirement of virtual desktops. Some estimates put the number of writes up to 90% of all IOPS. This can decrease the number of IOPS available due to the write penalties associated with different RAID types. Write penalties are assigned to RAID levels based on characteristics of their write activity. For example, with RAID 1 or 10, data is written once and read once to verify each write. This consumes two raw IOPS, so RAID 1 and 10 are assigned a write penalty of 2. Likewise, RAID 5 has a penalty of 4 because each write operation requires four raw IOPS, one to read the existing data, one to read existing parity, one to write new

data, and one to write new parity. Below is a chart of the write penalty assigned to different RAID types.

RAID Level	Write Penalty
RAID 0	1
RAID 1 or 10	2
RAID5 (3 data 1 parity)	4
RAID5 (4 data 1 parity)	5
RAID5 (5 data 1 parity)	6
RAID 6	6

Raw IOPS are factored with the percent of reads to writes and RAID penalty to calculate the functional IOPS of a storage system. The formula for calculating Functional IOPS is expressed as:

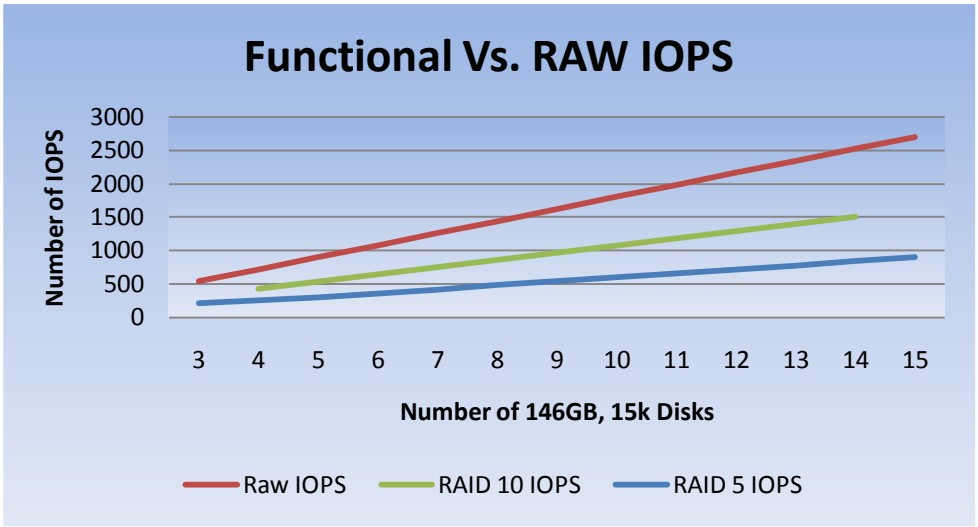
Functional IOPS=((Raw Storage IOPS*Write %)/RAID Write Penalty)+(Raw Storage IOPS*Read %)

In the example below, six 146GB 15K drives in a RAID 5 configuration with 80% write to 20% read ratio will provide 339 functional IOPS.
Functional IOPS=((1080*80%)/7)+(1080*20%)

In comparison, if we were to change the above to RAID 10 instead of RAID 5, our function will be 648.
Functional IOPS=((1080*80%/2)+(1080*20%)

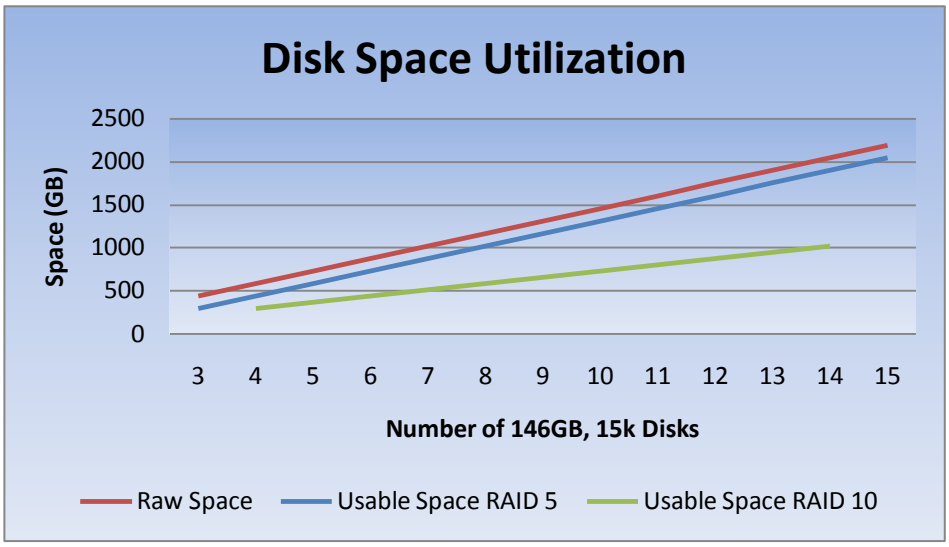
The contrast between RAW IOPS and Functional IOPS illustrates the importance of considering workload when planning for a VDI implementation. As you can see in the chart below, RAID 10 offers a significant increase in IOPS over RAID 5.

Figure 1 Functional Vs. RAW IOPS



With traditional storage, the tradeoff for higher performance is a loss in disk capacity. The amount of disk space dedicated to data protection is significantly more with RAID 10 compared to RAID 5. This makes RAID 10 more costly based on the number of disks needed to meet space requirements. The chart below shows the comparison of raw vs. usable disk space with RAID 10 and RAID 5.

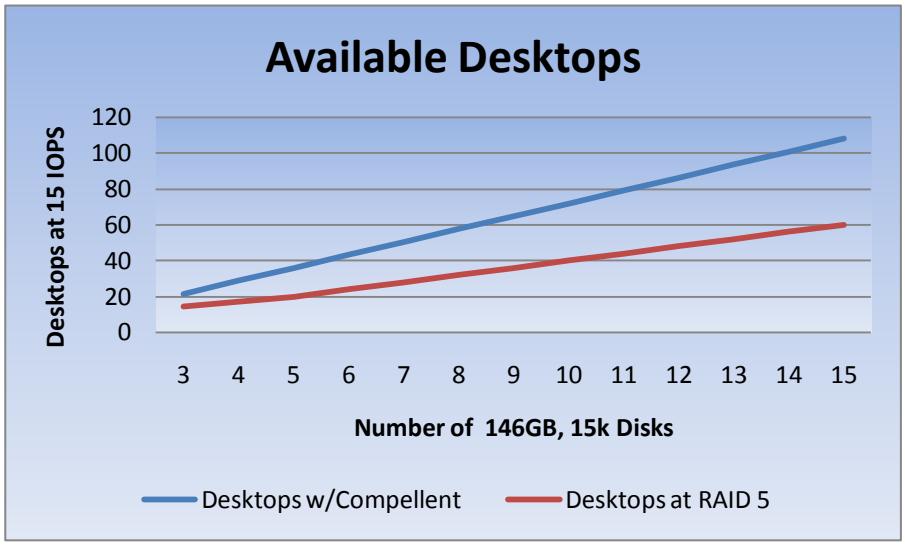
Figure 2 Disk Space Utilization



Due to the high percentage of writes in a VDI environment, most deployments are force to choose the more costly high performance RAID 10 option to support Functional IOPS requirements. This is where Dell Compellent storage can add significant value to a VDI deployment. With Dell Compellent virtualized storage, data is written at RAID 10, offering high level of Functional IOPS. While data is written at RAID 10, Dell Compellent also reads from RAID 5, offering better space utilization within the storage system.

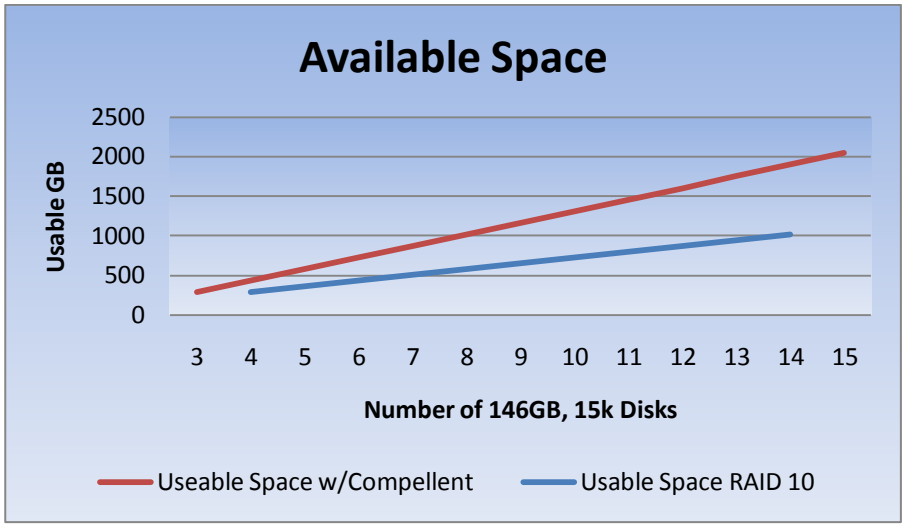
The unique combination of writing data at RAID 10 while reading from RAID 5 gives Dell Compellent the best combination of performance and space utilization. As illustrated with the graph below, the number desktops supported on Dell Compellent with a given amount of disks surpasses that of RAID 5.

Figure 3 Available Desktops



While write performance is at a RAID 10 level, disk capacity on Dell Compellent is comparable with RAID 5. With Dell Compellent Fluid Data technology, the storage system automatically moves data written as RAID 10 to RAID 5. This provides significantly more useable space compared to RAID 10 as illustrated below.

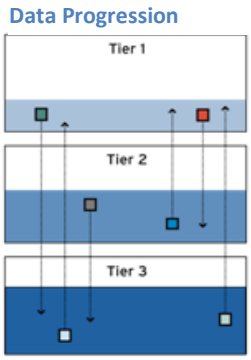
Figure 4 Available Space



*Based on blended RAID level

In addition to the space savings and performance provided by the combination of RAID 5 and RAID 10, Dell Compellent also thin provisions all data stored on the device. This provides greater efficiencies by eliminating allocated but unused space.

As illustrate earlier, different disks have different performance profiles. High performance disks, such as the 15k RPM SAS drive, offer twice the IOPS of a 7200 RPM SATA drive. However, with the higher performance comes a higher price. Because of the performance requirements of VDI environments, many administrators are forced to place all VDI data on higher cost, high performance disks.



This is not the case with Dell Compellent. With an easily modifiable rule set, administrators can have all data written to high performance disks on Tier 1, then use Dell Compellent Data Progression to migrate infrequently used data to less expensive lower tiers of storage. With Data Progression, infrequently accessed data, such as archived user data, moves automatically to lower tiers of storage while frequently accessed data, such as OS files, stay in the high performance tier.

Summary

Balancing performance and cost are critical to a successful VDI project. Dell Compellent Data Progression technology adds value to a VDI environment by providing RAID 10 performance and space utilization comparable to RAID 5. Automatic data placement and thin provisioning increases the value by optimally placing data on different tiers of storage. This makes Dell Compellent a high performance, efficient solution for VDI environments.