



**SPC BENCHMARK 1™ (SPC-1™)
Snapshot Extension**

Official Specification

Revision 1.0 – Effective TBD

Storage Performance Council (SPC)

PO Box 3504

Redwood City, CA 94064-3504

Phone (650) 556-9384

www.storageperformance.org

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Document History

Effective Date	Version	Description
TBD	1.0	Creation of stand-alone extension document.

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Clause 0 Introduction

0.1 Preamble

Benchmark extensions are optional additions to an existing benchmark (“the underlying benchmark specification”) that are designed to showcase a feature or set of features, and to provide vendors with a means to differentiate their products across dimensions other than the existing performance or price-performance metrics of the benchmark

The SPC benchmark extensions are intended to be vendor and platform independent. Any vendor should be able to sponsor and publish an SPC result, with or without extensions, provided their tested configuration satisfies the performance, integrity, and availability requirements of the specification.

Rather than requiring or favoring a particular implementation, it is the goal of SPC benchmarks and extensions to provide a robust, verifiable, reproducible environment within which the relative strengths of differing design and configuration approaches can be evaluated.

0.2 General Guidelines

The purpose of SPC benchmarks is to provide objective, relevant, and verifiable data to purchasers of I/O subsystems. To that end, SPC specifications require that benchmark tests be implemented with system platforms and products that:

- Are generally available to users.
- A significant percentage of the users in the target market segment (server class systems) would implement.
- Are relevant to the market segment that the benchmark represents.

More detailed requirements can be found in the body of the SPC Benchmark-1 specification.

0.3 Measurement Guidelines

SPC benchmark results are expected to be accurate representations of subsystem performance. Therefore, stringent measurement, auditing, and reporting guidelines are mandated by this specification. In general, fidelity and candor must be maintained in reporting any anomalies in the results, even if not specified in the benchmark requirements.

More detailed measurement, evaluation and disclosure requirements can be found in the body of the specification.

0.4 Related Documents

This benchmark extension relies on:

- Version 3 of SPC Benchmark-1
- Version 1 of the *SPC Pricing Guide*
- Version 1 of the *SPC Glossary (included as Appendix A)*

0.5 Document Conventions

This document follows the standard typographical conventions for SPC publications.

Generally, words and expressions will adhere to their common English usage. Where a particular term is being defined or assumed to have a benchmark-specific meaning, it appears in SMALLCAPS, and its formal definition can be found in the *SPC Glossary*, which is included here as Appendix A.

0.6 Disclaimer

While this workload models a rich multi-user environment that emulates a broad range of server applications, it neither represents the entire range of I/O requirements for server systems nor precisely mimics any particular application. In addition, the extent to which anyone is capable of achieving the results reported by a vendor is highly dependent upon how closely the customer's application maps to the SPC-1 workload. The extrapolation of SPC-1 results to other environments is therefore not recommended.

Actual system performance is highly dependent upon specific workload characteristics, platform configuration, and application-specific tuning. Relative system performance will vary as a result of these and other factors. Thus, SPC-1 should not be used as a substitute for customer application benchmarking when critical performance requirements are called for.

SPC-1 uses terminology and metrics that are similar to other benchmarks. This similarity does not imply that results from this benchmark are comparable with other benchmarks.

Clause 1 Workload Environment

1.1 Overview

One of the core capabilities of many enterprise storage arrays is the ability to take quick, crash-consistent, light-weight [SNAPSHOTS](#) that provide a self-consistent image of a given data set.

For modern storage arrays, taking and managing snapshots may have very little impact on storage system performance. For other architectures, managing snapshots introduces a significant overhead.

The goal of this extension is to allow [TEST SPONSORS](#) to demonstrate that their arrays can manage a significant snapshot inventory while maintaining a reasonable IO load.

Comment: *This test is limited to crash-consistent snapshots, which provide an image of a storage system and the data it manages at the time that the snapshot is taken. An assessment of application-consistent snapshots would require the modeling of an explicit application context, and is beyond the scope of SPC benchmarks.*

Clause 2 Storage Capacity and Content

This extension has no impact on the storage capacity and content requirements defined in SPC-1.

Clause 3 Workload and I/O Operation Profile

This extension has no impact on the workload and I/O operation profile as defined in SPC-1.

Clause 4 Benchmark Configuration and Tested Storage Configuration

- 4.1 Each [SNAPSHOT](#) created during the SPC-1 snapshot extension shall be a copy of ASU-1 and ASU-2.
- 4.2 Updates to the [ASU](#)s made after creating the [SNAPSHOT](#) shall not impact the contents of the [SNAPSHOT](#).
- 4.3 The [SNAPSHOT](#)(s) created during the execution of the SPC-1 snapshot extension shall be created and deleted on a schedule, and without manual intervention.
- 4.4 The [TSC](#) shall be capable of returning the [ASU](#)s to the precise content that they contained when the [SNAPSHOT](#) was created.

Clause 5 Test Methodology

This extension has no impact on the SPC test methodology as defined in SPC-1.

Clause 6 Measurement Requirements (Execution Rules)

6.1 General Requirements

6.1.1 The snapshot extension defines two execution models:

- [SNAPSHOTS](#) can be enabled throughout the metrics test of an audited SPC-1 run (“integrated execution”) as defined in the SPC-1 specification, or
- [SNAPSHOTS](#) can be enabled during an additional [TEST PHASE](#), executed after the completion of the audit run defined in the SPC-1 specification including metrics and persistence. While this additional [TEST PHASE](#) (“stand-alone test”) is subject to audit, it is distinct from the [TEST PHASES](#) defined in the SPC-1 specification, and introduces its own set of requirements.

The [TEST SPONSOR](#) shall select one of the two execution models for the snapshot extension. If the [TEST SPONSOR](#) opts for a stand-alone test, the benchmark execution shall satisfy the requirements of clause 6.2.

6.1.2 Snapshots shall be enabled during the measurement interval(s) for the selected execution model.

6.1.3 A single, crash-consistent [SNAPSHOT](#) spanning all of ASU-1 and ASU-2 shall be created every 15 minutes during the measurement interval. If the TSC employs multiple volumes with ASU-1 or ASU2, the test sponsor may employ multiple volume-based snapshots to provide appropriate coverage (“[SNAPSHOT SET](#)”), provided they satisfy all other requirements in this extension.

6.1.4 A given [SNAPSHOT](#) shall be completed and available for use less than 15 minutes from the time it is requested.

Comment: *The intent is to assure that the TSC is capable of sustaining a 15-minute snapshot schedule indefinitely.*

6.1.5 After the fourth [SNAPSHOT](#) is created, the oldest [SNAPSHOT](#) shall be deleted at approximately the same time as each subsequent [SNAPSHOT](#) creation.

6.2 Stand-alone Execution Requirements

6.2.1 The required parameters for the snapshot-enabled [TEST PHASE](#) are summarized in Table 6-1.

Table 6-1 Snapshot Test Phases

Test Phase Group	Test Phase	Load Percentage	Required Durations		
			Ramp Up (minimum)	Measurement Interval	RunOut
	SNAPSHOT	25	60 minutes	60 Minutes (minimum)	1 minute

6.2.2 All constraints on a [TEST PHASE](#) (see “*SPC-1 Benchmark Specification, version 3.9*”, clause 5) must be satisfied during the snapshot-enabled [TEST PHASE](#).

- 6.2.3 The [TEST SPONSOR](#) may configure a snapshot feature prior to starting the snapshot-enabled [TEST PHASE](#). There shall be no change to the set of hardware components that comprise the [TSC](#).
- 6.2.4 Any actions required to set and enable the snapshot feature and associated schedule must be disclosed.
- 6.2.5 The [TEST SPONSOR](#) shall not recreate the storage hierarchy, reload data, or otherwise perturb the [ASUs](#) between the audited run and the snapshot-enabled [TEST PHASE](#).
- 6.2.6 The average response time during the snapshot-enabled [TEST PHASE](#) may be significantly higher than demonstrated during the metrics run. This is acceptable, provided the run meets all requirements of a valid [TEST PHASE MEASUREMENT INTERVAL](#).

6.3 Validation Requirements

- 6.3.1 In addition to the performance test defined in 6.1 and 6.2, the [TEST SPONSOR](#) shall demonstrate minimal snapshot functionality. The [TEST PHASES](#) used for snapshot validation are summarized in Table 6-2.

Table 6-2 Snapshot Validation Test Phases

Test Phase	Load Percentage	Read Percentage	Required Durations		
			Transition (minimum)	Measurement Interval	RunOut
SNAP-1	25	0	3 minutes	5 minutes	1 minute
SNAPSHOT					
SNAP-2	25	0	0	0	0
SNAP-3	25	100	0	0	0
ROLLPACK					
SNAP-3	25	100	0	0	0

Comment: *Since the SNAP-2 and SNAP-3 test phases are replaying the IO sequence established by SNAP-1, they don't have an explicit set of durations. They are expected to traverse the entire IO sequence from SNAP-1, however long that takes.*

- 6.3.2 Prior to beginning the snapshot validation test, the [TEST SPONSOR](#) shall disable automatic snapshots.
- 6.3.3 [TEST PHASES](#) SNAP-1, SNAP-2 and SNAP-3 each access an identical, randomly-selected set of locations throughout the [ASU CAPACITY](#).
- 6.3.4 SNAP-1 writes a unique pattern at the selected location, which must be verified during the execution of SNAP-3 in order for SNAP-3 to succeed.
- 6.3.5 SNAP-2 accesses the identical locations, but writes a different unique pattern.
- 6.3.6 The IO load level required for a given [TEST PHASE](#) shall be at least the integer value resulting from truncating the product of the I/O load level used to generate the

reported SPC-1 IOPS™ rate and the load percentage for the [TEST PHASE](#) from Table 6-2.

- 6.3.7 The required duration values for SNAP-3 are chosen to allow the [TEST PHASE](#) to run until it has verified all writes done during the SNAP-1 or SNAP-2 [TEST PHASE](#).
- 6.3.8 Following the completion of the SNAP-1 [TEST PHASE](#) and prior to the SNAP-2 [TEST PHASE](#), the [TEST SPONSOR](#) shall create a [SNAPSHOT](#) of ASU-1 and ASU-2.
- 6.3.9 Once the snapshot has been created, the test sponsor shall execute SPC1_SNAP_2, followed by SPC1_SNAP_3. The execution of SNAP-3 must fail. If it does not, the test is deemed to have failed.
- 6.3.10 Following the first execution of SNAP-3 (“SNAP-3-1”), the [TEST SPONSOR](#) shall roll-back ASU-1 and ASU-2, using the [SNAPSHOT](#) created
- 6.3.11 Once the roll-back completes, the [TEST SPONSOR](#) shall re-execute SNAP-3 (“SNAP-3-2”), which must succeed, indicating that the storage system has been restored to the consistent state established before the execution of the SNAP-2 [TEST PHASE](#). If the execution of the SNAP-3-2 test phase fails, the test fails.

Clause 7 Data Persistence Requirements and Test

This extension has no impact on the Persistence test defined in SPC-1

Clause 8 Reported Data

8.1 **General Requirements**

- 8.1.1 The output from this extension to SPC-1 is the demonstrated capability to create and manage snapshots.
- 8.1.2 If the testing defined in this extension is completed successfully, the result may be referred to “SPC-1 Snapshot Enabled”.

8.2 **Comparability and Permitted Use**

- 8.2.1 Results that execute this extension are subject to all Permitted Use requirements.
- 8.2.2 Public reference that includes a comparison of one or more SPC-1 RESULTS may distinguish those results that included the execution of this extension from those that did not.

Clause 9 Pricing

- 9.1 This extension has no impact on the pricing requirements defined in SPC-1.
- 9.2 This extension is subject to the general pricing guidelines defined in version 0.2 of the *SPC Pricing Guidelines*.

Clause 10 Full Disclosure Report

- 10.1 For the snapshot extension, the [FDR](#) shall disclose:
- The execution model selected for this extension (see 6.1).
 - The commands or steps needed to create the snapshot schedule and enable it.
 - The name of the files included in the SUPPORTING FILES that contain the data resulting from the execution of the [TEST PHASES](#) defined in Table 6-2, as produced by a supported version of the SPC [WORKLOAD GENERATOR](#).
- 10.2 A table presenting key results from the SNAPSHOT VALIDATION TEST shall be disclosed. The content, appearance, and format of this table are illustrated by example in Table 9-1.

Table 10-1 Snapshot Validation Test Results

Snapshot Validation Test Results				
	SNAP-1	SNAP-2	SNAP-3-1	SNAP-3-2
Total Number of Logical Blocks Written (1)	XXX,XXX	XXX,XXX		
Total Number of Logical Blocks Verified (2)			YYY,YYY	YYY,YYY
Total Number of Logical Blocks that Failed Verification (3)			ZZ	ZZ
Duration for Test Phase (sec.)	SSS	SSS	SSS	SSS
Size in Bytes of each Logical Block (bytes)	ZZ,ZZZ,ZZZ	ZZ,ZZZ,ZZZ	ZZ,ZZZ,ZZZ	ZZ,ZZZ,ZZZ
Number of Failed I/O Requests in the process of the Test (4)	NNN	NNN	NNN	NNN

Footnotes to **Error! Reference source not found.** XE "Logical Block" s written during the test phase.

1. The total number of [LOGICAL BLOCKS](#) written during the [TEST PHASE](#)
2. The total number of [LOGICAL BLOCKS](#) that passed verification in during the [TEST PHASE](#).
3. The total number of [LOGICAL BLOCKS](#) that failed verification during the [TEST PHASE](#)
4. The number of failed i/o requests per the definition in Clause 5.1.6 of SPC-1.

- 10.3 The FDR shall contain a brief description of how the TSC ensures the consistency of snapshots, and an attestation to the correctness of that implementation. An example description is:

The RBBL Storage Model XYZ storage array supports Multi-LUN Consistent Snapshot Copies. Such Snapshot copies are made by establishing a write-fence across all included LUNs, creating the Snapshot Copy, and releasing

the fence. RBBL Storage, Inc. believes this functionality provides the level of protection required for enterprise-level snapshots

10.4 If the tests sponsor selected the stand-alone execution model, the [FDR](#) shall fully disclose the snapshot [TEST PHASE](#), including:

- The name of the file included in the SUPPORTING FILES and that contains the data resulting from the execution of the snapshot [TEST PHASE](#), as produced by a supported version of the SPC-1 data reduction tool.
- The timing of the execution of the [TEST PHASE](#), including the [TRANSITION](#) period and the MEASUREMENT INTERVAL.
- The Throughput Graph, as produced by a supported version of the SPC-1 data reduction tool.
- The Response Time Graph, as produced by a supported version of the SPC-1 data reduction tool
- The Data Rate Graph, as produced by a supported version of the SPC-1 data reduction tool.
- The Response Time Frequency Graph, as produced by a supported version of the SPC-1 data reduction tool
- The measured intensity multiplier for each I/O STREAM, its coefficient of variation and the percentage of difference from the intensity multiplier defined for that I/O STREAM .
- A summary of the I/O requests during the MEASUREMENT INTERVAL, including the total number of completed I/O REQUESTS, the number of I/O REQUESTS with a RESPONSE TIME less than or equal to 30.00 milliseconds and the number of I/O REQUESTS with a RESPONSE TIME greater than 30.00 milliseconds.
- Any and all changes made to the TSC between the audited run and the snapshot [TEST PHASE](#).

Clause 11 Measurement, Audit and Result Submission

1. Obtain the TEST RESULTS FILES from the snapshot validation [TEST PHASES](#)
2. If the stand-alone execution model was employed, obtain the TEST RESULTS FILES from the snapshot [TEST PHASE](#).
3. Authenticate the TEST RESULTS FILES obtained in #1.
4. Inspect the TEST RESULTS FILE s to determine compliance or non-compliance with all constraints and requirements.

Appendix A Glossary

The SPC Glossary is used in all SPC specifications, and is available as a stand-alone document. It is included here in its entirety for ease of reference.

SPC Glossary, version 1.0, which was current as of 24 March 2020

A.1 A

ADDRESSABLE CAPACITY

the portion of the storage capacity of a [LOGICAL VOLUME](#) that is accessible to the [WORKLOAD GENERATOR](#).

APPLICATION STORAGE UNIT (ASU)

the logical representation of the persistent, non-volatile storage read and or written in the course of executing a [BENCHMARK](#).

An ASU represents is a logical interface between a [BENCHMARK CONFIGURATION](#)'s data and a workload generator.

APPLICATION STORAGE UNIT CAPACITY

the total [ADDRESSABLE CAPACITY](#) of all the portions of [LOGICAL VOLUMES](#) to which an [ASU](#) is mapped.

APPLICATION STORAGE UNIT STREAM

a collection of one or more [I/O STREAMS](#), that completely defines the I/O sent to a given [ASU](#).

ASSOCIATED DATA

data and measurements defined by a given [BENCHMARK](#) that are used to calculate, clarify or reinforce the metrics reported as part of a [RESULT](#).

ASU

see [APPLICATION STORAGE UNIT](#).

ASU CAPACITY *see [APPLICATION STORAGE UNIT CAPACITY](#).*

ASU PRICE *the ratio of [TOTAL SYSTEM PRICE](#) to [ASU CAPACITY](#).*

ASU STREAM *see [APPLICATION STORAGE UNIT STREAM](#).*

AUDIT *the process that verifies that a [MEASUREMENT](#) is eligible for submission as a [RESULT](#).*

AUDITOR *An individual who has been certified by the SPC to perform an [AUDIT](#).*

AVAILABILITY DATE

a date by which a given product, component or configuration is released for general availability.

AVERAGE RESPONSE TIME

the sum of the [RESPONSE TIMES](#) for all [MEASURED I/O REQUESTS](#) within a given interval, divided by the total number of [MEASURED I/O REQUESTS](#).

A.2 B

BC *see [BENCHMARK CONFIGURATION](#).*

BENCHMARK a collection of [TESTS](#), [TEST PHASES](#), documentation requirements, and comparability constraints that fully define the process for taking a [MEASUREMENT](#) and creating a [RESULT](#).

BENCHMARK CONFIGURATION

all hardware and software components used in the creation of a [MEASUREMENT](#).

A.3 C

COMPLETED I/O REQUEST an [I/O REQUEST](#) with a [START TIME](#) and a [COMPLETION TIME](#).

COMPLETION TIME

the time recorded by the [WORKLOAD GENERATOR](#) when an [I/O REQUEST](#) is satisfied by the [TSC](#).

COMMITTED: Of an IO operation, written to persistent, non-volatile storage, in such a manner that the data can be retrieved after recovery from a [TSC](#) failure.

CRASH-CONSISTENT:

A data image (logical or physical) is considered crash consistent if there exists a point in time such that all write operations completed prior to that time are included in the image, and no write operation initiated after that time is included.

A.4 D

DATA RATE the data volume transferred in a given interval divided by the duration of the interval, in seconds.

A.5 E

EXTENSION optional addition(s) to an existing [BENCHMARK](#) that showcase a feature or set of features not captured by the [BENCHMARK'S](#) existing metrics.

EXTENSION CONFIGURATION

all hardware and software components used in the execution of an [EXTENSION](#).

EXPECTED I/O COUNT

for any given [I/O STREAM](#) and [TEST PHASE](#), the product of requested IO load in IOs per second, the duration of the [TEST PHASE](#) in seconds, and the [INTENSITY MULTIPLIER](#) parameter for that [I/O STREAM](#).

EXECUTIVE SUMMARY

a high-level report summarizing a [RESULT](#), and the configuration used to produce it.

A.6 F

FAILED I/O REQUEST

any [I/O REQUEST](#) issued by the [WORKLOAD GENERATOR](#) that could not be completed or was signaled as failed by the OS running on the [HOST SYSTEM](#).

A FAILED I/O request has no [COMPLETION TIME](#).

FDR see [FULL DISCLOSURE REPORT](#).

FULL DISCLOSURE REPORT

a report detailing a [RESULT](#), along with the procedures, configuration, and equipment used to produce it.

A.7 **G**

No terms defined.

A.8 **H**

HOST SYSTEM a computer system where the [WORKLOAD GENERATOR](#) executes.

A.9 **I**

IN-FLIGHT I/O REQUEST

an [I/O REQUEST](#) issued by the [WORKLOAD GENERATOR](#) that does not complete within a given [MEASUREMENT INTERVAL](#).

INTEGRATED EXECUTION

of a benchmark extension: completed during one of the test phases of a benchmark execution.

INTENSITY MULTIPLIER

the ratio of the IO load produced by a given [I/O STREAM](#) to the total IO load produced by all active [I/O STREAMS](#).

I/O COMMAND see [I/O REQUEST](#).

I/O STREAM a single, well-defined, sequence of [I/O REQUESTS](#).

I/O REQUEST a single, atomic I/O operation.

I/O REQUEST THROUGHPUT

the total number of [MEASURED I/O REQUESTS](#) in a [TEST PHASE](#), divided by the duration of that [TEST PHASE](#)'s [MEASUREMENT INTERVAL](#), expressed in seconds.

A.10 **J**

No terms defined.

A.11 **K**

No terms defined.

A.12 **L**

LOGICAL BLOCK the smallest directly addressable unit of storage on the [ASU](#).

LOGICAL VOLUME an individually addressable logical unit of storage presented to the [WORKLOAD GENERATOR](#).

A.13 M

MEASURED I/O REQUEST

an [I/O REQUEST](#) with a [COMPLETION TIME](#) occurring within the [MEASUREMENT INTERVAL](#).

MEASURED INTENSITY MULTIPLIER

the percentage of all [MEASURED I/O REQUESTS](#) that were issued by a given [I/O STREAM](#).

MEASUREMENT: the data gathered during the execution of a [BENCHMARK](#).

MEASUREMENT INTERVAL

of a [TEST PHASE](#), the time from the end of the [TRANSITION](#) to the start of the [RUNOUT](#).

A.14 N

No terms defined.

A.15 O

ON-SITE AUDIT an [AUDIT](#) for which the [AUDITOR](#) is physically present.

A.16 P

PHYSICAL CAPACITY UTILIZATION

[ASU CAPACITY](#) divided by the [PHYSICAL STORAGE CAPACITY](#).

PHYSICAL FREE SPACE

the persistent storage capacity that could be used to hold application data and the metadata required to access, maintain and protect that data, but is not in use at the time of the measurement.

PHYSICAL STORAGE CAPACITY

the total storage capacity of all of the [STORAGE DEVICES](#) in the [TESTED STORAGE CONFIGURATION](#).

PRICED STORAGE CONFIGURATION ("PSC"):

the customer-orderable version of the [TSC](#).

PRICE-PERFORMANCE

the ratio of the [TOTAL SYSTEM PRICE](#) to the primary performance metric for a [BENCHMARK](#)):.

PRICING SPREADSHEET

a detailed computation of the total cost of ownership for a [PRICED STORAGE CONFIGURATION](#).

PRIMARY METRIC a metric that provides a primary basis for comparison of [RESULTS](#).

PROTECTED 1 a data protection level in which the failure of any single [STORAGE DEVICE](#) in the [TSC](#) will not require user intervention to restore access to the [BENCHMARK'S](#)) data repository.

PROTECTED 2 a data protection level in which the failure of any single component in the [TSC](#) will not require user intervention to restore access to the [BENCHMARK'S](#) data repository.

PSC see [PRICED STORAGE CONFIGURATION](#).

A.17 **Q**

No terms defined.

A.18 **R**

REFERENCE PRICE

the price at which component or subsystem could be ordered individually from the [TEST SPONSOR](#) or designated third-party supplier.

REMOTE AUDIT *an [AUDIT](#) for which the [AUDITOR](#) is not physically present. See [ON-SITE AUDIT](#).*

REPLICATION *the automatic execution of all I/O operations executed against a primary storage system on a one or more, independent storage systems.*

RESPONSE TIME *for an [I/O REQUEST](#), [COMPLETION TIME](#) minus [START TIME](#).*

RESULT *an audited [MEASUREMENT](#) which has been submitted to the SPC for publication*

RESULTS FILES *the output of the [WORKLOAD GENERATOR](#), created during a [MEASUREMENT](#).*

REPORTED DATA *The set of data, as defined by a given [BENCHMARK](#), which fully characterizes a [MEASUREMENT](#).*

RUNOUT *of a [TEST PHASE](#), the time period immediately following the [MEASUREMENT INTERVAL](#) during which the IO load presented by the [WORKLOAD GENERATOR](#) to the [TSC](#) remains constant long enough for any IO issued during the [MEASUREMENT INTERVAL](#) to complete.*

A.19 **S**

SER *see [SPACE EFFECTIVENESS RATIO](#).*

SOR *see [SPACE OPTIMIZATION RATIO](#).*

SNAPSHOT *a logical, point-in-time, [CRASH-CONSISTENT](#) image of one or more [LOGICAL VOLUMES](#).*

SNAPSHOT SET *a crash-consistent collection of [SNAPSHOTS](#), taken and managed as a unit.*

SPACE EFFECTIVENESS RATIO (“SER”)

the ratio of the total amount of data that the [TSC](#) can hold to its [PHYSICAL CAPACITY](#).

SPACE OPTIMIZATION RATIO (“SOR”)

the size of a data set as generated by the [WORKLOAD GENERATOR](#) divided by the amount of incremental space consumed by that data set.

SPC RESULT *see [RESULT](#).*

SSU *see [STIMULUS SCALING UNIT](#).*

START TIME *for an [I/O REQUEST](#), the time recorded by the [WORKLOAD GENERATOR](#) when the request is submitted for execution on the [TSC](#).*

STEADY STATE *a state in which the behavior of the [TSC](#) is stable and sustainable while the load presented to the [TSC](#) by the [WORKLOAD GENERATOR](#) is constant.*

STIMULUS SCALING UNIT *a logical abstraction that captures the key elements in the IO demands of an application's user population.*

STORAGE DEVICE *a discrete, physical hardware component, such as an HDD or an SSD, that provides permanent data storage.*

A [STORAGE DEVICE](#) must be capable of storing data indefinitely without external power. The requirement excludes components that provide volatile data storage, such as a read and/or write cache.

SYNCHRONOUS REPLICATION *REPLICATION IN WHICH THE INITIAL I/O OPERATION IS NOT MARKED AS COMPLETE UNTIL THE RELATED OPERATION HAS COMPLETED ON THE OTHER, INDEPENDENT STORAGE SYSTEM(S).*

SUBMISSION IDENTIFIER *a unique identifier, assigned by the SPC, for each new [RESULT](#).*

SUPPORTING FILES *a collection of data, documentation, and illustrations used to demonstrate the validity of a [RESULT](#).*

A.20 T

TARGET COUNTRY *the country in which the [PRICED STORAGE CONFIGURATION](#) is available for sale no later than the [AVAILABILITY DATE](#), and in which the required hardware maintenance and software support is provided either directly from the [TEST SPONSOR](#) or indirectly via a third-party supplier*

TEST *a collection of one or more [TEST PHASES](#) sharing a common objective.*

TEST PHASE *the smallest logical component of a [TEST](#), during which a data is collected to satisfy the requirements of a [BENCHMARK](#).*

TEST SPONSOR *a distinctly identifiable entity that acts as the sponsor of an [RESULT](#).*

TESTED STORAGE CONFIGURATION *all software and hardware necessary to implement and support the storage configuration defined for a [MEASUREMENT](#).*

TESTED STORAGE PRODUCT *a distinct, customer orderable product, which is the focal point of a [RESULT](#).*

TOTAL SYSTEM PRICE *the total cost of ownership for the [PRICED STORAGE CONFIGURATION](#).*

TRANSITION *of a [TEST PHASE](#), a time period during which the IO load presented by the [WORKLOAD GENERATOR](#) to the [TSC](#) is changing, either increasing or decreasing.*

TSC *see [TESTED STORAGE CONFIGURATION](#).*

TSC BOUNDARY *the boundary between the [HOST SYSTEM](#) and [TSC](#).*

TSC EXECUTIVE the software component of the [TSC](#).

TSP see [TESTED STORAGE PRODUCT](#).

A.21 **U**

No terms defined.

A.22 **V**

No terms defined.

A.23 **W**

WORKLOAD a collection of [ASU STREAMS](#).

WORKLOAD GENERATOR

a user-space application, provided by the SPC, that produces benchmark-specific [IO STREAMS](#).

A.24 **X**

No terms defined.

A.25 **Y**

No terms defined.

A.26 **Z**

No terms defined

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