Thin Provisioning with Pillar Axiom 600

Introduction

As IT organizations work to maintain application availability while controlling costs, a greater emphasis on operational efficiency is essential. One key area where operational efficiencies can be achieved is in the storage infrastructure. Traditional storage systems are inherently inefficient, with multiple arrays of dedicated storage and various management points. Thin provisioning is now recognized in the industry as a critical approach to simplifying storage management while drastically improving capacity utilization. Additionally, the ability to defer system and capacity purchases until additional capacity is actually required results in less frequent and higher utility capital expenditures. This white paper explains how Oracle's Pillar Axiom 600 storage system creates an application-aware storage environment to most efficiently provide all the benefits of thin provisioning.

Challenges with Traditional Storage Systems

In traditional systems, when storage is allocated to a particular application, the volume is claimed for sole use by that application. This prevents other applications or users from accessing this capacity— even if the amount allocated is never actually used. As a result, the array may only have half its capacity physically written to, but because the allocation was for more capacity than needed, the unused but allocated capacity is stranded and cannot be leveraged in support of additional requirements. When this occurs, a new storage system may need to be purchased. This is far more costly than simply adding physical capacity to an existing system.

Storage forecasting is another victim of inefficient traditional storage infrastructures. Storage administrators must attempt to accurately forecast the future utilization associated with each given application or customer requirement. This difficult, time-consuming task often results in over-provisioning of capacity when a new application is brought online. Or, even worse, too little capacity is allocated and an application must be taken down to correct the condition. Since most operating systems do not support dynamic volume expansion, additional LUNs must be concatenated to provide more storage space. This leads to greater complexity, potential performance impacts and increased storage management overhead; none of which are desirable.

The costs associated with these traditional practices are significant. Many organizations will purchase more storage than necessary at initial deployment, the storage allocated is grossly underutilized, and valuable administration cycles are spent managing the environment. Also, the power and floor space expense resulting from the operation of larger or additional arrays is not insignificant.

Operational Efficiency with Thin Provisioning

Thin provisioning mitigates these issues by allowing administrators to allocate storage based on future need while drawing upon a common pool of shared storage as capacity is physically consumed. With thin provisioning, an administrator creates a LUN or file system of any size without committing the physical capacity at the time of creation. This reduces the amount of physical disk necessary to support a given workload.

Each user or application has what appears to be all the storage necessary for ongoing operations, but the physical capacity is not locked to a particular volume. As actual used capacity grows toward the limit of physical capacity, more capacity will be dynamically added only as required.

Thin provisioning benefits include:

- Higher utilization rates, in that several applications can draw upon a single shared pool of physical capacity

- Ease of provisioning and management since new volumes no longer require large amounts of physical space at inception

- Lower capital expenditures, since incremental system capacity can be added to the general storage pool as needed without being tied to a single host

Oracle's Approach to Thin Provisioning

Oracle recognizes the value of thin provisioning and has taken these inherent benefits one step further by introducing a smarter approach to thin provisioning with Pillar Axiom 600. No other thin provisioning vendor provides the ability to consolidate multiple applications in a single, multi-tenancy array while allowing administrators to assign a dynamic quality of service (QoS) to each volume.

In other systems that have thin provisioning, a common pool of generic, physical storage backs each volume. This creates a situation in which each supported application draws upon a pool of storage with one performance profile, drive type, or connectivity method. All data and associated applications are treated equally at the physical storage layer, and the characteristics of the storage are not matched to the unique needs of each application. In this case, mission-critical databases receive the same priority as archive files.

Pillar Axiom 600 allows storage administrators to provide thinly provisioned file systems and LUNs with characteristics appropriate for supporting each unique application—all on a single, consolidated storage system. Each application-aware volume is automatically tuned for drive type (SATA, SSDs, and Fibre Channel) and connectivity method (NAS, FC, or iSCSI), along with specific performance and capacity attributes. Thin provisioning in Pillar Axiom 600 works identically for LUNs and file systems.

One of the major advantages of Pillar Axiom 600 thin provisioning relates to management efficiency. In the past, storage administrators and DBAs spent hours forecasting how much storage was required for an application initially and over multiple years of growth. Experience shows that this is virtually impossible to estimate accurately. As a result, administrators were forced to make a best-guess estimate and then double or triple it to allow for a cushion. The result was capital expenditures of far more capacity than was required at the outset. Initially, storage vendors responded to this issue by providing the ability to increase the size of a LUN when needed. Unfortunately, many operating systems (OSs) could not recognize the larger LUN, or the applications would have to be taken offline to see the new capacity. Once the capacity was recognized by the OS, assuming it could be recognized, the file systems would then need to be expanded, causing more downtime. An OS that could not recognize the larger LUN would require much longer downtime to add capacity.

As capacity needs begin to grow, there is no administrative overhead to increase the physical capacity of the LUN or Filesystem, no application downtime, and greatly reduced ongoing management interaction. As data is written to the thinly provisioned LUN and physical capacity is consumed, additional physical capacity is allocated to the LUN or file system automatically in increments that are automatically managed by the storage system.

Application-aware thin provisioning reinforces the ability of Pillar Axiom 600 to drive storage efficiency through storage consolidation, modular scalability, and simplified management.

Storage Consolidation

Each thinly provisioned volume is optimized through data placement and access prioritization. Oracle's unique approach to application-aware storage allows administrators to assign a quality of service to these optimized volumes, allowing for mixed workloads on a single system and directing performance based on application importance. Each application is supported by an appropriate QoS level from within one or more virtualized storage pools.

The ability of Pillar Axiom 600 ability to consolidate multiple storage functions into a single array has proven to dramatically increase storage utilization at a much lower level of capital spending. Oracle customers, on average, utilize 62 percent of their existing capacity and often reach over 80 percent utilization—compared to an estimated industry average of only 30-35 percent of capacity allocated or utilized (Gartner).

Modular Scalability

Pillar Axiom 600 provides for easy, granular scaling because physical storage is consumed without disruption or reconfiguration. This makes Pillar Axiom 600 a more efficient storage system with lower energy and space costs. Also, when additional storage is needed for thinly provisioned systems, Pillar Axiom 600 automatically adds capacity to the system's pool(s) of shared storage while maintaining the QoS previously assigned to thinly provisioned volumes.

Pillar Axiom 600 combines thin provisioning to deliver industry-leading utilization rates while maintaining consistent deterministic performance. Other solutions are hindered by the availability of only two RAID controllers, their inability to control data placement, and the inability to easily manage resources. This prevents other systems from delivering consistent performance as capacity is increased. Also, Pillar Axiom 600 improves SATA drive performance to rival that of some Fibre Channel drives, allowing storage administrators to gain high utilization without sacrificing performance and without paying for expensive drives. This is impossible with traditional storage technologies.

Simplified Management

To simplify management, administrators can provision larger virtual LUNs (VLUNs) at inception. An intuitive provisioning tool facilitates the creation of each thin file system or VLUN in only six clicks with deterministic performance for five levels of service before the volume is created. Pillar Axiom 600 reduces the management interaction needed to increase the size of the LUN/Filesystem or the usual application downtime. In addition, the Pillar Axiom 600 "call home" functionality and system notifications virtually eliminate the risk of unexpectedly running out of physical capacity. Finally, Pillar Axiom 600 was designed for easy, guided maintenance with customer-replaceable components.

Thin Provisioning Example

Consider an example where a customer has estimated a requirement for forty TB of SATA Drive capacity in support of several applications that require block-mode access. In normal provisioning with Pillar Axiom 600, LUNs are spread across multiple stripe groups that consist of six physical SATA drives. In this example, the customer has four different LUNs, each with a unique QoS (Figure 1). Pillar Axiom 600 drives higher utilization levels by leveraging all sectors of a drive and delivering the appropriate level of performance for each LUN.

In Figure 1, each LUN has been allocated at three times the current required capacity to account for growth. This is illustrated with the blue disk group. In traditional arrays given unknown future operational requirements, this capacity may not be ever used and becomes stranded.

Figure 1.

Traditional Provisioning
Physical Capacity: 40TB
Written Capacity: 10TB
Allocated Capacity: 30TB
Utilization Rate: 20%

QoS Level
High
Medium
Low
Archive

Written 10TB

Allocated/ Unwritten 30 TB
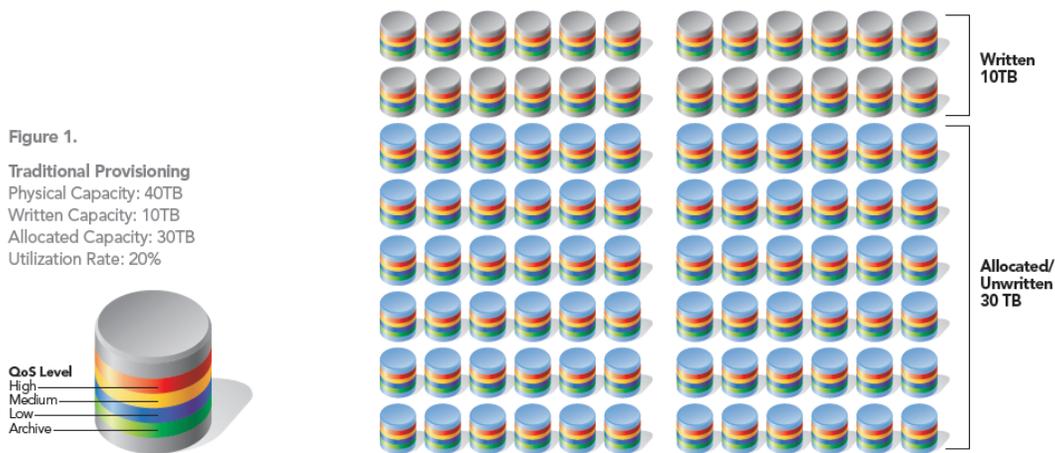
Figure 1. Traditional provisioning results in excess storage capacity.

With Oracle's smarter approach to thin provisioning, only 10 TB is initially needed to support the same utilized capacity, with an additional 30 TB of virtual capacity available when and if needed, all while maintaining the same QoS for each LUN as it grows. In the example below (Figure 2) 20 TB was purchased to allow for near-term growth; one half the physical capacity required by the previous example..
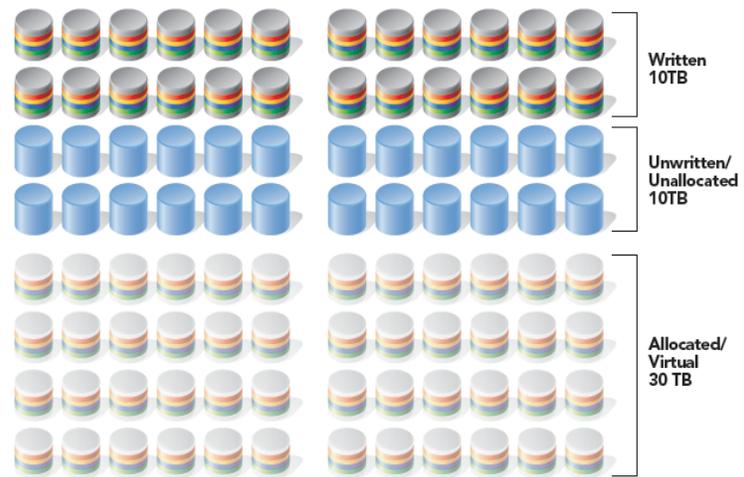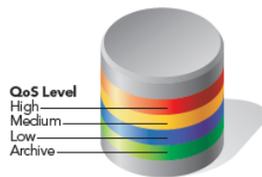
Figure 2. Thin provisioning with Pillar Axiom 600 results in efficient storage utilization.

In this example, thin provisioning results in several benefits:

- Only a small amount of physical capacity is required to support the host applications and utilization has increased significantly.

- Costs are greatly reduced, because incremental capacity purchases are delayed and executed only as needed.

- Capacity allocation per LUN is significantly higher, eliminating the need to accurately forecast the growth of each LUN.

- The system draws from a common pool of un-allocated storage as needed, sharing the storage assets and growing in granular increments.

Conclusion

Oracle is the only vendor that delivers an application-aware storage solution with thin provisioning and true QoS that is configured at LUN or file system creation. This delivers capacity utilization as much as two times the industry average, all while driving down solution complexity, simplifying management, and reducing acquisition and operation costs. With complete QoS functionality and distributed RAID technology, Oracle's Pillar Axiom 600 storage system is the most complete and effective thin provisioning solution on the market.

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