

FLASHRECOVER SNAPSHOTS

Instant, limitless snapshots re-imagined
for 100% flash storage



FLASHRECOVER SNAPSHOTS DELIVER SPACE EFFICIENT, SCALABLE, AND SIMPLE TO MANAGE SNAPSHOTS WITH ZERO COMPROMISES

FlashRecover Snapshots are an intrinsic part of the Purity Operating Environment. They deliver superior space efficiency, high scalability, and simplicity of volume snapshot management.

Several storage vendors have developed various technologies to optimize the space requirements and reduce the performance impact of snapshots on their storage systems. The two most commonly used technologies - Copy-on-Write and Redirect-on-Write - are optimized to reduce the capacity requirements of snapshots however they differ in their impact on performance.

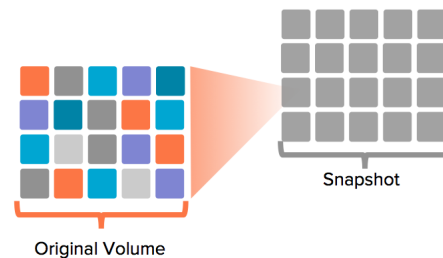
Both Copy-on-Write and Redirect-on-Write snapshots update the metadata associated with the blocks of a volume at the time of snapshot creation. However, with Copy-on-Write, any subsequent overwrites to the original blocks cause the storage system to first copy the blocks to a pre-designated snapshot area and then new data is overwritten in-place, resulting in the storage system suffering at least a 2X write penalty for each block overwrite. Redirect-on-Write snapshots overcome this 2X write-penalty of Copy-on-Write snapshots by redirecting all overwrites to new blocks, thus incurring no additional writes or data copy.

Though Redirect-on-Write is efficient during snapshot creation and block overwrites, it pays a high performance penalty on disk-based storage systems as they age with a large numbers of snapshots. Each time a new snapshot is created, the redirection of subsequent writes causes data to become more fragmented. Thus, disk-based storage systems have difficulty in cost-efficiently handling large amounts of random reads and writes with competitively low response times due to non-contiguous data. Pure Storage is able to consistently deliver competitively low response times for both random reads and writes as the fragmentation caused by Redirect-on-Write snapshots does not impose the performance penalties on flash drives as experienced by the disk-based storage systems.

Copy-on-Write Snapshots:

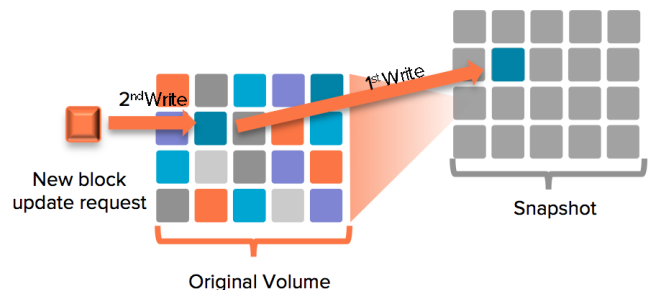
Snapshot Creation

- Instantaneous (No copy required at creation)
- No additional space required



Block Overwrites

- Requires 2X writes (Write performance impact)
- Reserved space required for snapshots



Redirect-on-Write Snapshots:

Snapshot Creation

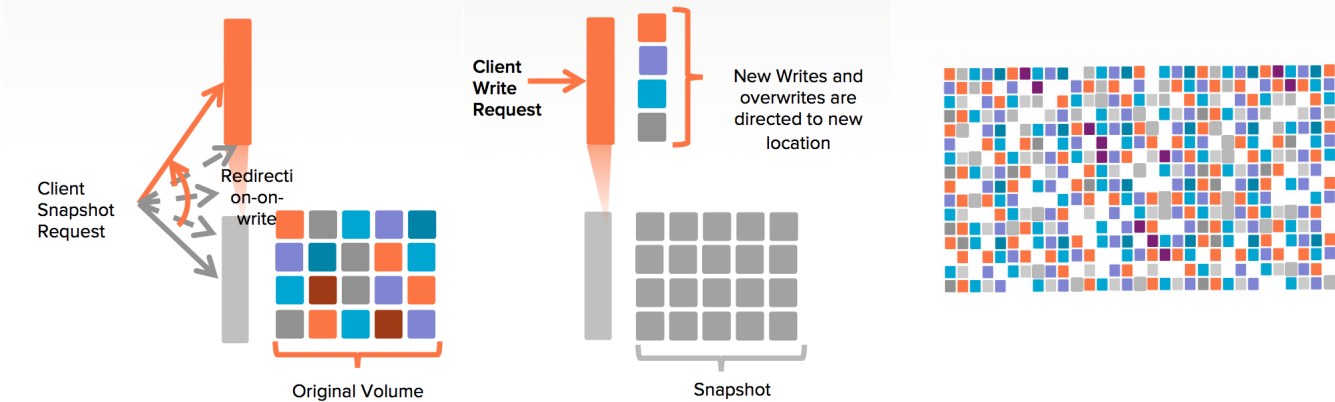
- Instantaneous
- Metadata update on creation

Block Overwrites

- Directed to new location

Data pattern in aged systems

- Fragmented data allocation
- Snapshots and Unused spaces spread over array



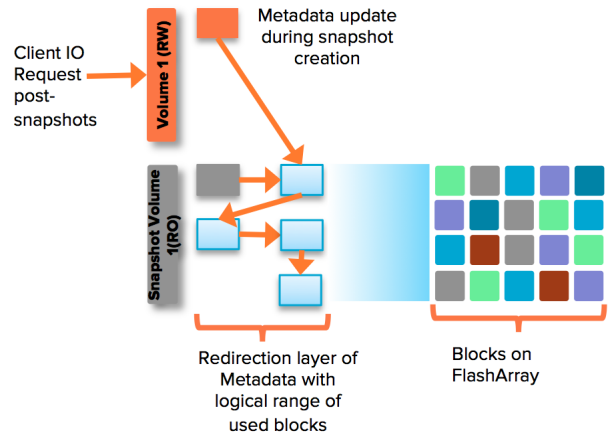
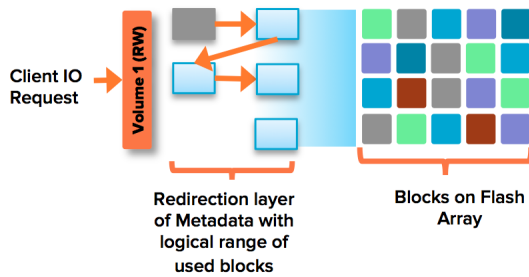
The Purity Operating Environment uses distributed three-dimensional metadata that introduces a level of redirection associated with each volume. The metadata is used as a logical layer to lookup physical blocks on the FlashArray. The metadata is laid out in a format that helps the Purity Operating Environment reduce the space required for metadata and to improve block lookup for faster reads. When a block is written

or overwritten on a Pure Storage FlashArray, new blocks are allocated for the incoming writes or overwrites and the redirection layer is updated to reflect the most recent data on the flash. As data grows in the system, the Purity Operating Environment's proprietary metadata optimization process actively collapses the metadata to further reduce block lookup to a single metadata mapping, making data reads much faster.

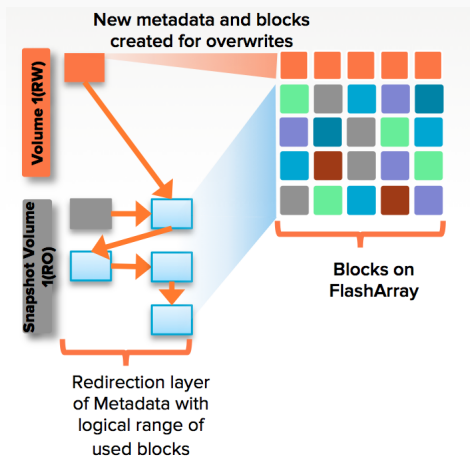
FlashRecover Snapshots:

FlashArray's aged data layout with metadata

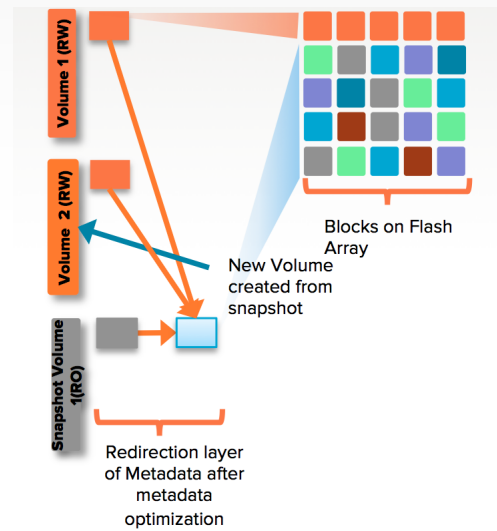
Snapshot Creation



FlashRecover Snapshots:
New block writes or overwrites



New volume activation from existing Snapshot



The three-dimensional metadata and the redirection layer make snapshots inherent to the Purity Operating Environment. Snapshots share the same metadata structure as volumes, incurring no additional cost on capacity and performance. During snapshot creation, only the redirection layer is updated in an atomic operation with no data copy or block move. The atomic operation allows Pure Storage FlashArray to instantaneously take snapshots off multiple volumes with no impact to the client IO and to the performance of the overall storage system. Writes and overwrites, following the creation of a snapshot, continue to allocate new blocks on flash as usual.

FLASHRECOVER SNAPSHOTS ARE JUST NEW VOLUMES WITH FULL CAPABILITIES. THEY INHERIT THE DATA REDUCTION CHARACTERISTICS OF THEIR PARENT VOLUME AND CAN BE RESTORED INSTANTANEOUSLY TO ANY VOLUME

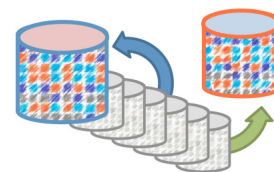
The Purity Operating Environment does not differentiate between volumes and snapshots. Snapshots are just volumes with static data and are programmatically made non-writable. Unlike snapshots in other storage arrays, FlashRecover snapshots are not owned by a volume, and hence can be used to restore any volume or to create new volumes.



Zero Performance Penalties

100% Metadata Operation

- Instantaneously create multi-volume time consistent snapshots with zero impact to client IO
- Create 1000s of snapshots without disrupting system latency



Zero Recovery Restrictions

- Create new volumes from any snapshot or assign snapshots to any existing volume
- Instantly recover snapshots to active volumes

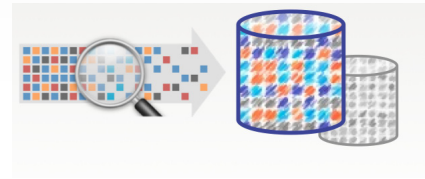


FlashRecover snapshots are thin provisioned with no dedicated space allocated. As data is overwritten in the volumes, new capacity is assigned to the overwritten blocks while unchanged blocks are shared between snapshots and volumes. Additionally, the Purity Operating Environment data structures allow snapshots to preserve the granular data reduction efficiencies of volumes through global deduplication and compression, thus volume snapshots require minimal physical capacity on flash drives.

The snapshot management interface is designed to provide flexibility, scale, and ease of use. The interface allows users to select one or multiple volumes simultaneously in order to create a consistent point-in-time snapshot of all the selected volumes. Snapshots can also be created instantaneously for all the volumes owned by a host or host group thereby providing a consistent view of data for all the volumes assigned to selected hosts at a given point in time. Purity snapshot also protect volumes from accidental deletion by creating an internal snapshot before a volume delete is triggered. Leveraging FlashArray's flexible protection policy management, user can automate the creation and retention of snapshots for local data protection and recovery.

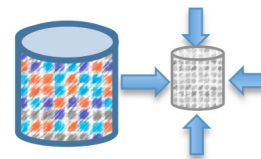
ACCELERATED VOLUME CLONING AND XCOPY LEVERAGE PURE STORAGE'S ROBUST AND RELIABLE SNAPSHOT TECHNOLOGY

Pure Storage leverages FlashRecover Snapshots' robust and flexible design to incorporate data replication and protection solutions such as fast cloning of VMs, application-offloaded workloads (XCOPY), and volume data protection. As Pure Storage introduces new capabilities to its FlashArray, Purity snapshot's reliable and efficient technology will continue to evolve in new forms.



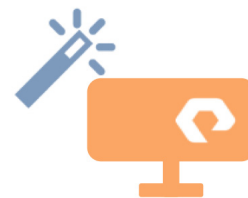
Zero Data Duplication

Snapshots preserves data reduction of parent volume through pattern removal, deduplication and compression



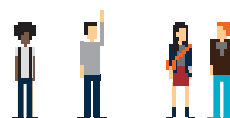
Zero Space Overhead

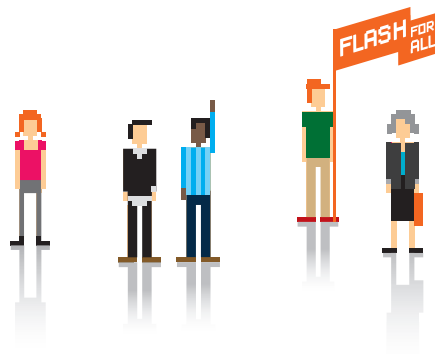
Snapshots are always thin provisioned and share the blocks with volumes incurring practically Zero space overhead



Zero Complexity

Automate multi-volume snapshot creation and retention through flexible policy-based management





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