Technical Validation

Boosting Performance of Business and Mission-critical Applications with Infinidat InfiniBox SSA II

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August 2022

Introduction

This ESG Technical Validation documents our evaluation of the Infinidat InfiniBox Solid State Array (SSA) II. We reviewed how the Infinidat InfiniBox SSA II can help organizations to maximize application performance via low storage latencies, increase operational efficiency, and bolster data security.

Background

The need for organizations to capture value from data is critical in order for them to gain competitive advantage. And organizations face ever-growing amounts of data, as ESG research recently uncovered that 55% of survey respondents are managing between 500TB and 9.999PB of total storage capacity for their primary data (see Figure 1).[1] 67% of respondents also indicated that they expect this capacity to grow up to 50% annually over the next three years,[2] as they anticipate collecting more data to drive business improvements or generate new revenue streams.

Figure 1. Amount of Installed/Available Capacity Associated with Primary/Active Data

To the best of your knowledge, what is your organization's total installed/available capacity associated with storing its primary/active data? (Percent of respondents, N=359)

Category	Percent
Less than 100 TB	4%
100 TB to 249 TB	4%
250 TB to 499 TB	6%
500 TB to 999 TB	19%
1 PB to 2.499 PB	13%
2.5 PB to 4.999 PB	12%
5 PB to 9.999 PB	11%
10 PB to 24.999 PB	8%
25 PB to 49.999 PB	3%
50 PB or more	1%
Don't know	18%
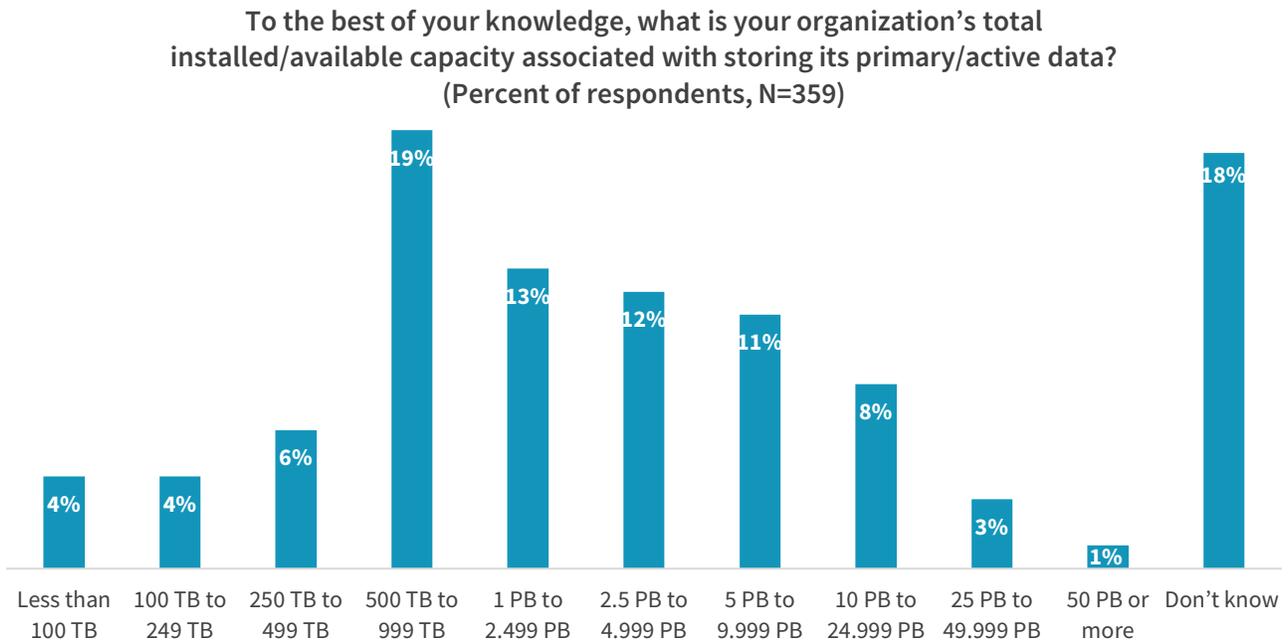
Source: ESG, a division of TechTarget, Inc.

Storage continues to play a huge role in helping organizations maintain competitive advantage as they house the ever-increasing amount of data for business and mission-critical applications and workloads. Organizations must then build out a storage infrastructure that maintains the expected performance of both existing and new workloads and applications, while limiting capital expenditures that can incur additional operational costs. And with the ever-present threat of malicious attacks, it is imperative that any storage infrastructure provide the necessary security measures.

Infinidat InfiniBox SSA II

InfiniBox Solid State Array (SSA) II is the next generation of Infinidat's primary storage and cyber-resilient solutions. Building upon InfiniBox SSA, the InfiniBox SSA II has been designed to help significantly improve performance of business and

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[1] Source: ESG Research Report, *Data Infrastructure Trends*, November 2021. All ESG research references and charts in this technical validation have been taken from this research report, unless otherwise noted.
[2] Source: ESG Survey Results, *2021 Data Infrastructure Trends*, September 2021.

mission-critical workloads and applications, as well as increase total available capacity while minimizing overall storage infrastructure footprint. Organizations can take advantage of two InfiniBox SSA II models, the F4304T and F4308T, offering up to 656TB and 1.312PB of usable capacity (1.31PB and 2.62PB of effective capacity), respectively, in a 42RU chassis.

To increase storage performance, the InfiniBox SSA II architecture leverages a higher number of CPU cores—144 CPU cores—distributed over triple-active storage controller nodes, with additional InfiniBand interconnects added, servicing two storage tiers: DRAM cache and TLC SSDs. With this updated architecture, the InfiniBox SSA II leverages Infinidat's Neural Cache, a machine learning caching algorithm that learns about the type and amount of data applications accessed over time. Once it has learned those patterns, Neural Cache will store data either in DRAM cache or the back-end SSDs, with the goal of minimizing storage-related latencies. As the number of types of applications increase (e.g., database, payment processing, analytics, artificial intelligence), Neural Cache autonomously learns their behavior to ensure that the InfiniBox SSA II delivers the expected performance, without any storage administrator performance tuning. Infinidat customers have reported that they have achieved storage-related latencies as low as 35 microseconds in production networks and cache hit rates exceeding 90%.

With data security top of mind, organizations can leverage the InfiniSafe reference architecture with InfiniBox SSA II to establish its cyber-resiliency. The reference architecture addresses four key areas of data security: immutable snapshots, near-instantaneous recovery, isolated/fenced forensic network environment, and logical local and remote air gapping. While the first two areas are required for bolstering data security, the other areas are recommended depending on use case.

Figure 2. Infinidat InfiniBox SSA II
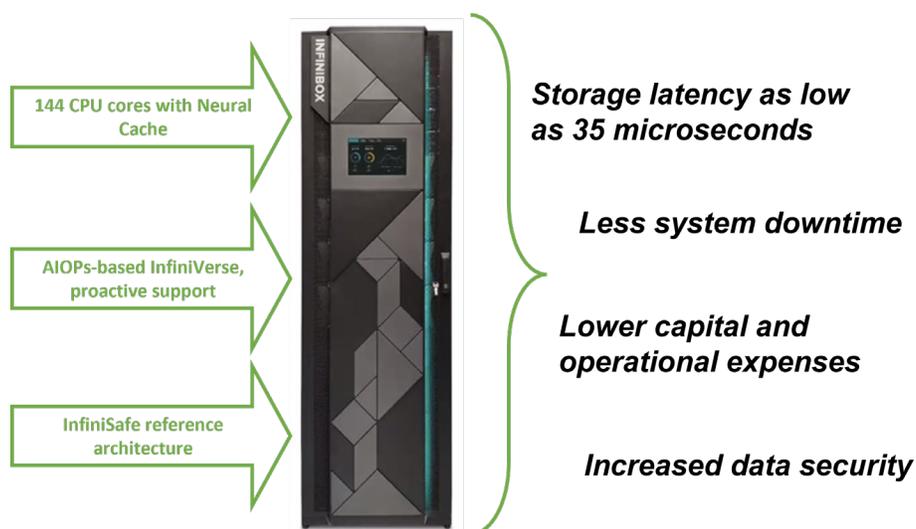
Source: ESG, a division of TechTarget, Inc.

The benefits that organizations can expect from the Infinidat InfiniBox SSA II include:

- Extremely low storage latencies for maximizing application performance, enabling organizations to meet business needs with little to no delay.
- Minimal capital expenditures with both increased storage capacity and storage efficiency enabled with Neural Cache.
- Minimal to no costs related to manual tuning and administration of storage, as Neural Cache can optimize performance for any mix and number of application types.
- Simplified operations and management with automated capabilities (e.g., preemptive support via "call home capabilities" and InfiniVerse, part of InfiniOps, an AIOps cloud-based, analytics-driven environment that monitors, reports, and delivers insights that predict the impact of infrastructure changes on performance).

To back InfiniBox's performance and availability in the field, Infinidat offers a 100% availability guarantee, backed by InfiniVerse and its proactive monitoring and support, plus Infinidat cyberstorage guarantees for recoverability of immutable snapshots with an SLA of one minute or less.

ESG Technical Validation

ESG evaluated the InfiniBox SSA II via remote product demonstrations conducted at Infinidat headquarters in Waltham, MA. Testing was designed to validate how the InfiniBox SSA II can deliver extremely low latencies to maximize application performance while simplifying storage-related operations and bolstering overall data security.

Boosting Application Performance

Achieving business agility translates into optimal application and workload performance to help meet business needs as required. Traditionally, storage administrators have optimized performance by purchasing more storage that is dedicated to applications with similar storage performance requirements and manually tuning storage as more applications and workloads are added. However, this causes both capital and operational expenses to increase. In this day of "doing more with less," incurring these additional expenses is not acceptable.

With the Infinidat InfiniBox SSA II, organizations can achieve extremely low latencies that help to minimize overall application and workload performance, without incurring additional capital and operational costs.

ESG Testing

ESG examined performance numbers of a real-world Oracle RAC workload of a Fortune 100 company. The installed InfiniBox SSA II contained 546TB of usable capacity. Performance data was monitored 24/7 for over a year. Infinidat used InfiniVerse (part of Infinidat's AIOps InfiniOps toolset) to track "*Read-internal*" (observed latency when reading data from storage) and "*Read-total*" (total read latency when accounting for storage, networking, and server resources). We observed the data live, as shown in Figure 3, and noted both "*Read-internal*" and "*Read-total*" at three specific times (9:02, 12:53, and 14:27 Pacific time) on the day of the remote demonstration.

Figure 3. Storage Latencies Observed on InfiniBox SSA II in Live Fortune 100 Environment

Source: ESG, a division of TechTarget, Inc.

At the specified times, ESG noted that "*Read-internal*" times remained at 0.03 milliseconds or 30 microseconds. While we observed other "*Read-internal*" times that were greater than 30 microseconds (e.g., increasing by 10-20 microseconds), the vast majority of observed storage latencies did not deviate from 30 microseconds. At these same timestamps, ESG observed that "*Read-total*" latencies ranged from 90 to 100 microseconds, denoting very low application latencies.

ESG then examined read cache performance. We looked at a 30-minute time period that ended shortly after our 9:02 timestamp, as shown in Figure 4. At 9:02 (with an observed storage latency of 30 microseconds), the "*RAM hit ratio*" was measured at 100%, indicating that all data was located on and read from DRAM. At other times in this 30-minute period, the "*RAM hit ratio*" varied between 50% and 100%, indicating that data was accessed from both DRAM and the back-end SSDs. However, the majority of observed times for storage latency remained close to 30 microseconds.

Figure 4. Read Cache Performance Observed on InfiniBox SSA II in Live Fortune 100 Environment
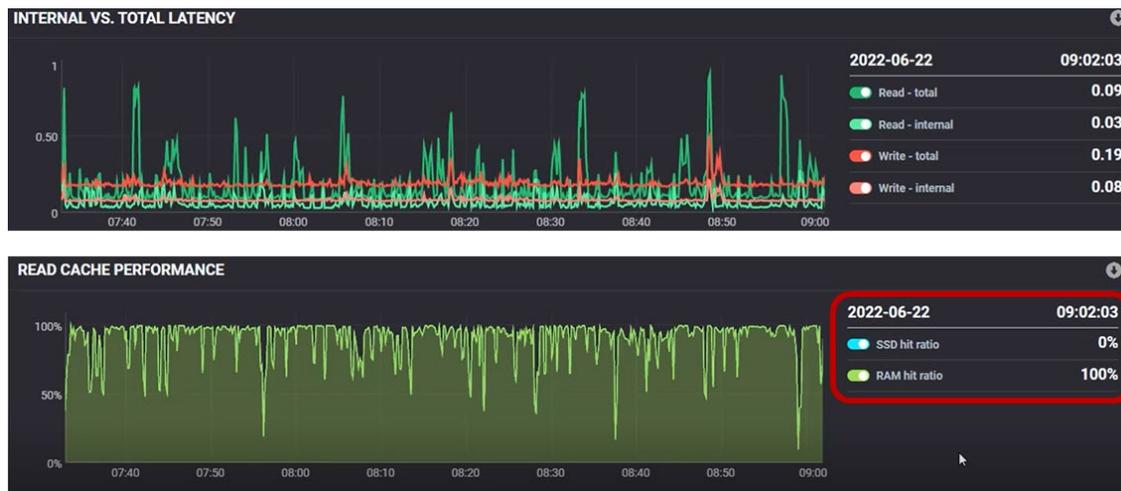
Source: ESG, a division of TechTarget, Inc.

ESG proceeded to observe customer data from a live workload deployed at a Fortune 10 company. The InfiniBox SSA II was configured with 1PB of usable capacity. At timestamp 1:01, we observed read performance of 197,446 IOPS with a 15.01 GiB/sec throughput (see Figure 5).

Figure 5. Read IOPS and Throughput Observed in a Live Fortune 10 Environment (Timestamp = 1:01)

Source: ESG, a division of TechTarget, Inc.

Finally, ESG examined both IOPS and throughput measured over a 57-day period (between April 24 and June 19). As shown in Figure 6, read and write IOPS and throughput are slightly trending up and to the right. This indicates that performance is improving as applications continue to access the InfiniBox SSA II over time.

Figure 6. Read IOPS and Throughput Observed in a Live Fortune 10 Environment (Timestamp = 2:00)
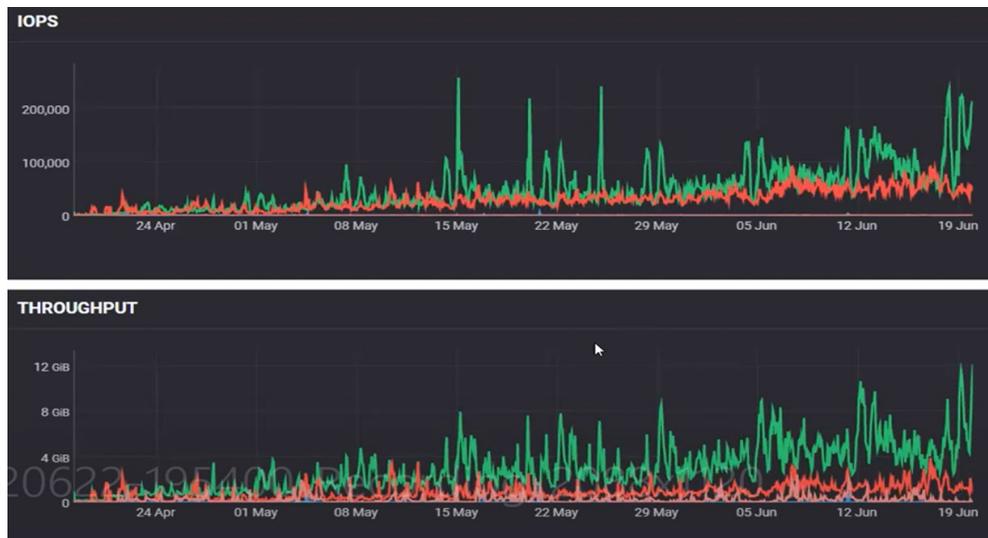
Source: ESG, a division of TechTarget, Inc.

What the Numbers Mean

- Based on our observations of live customer data from a Fortune 100 company, ESG validated that the InfiniBox SSA II is capable of achieving storage read latencies as low as 30 microseconds. More importantly, we found that the InfiniBox SSA II can achieve such low latencies with little variation.

- ESG noted that these low latency observations typically corresponded to a high DRAM hit ratio close or equal to 100%. We attribute this to the Neural Cache algorithm that has placed the most frequently accessed data in RAM cache, as opposed to the back-end SSDs. This contributed to the observed low storage latencies.

- After examining live customer data from a Fortune 100 company, ESG observed that both read IOPS and throughput increased over time. ESG attributed this increase to the Neural Cache algorithms that optimize how data is stored on both DRAM cache and the back-end SSDs. As the algorithms learn behavior across all applications' I/Os, the way the InfiniBox SSA II stores data is optimized, leading to overall performance improvements.

- From the Fortune 10 test results, ESG expects that both read IOPS and throughput can increase as more applications are pointed toward the InfiniBox SSA II due to Neural Cache. We can see how organizations do not have to purchase multiple storage arrays to support applications with different performance requirements. Not only can they manage and support fewer arrays, but also lower expenses for tuning storage are incurred. ESG also anticipates consolidating multiple applications on fewer arrays, subsequently reducing footprint and related power and cooling costs.

ℹ️ Why This Matters

Performance is a critical factor to consider for storage. Along with traditional workloads (such as database applications), organizations are leveraging modern workloads (such as AI/ML) that require extremely high performance—specifically low latencies—so that organizations can extract the most value from data in the least possible time.

ESG validated that the InfiniBox SSA II can achieve 30-microsecond read latencies consistently with the support of Neural Cache. By examining storage latencies, IOPS, and throughput obtained from live customer data from a Fortune 10 and a Fortune 100 company, we verified that the InfiniBox SSA II can boost application performance, enabling organizations to increase agility in light of changing business needs. We also validated that performance can improve over time, even as organizations point more applications to the InfiniBox SSA II. Given this improvement, organizations can point more applications to the InfiniBox SSA II, leading to storage consolidation and a subsequent decrease of related capital and operational costs.

Simplifying Storage Operations and Management

To further minimize storage downtime, organizations have begun to explore storage solutions that leverage AI for conducting everyday maintenance and management tasks. AI has the potential to help storage administrators minimize the time and effort spent on such tasks, thus increasing overall storage availability without incurring additional operational expenses.

With the InfiniBox SSA II, organizations can take advantage of Infinidat's InfiniOps, which provide AIOps and DevOps capabilities for automation, tuning, and administration tasks, as well as receiving proactive support (via customer support centers and dedicated technical advisors) for hardware- and software-affecting issues detected automatically. For performing specific tasks on the InfiniBox SSA II, Infinidat has designed a management system and interface that simplifies operational workflows, thus reducing manual effort.

ESG Testing

To verify how Infinidat simplified operational workflows, ESG examined how it facilitated the completion of typical storage-related tasks. We first observed how a storage administrator could get insights into system health easily from a dashboard, as well as from alerts automatically generated, such as those in the left-hand side of Figure 7. We could also locate specific hardware by virtually unboxing a 3D interactive model of the system.

Figure 7. Assessing System Health of the InfiniBox SSA II
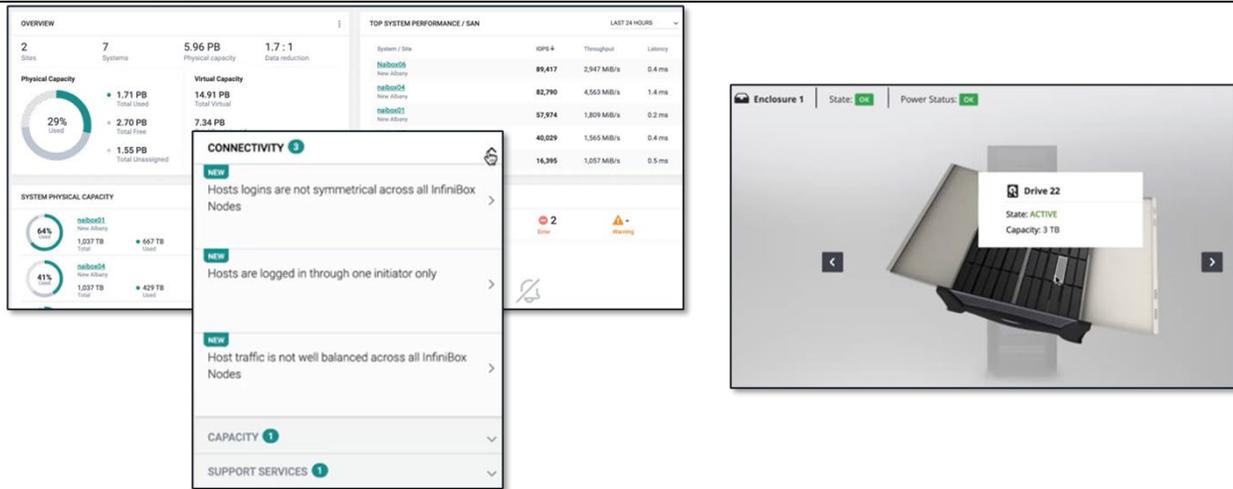
ESG then observed how to create immutable snapshots, as illustrated in Figure 8. We navigated to the storage volume "*bsvm-vol1*" from a server connected to an InfiniBox SSA II via Fibre Channel (FC) and iSCSI. We then created a snapshot of a snapshot named "*bsvm2_vol1_snap2*" via a pop-up menu, based on an expired snapshot, "*bsvm2_vol1_snap1.*"

We should note that Infinidat has also enabled consumers of end storage to create snapshots (as well as any storage management task or API calls) via a command-line interface (CLI)-based tool called InfiniShell. Storage administrators could permit select end users (such as server administrators) to leverage this capability, should business needs dictate. We observed the creation of another snapshot, "*bsvm2_vol1_snap3.*" By using scripts instead of the GUI, ESG could see how organizations can also automate these types of tasks to save both time and manual effort.

Figure 8. Creating Snapshot via Management GUI
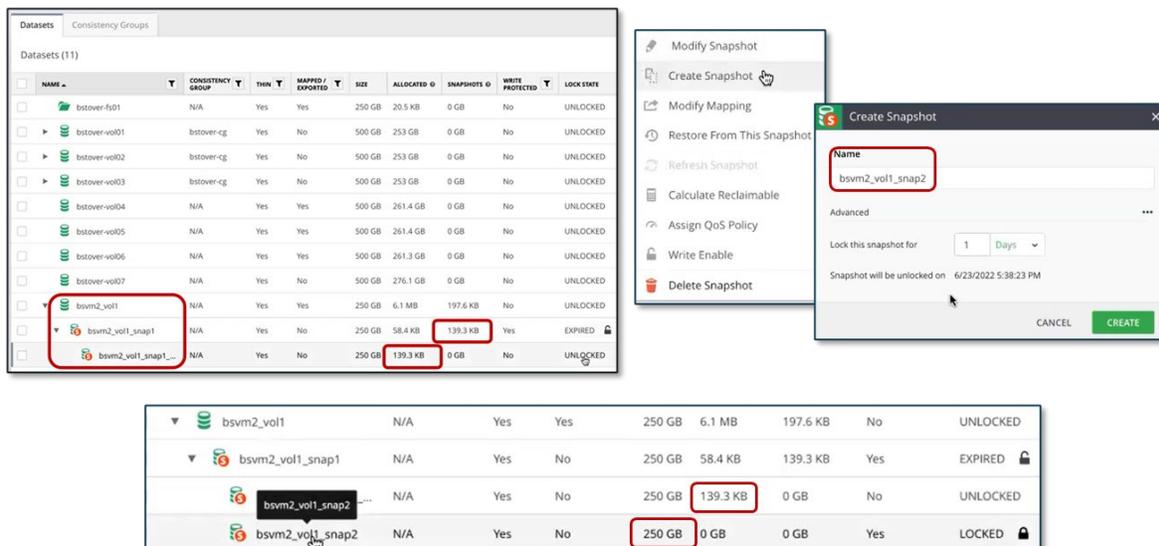
> ### ℹ️ Why This Matters
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> A significant part of minimizing system downtime requires minimizing the time that organizations spend on IT operations.
>
> ESG validated that Infinidat can help to drastically reduce time spent on storage management and administration. We observed how Infinidat simplified workflows via Infinidat's GUI to complete routine IT tasks, resulting in lower operational expenses. We also noted how these workflows can be scripted so that organizations can automate the completion of such tasks. ESG should note that the AIOps-based InfiniVerse and Infinidat's proactive support can help to further decrease operational expenses by eliminating additional effort spent on maintenance and monitoring.

Bolstering Data Security

Securing data against cybersecurity threats and attacks has become a constant challenge to manage, especially as ransomware has become commonplace. With the InfiniSafe reference architecture, organizations using the InfiniBox SSA II can bolster their data security and recover quickly from any cybersecurity attack with very little delay. Infinidat is also guaranteeing the recovery of an immutable snapshot in a minute or less.

ESG Testing

While organizations can automate the four capabilities of the InfiniSafe reference architecture via API calls, ESG specifically observed how Infinidat can present immutable snapshots to a fenced/isolated forensic network and then recover from those snapshots. (We explored how immutable snapshots were created in the previous section.) Organizations can use these forensic environments to ensure that clean snapshot copies are always available in the case of cybersecurity attacks.

ESG used a testbed consisting of two Windows-enabled machines, a physical server named "*io-wt-07,*" and a guest VM on the other server, "*bsvm-win,*" connected via FC to an InfiniBox SSA II named "*ibox2233.*" The physical server was also connected via FC to another InfiniBox SSA II named "*ibox2817.*"

To present a clean snapshot to a designated fenced forensic network, ESG first created another snapshot named "*bsvm2_vol1_snap3_copy*" based on the snapshot previously created. We designated "*ibox2288*" as part of our fenced forensic network. From the "*io-wt-07*" machine, we mapped the storage volume containing the clean snapshot to "*ibox2288,*" then mounted that volume into the S:\ directory, as shown in Figure 9. To verify that we had a clean copy, we opened a known clean data file, "*data-index1,*" and confirmed its contents.

Figure 9. Presenting a Clean Snapshot to a Fenced Forensic Network
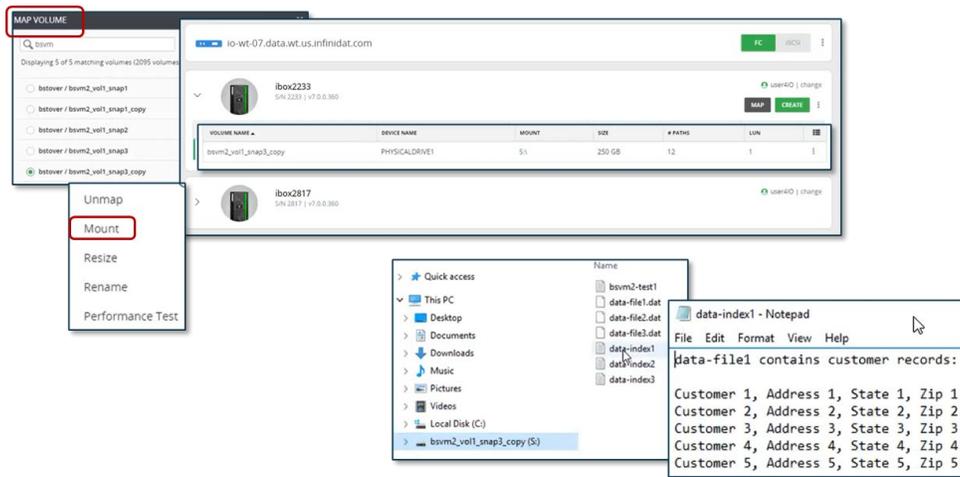
To ensure that we could restore from a clean file, we "infected" the "*data_index1*" on the "*bsvm-win*" Windows VM by adding extra text (see Figure 10). We then unmounted and unmapped "*bsvm2_vol1*" from "*ibox2233*," since that contained the infected file. Once the volume was unmapped, we navigated to the clean locked snapshot, "*bsvm2_vol1_snap3*," from the GUI associated with "*bsvm-win*" and chose "**Restore from This Snapshot**." After a brief time, we then examined "*data-index1*" again and found that the uninfected data was restored.

Figure 10. Restoring from a Clean Snapshot
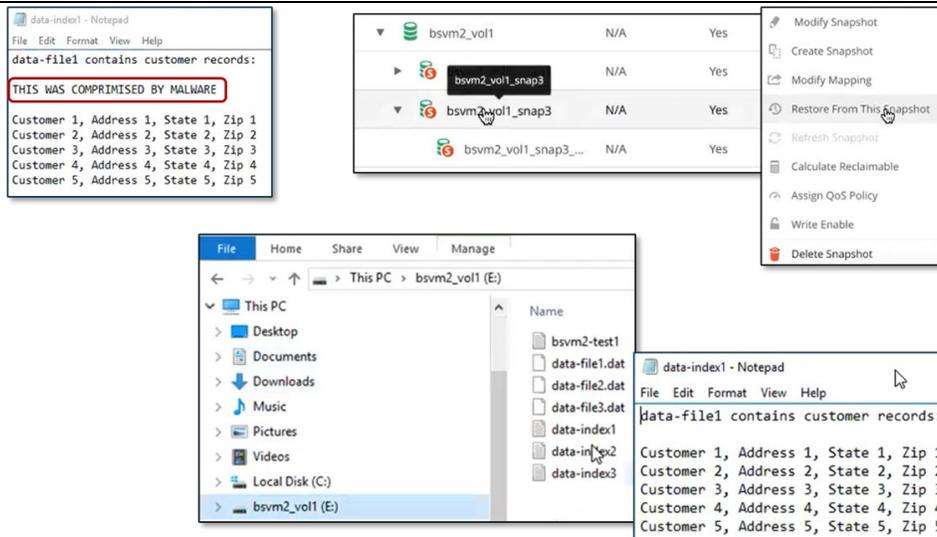
> ### ⓘ Why This Matters
>
> Securing data is a given in today's business environment, as cybersecurity threats and attacks are a constant. Should a breach occur, organizations must recover as quickly as possible.
>
> ESG validated that the InfiniSafe reference architecture can help organizations to secure data stored on the InfiniBox SSA II comprehensively. While organizations can automate the workflows associated with creating immutable snapshots, presenting clean snapshots to a fenced forensic network and creating logical air gaps, we validated how recovery can be done at any given point in time, using locked snapshots, without having to restore entire storage volumes. This supports near-instantaneous business recovery.

The Bigger Truth

Extracting value from the ever-increasing amounts of data stored requires optimized application performance to meet business needs without delay. Optimizing performance depends in large part on how quickly applications can access stored data. As the amount of data and number of applications grow, ensuring that storage performance is optimized becomes challenging. Organizations resort to purchasing additional storage to cater to differing application requirements, which leads to unwanted additional capital expenditure. And the time and effort spent on manually tuning storage to meet performance targets, minimizing downtime, and protecting against cybersecurity threats incur operational expenses.

With the InfiniBox SSA II, organizations can maximize application performance in order to extract the necessary value from data with very little delay. With Infinidat's Neural Cache, organizations can reduce storage latencies for multiple applications pointed to the InfiniBox SSA II. By learning the behavior of multiple applications over time, the InfiniBox SSA II will efficiently store data between the DRAM cache and the back-end SSDs, so that performance of any application is optimized. As the InfiniBox SSA II operates over time, overall storage performance improves. Organizations have experienced read latencies as low as 35 microseconds.

In reviewing performance numbers measured from application data in live production networks of two Fortune 100 companies, ESG validated that storage read latencies were as low as 30 microseconds and attributed this to the Neural Cache algorithms. By observing read IOPS and throughput over a two-month period, ESG validated that storage performance can improve over time, as the Neural Cache optimizes data placement between the DRAM cache and the SSDs to minimize latencies. We believe that this performance optimization eliminated the need to purchase additional storage, thus lowering the related capital and operational expenses.

ESG also validated that Infinidat:

- Has simplified workflows for routine IT management and monitoring tasks, thus reducing manual effort and related operational expenses. We noted that these workflows could be scripted to automate these IT tasks. To further reduce any manual effort related to IT management and maintenance, ESG did note that Infinidat offers both proactive support and InfiniVerse to automate alerts of potential service-affecting issues.

- Can bolster data with the InfiniSafe reference architecture. We specifically observed how the InfiniBox SSA II can minimize the time to recovery from a cybersecurity event without having to restore entire storage volumes.

Based on customer testimony, the InfiniBox SSA II has exceeded their expectations in delivering optimal application performance for any given mix of traditional and modern workloads, without the burden of excessive costs. Organizations have no choice but to extract value from an ever-growing amount of data. They will always face the tasks of storing,

managing, and securing such data and of minimizing associated costs without sacrificing performance and availability. To that end, ESG believes that the InfiniBox SSA II deserves a closer look.

The goal of ESG Validation reports is to educate IT professionals about information technology solutions for companies of all types and sizes. ESG Validation reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objectives are to explore some of the more valuable features and functions of IT solutions, show how they can be used to solve real customer problems, and identify any areas needing improvement. The ESG Validation Team's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments.

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