STORAGE PERFORMANCE ANALYTICS FOR COMPREHENSIVE WORKLOAD INSIGHT

Key Benefits

Deeper understanding of storage system behavior through highly realistic and granular workload modeling

Find performance and scalability issues faster and a more comprehensive characterization of storage system performance

Superior engineering productivity dramatically simplifies and speeds testing, enabling many more tests to be run

Virtana Storage Load Testing (SLT) software is the industry's only automated workload acquisition, workload analysis, workload modeling, and workload performance analytics solution that uses your own production workload data.

The solution empowers storage professionals with an understanding of their own application workloads, including how they affect storage performance.

Storage professionals have consistently struggled with systematically understanding and predicting how changes in application workload behavior impact storage performance. Before Virtana, there was no easy method to acquire and analyze storage workload data and no way to correlate workload I/O profiles to performance. This has resulted in either poor performance due to under provisioning or significant wasted spending due to over provisioning of storage infrastructure.

Virtana SLT can be used to analyze production workloads, create workload models, and then administer the generation of highly realistic simulated workloads against any file, block or object storage target via custom-built workload generators.

Virtana SLT automatically generates useful reports that can be analyzed to make intelligent vendor-independent decisions about storage purchases, configurations and deployments.

Features

- Includes an easy to use web-based UI for acquiring workloads, modeling workloads, configuring tests and running complex performance validation scenarios

- Provides an easy methodology to characterize production workloads with high fidelity and analyze test results

- Is a convenient and effective way to share Virtana SLT appliances, ports, tests and reports in a centralized repository

- Simplifies the workload acquisition, workload modeling and workload analysis process

- Offers dozens of workload models and application workload examples, right out of the box

Virtana SLT for Workload Acquisition and Analysis

There are two key modules that help storage professionals understand their current production workload profiles to better understand performance requirements:

- **Workload Data Importer Module**

  The Workload Data Importer software module imports any production array I/O data from storage array logs and other performance monitoring tools for workload profiling, simplifying the workload modeling and creation process.

  Examples of array data that is useful for workload profiling include: read/write ratios, random/sequential request mix, data/metadata command mix, and IOPS over time. The Workload Data Importer provides out-of-the-box policies for most major storage vendors and allows users to add profiles from new vendors.

- **Workload Analyzer Module**

  Before now, IT organizations had no fast and simple way to analyze and characterize production workloads and their changing behaviors.

  The Workload Analyzer is a software module of Virtana SLT that allows storage engineers to analyze temporal workload behavior via powerful visualization to understand workload I/O patterns that affect storage performance.

  The Workload Analyzer processes the data from both the Workload Data Importer and/or Virtana Observability SAN Performance Probes. It creates a detailed workload profile that can be used to automatically generate a highly accurate workload model.
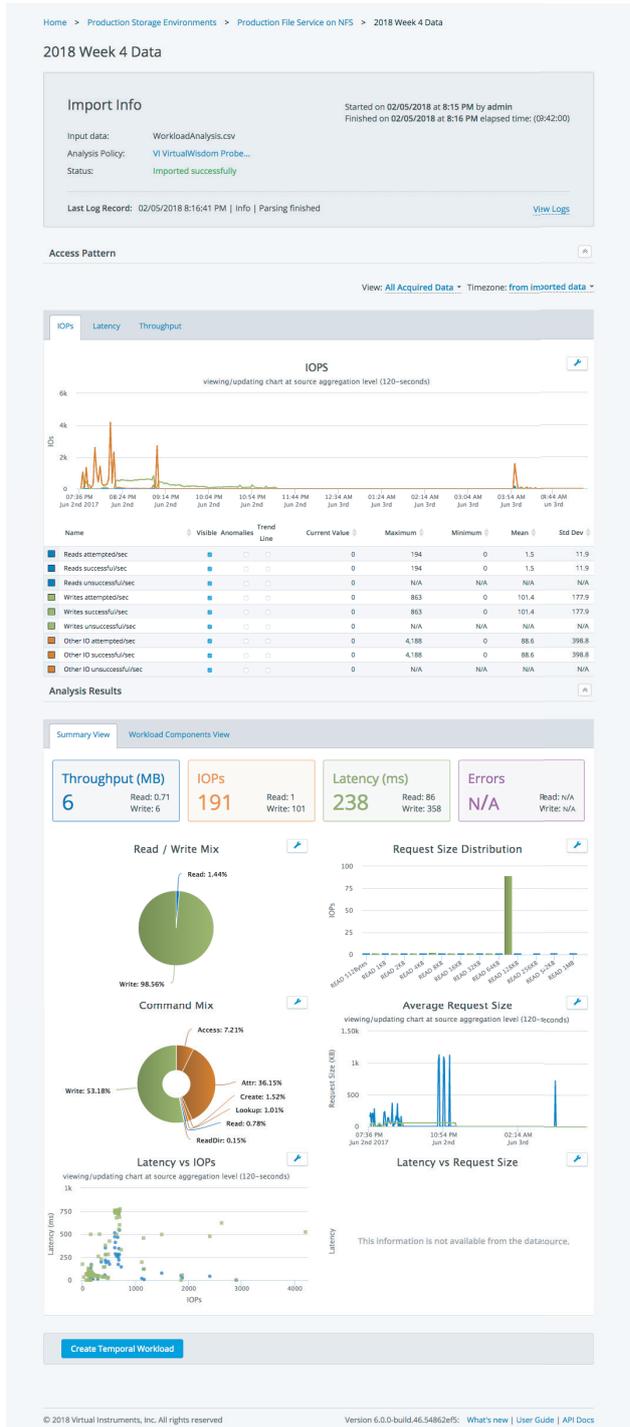

Figure 2: Workload analyzer example; access pattern, IOPS over time.

Workload Modeling

Once the workload I/O profile has been analyzed, a workload model can be prepopulated based on the access protocol.

When creating or populating a workload model, users can characterize their existing environment as described above, or they can sweep through a spectrum of IO characteristics to cover future application workloads.

For situations where an existing production environment can serve as reference, a precise workload model can be derived directly from production storage systems.

There are two approaches available:

- **In Virtana SLT**

  For most leading vendors' arrays, statistical data about the I/O profile can be imported using vendor reports and log files.

  Virtana SLT creates the workload model, including statistics on command mix (read/write, data/metadata, sequential/random) and file/block size distributions.

  This is a unique capability, and a first for the industry.

- **Other Vendors' Arrays**

  For other vendors' arrays, statistical data about I/O profiles can be extracted using vendorprovided log files. Appropriately formatted CSV files can then be extracted in order to automate model creation.

To understand storage infrastructure performance in new "green field" situations, where production statistics don't exist, Virtana SLT offers a growing library of pre-configured workload models.

Figure 3: Configuring an NFS access pattern using the Virtana SLT storage workload modeling solution.

Once a workload model is created via statistics collected from production storage systems, users can customize those models and vary workloads under a variety of conditions.

Workload models allow for easy, yet powerful configuration of I/O access patterns, including control of command mix distributions, directory structures, file sizes and block/chunk size distributions and hot spots.

Precise distribution of metadata commands, unique to Virtana SLT, is key to accurately reflecting real-world, filebased workloads.

Virtana SLT also generates reducible data content patterns that can test vendors' compression and de-dupe implementations, which is critical to evaluating flash storage. Workload modeling is accomplished with simple to use slider bars that enable quick 'what-if' scenarios of 'apples to apples' comparisons of different products, technologies or configurations.

Key Workload Modeling features of Virtana SLT

- **Pre-configured Protocol Workload Models Library**

  The following sample workload models are shipped with Virtana SLT: iSCSI, FC, NFSv3, NFSv4.1, SMB2/3, Amazon S3, and OpenStack Swift. These workload models allow users to define and control key I/O access patterns with a simple web interface, and deploy them to a test bed. All workload models support the ability to specify I/O characteristics for Read and Write operations independently and select Data Content in the payload.
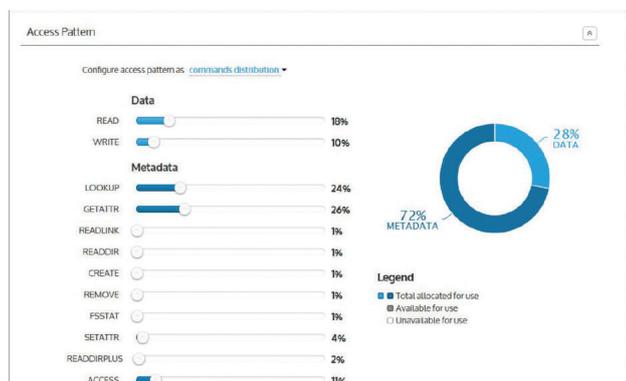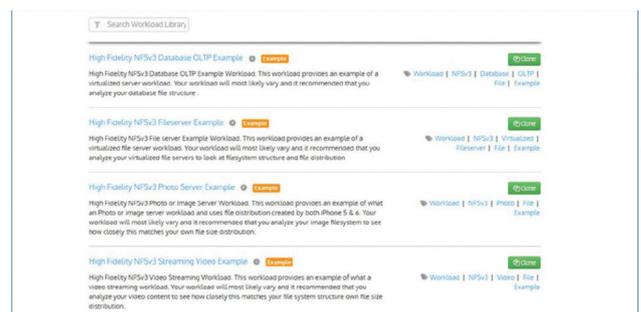

Figure 4: Partial menu of pre-populated protocol workload models.

- **Pre-configured Application Workload Examples Library**

  Virtana SLT provides a set of customizable workload models that are characterized and pre-configured for specific applications, such as OLTP, VDI, and various

OLTP database, fileserver, photo server, streaming video, Linux server, Windows server, and webserver. Such valuable assets allow users to generate realistic workloads without the need to do extensive research and manual data collection.

- **Workload Iterator**

  The Workload Iterator is a powerful feature of Virtana SLT that finds breaking points (blind spots) and optimal workloads (sweet spots) in storage arrays.

  It is built on top of a sophisticated High-Fidelity Networked Storage Workload Model, allowing users to easily automate iterations over hundreds of parameter permutations that define many different characteristics of application and protocol workloads.

  These characteristics include block sizes, read vs. write percentages, sequential vs. random percentages, number of files and folders (NAS), LUN hot spots (SAN), load profiles, deduplication and compression ratios, FC queue depth, and more.

- **Composite Workload Editor**

  Taking a leap from traditional workload benchmarking methods based on freeware tools, where storage protocols are validated one at a time, independently, the Virtana SLT Composite Workload feature allows the user to create many different workloads, across different storage protocols, and run them all at the same time against the storage infrastructure.

  This results in a much more realistic and holistic simulation of production environments, such as commonly found in virtualized infrastructures.

Figure 5: Sample Composite Workload Editor configuration screen, with a multi-LUN Oracle DB.

- **Simple Test Execution**

  Load, run and configure tests with a simple "push button" interface. Virtana SLT enables configuration and test execution without requiring specialized protocol expertise.

- **Historical Data Capture and Presentation**

  Recall any output results and statistics from previous test runs for comparison and analysis.

- **Preconditioning Workload for Flash**

  Ensures you are testing a seasoned array and avoids getting artificially fast read results.

- **Test Lab Administration**

  Create and save configurations (network profiles) for test beds, devices under test, etc. Allows users to simply deploy their tests to pre-configured test beds, and allows network administrators to enforce network constraints, lowering incidences of IP space conflicts, VLAN congestion, and other conflicts.

- **Batch Mode with Pass/Fail Conditions**

  Launch an execution of test series governed by logical conditions. Allows users to efficiently execute batteries of tests, sequentially or in parallel, which is common in regression testing

- **Automation**

  Control all shared resources from a web service API. Allows for easy integration of Virtana SLT into an existing test automation harness.

- **Simple Collaboration**

  Share Virtana SLT resources such as workload generators, ports, tests, and test results with specified groups or individuals based on their role within the organization.

  Access to specific resources and tests can be dynamically determined to support higher levels of security and efficiency. Such functionality allows team members to work more effectively with each other and increase the ROI in Virtana SLT appliances.
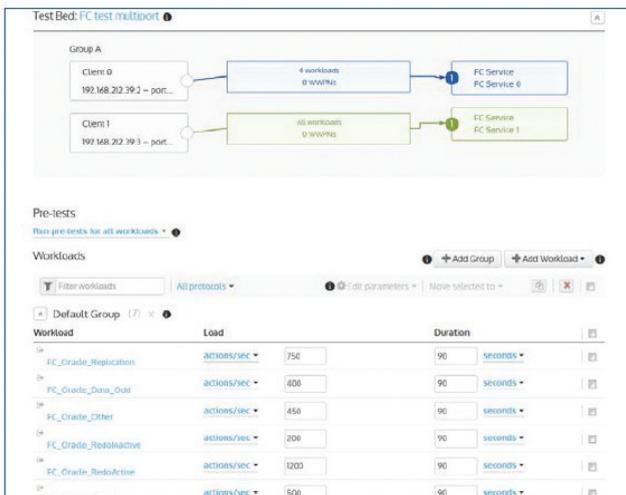
Reporting

Virtana SLT comes with a broad array of standard output reports as well as the flexibility to create custom reports that are most valuable to your organization. You may choose to view reports as a summary table, a time-based line graph, or as a histogram, in real-time, as the test runs.

Figure 6: Example of summary table, response time delivered by the storage infrastructure to I/O requests.
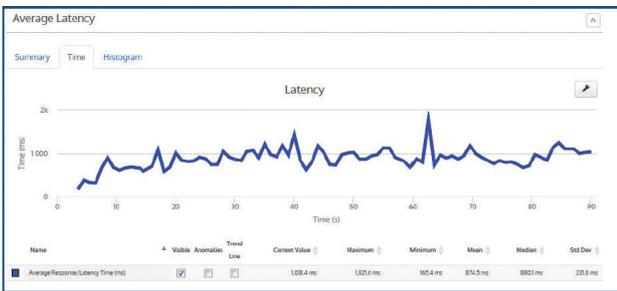

Figure 7: Example of time-based graph, response time delivered by the storage infrastructure to I/O requests.
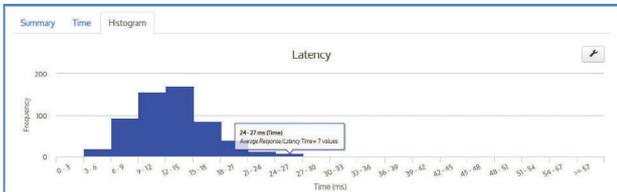

Figure 8: Example of a response time histogram delivered by the storage array / infrastructure to I/O requests.

Custom reports are available as baseline charts and multi-statistic charts. A baseline compares the same statistic from different test runs, where one of the test runs is the baseline. For example, if you are creating a report that compares how five (5) different firmware versions perform when handling the same workload, and you want the performance obtained with the current firmware version to be the baseline.

Use a multi-statistic chart if you want to plot different statistics on the same chart. For example, if you want to plot throughput, IOPS and latency on the same time-series chart, you can see how these statistics relate and/or correlate to each other over the course of a workload, as shown below.
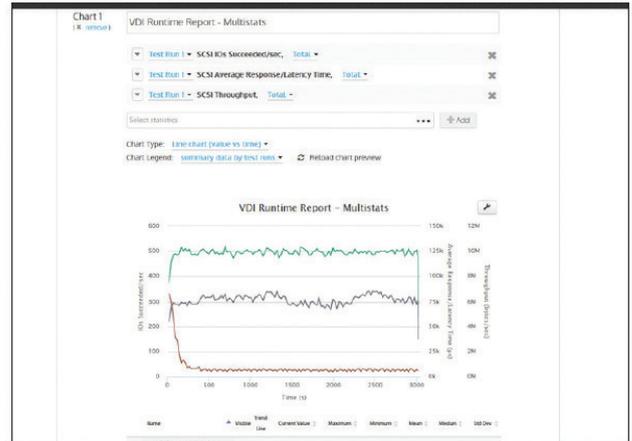

Figure 9: Multi-statistics report, showing IOPS, latency, and throughput on a single graph.

Primary Testing Methodologies

When using Virtana SLT storage performance validation products, there are two common methodologies for assessing the performance capabilities of networked storage infrastructure: Workload Modeling and Performance Profiling.

Workload Modeling

Workload modeling is the primary testing methodology. For detailed information, refer to "Workload Modeling" on page 2.

Performance Profiling

In addition to workload modeling, many architects and engineers also conduct Performance Profiling.

The objective of Performance Profiling is to fully characterize the behavior of a storage system under a large set of workload conditions. This method is sometimes referred to as "four corners testing" or "sweet spot/blind spot analysis" or "multidimensional benchmarking".

Doing so provides the storage engineer with a map of the behavior of the storage system – making it easy to understand the strengths and weaknesses of the array and which workload attributes most directly affect performance.

Engineers and architects can then use this information to optimally match their workloads to storage system purchases and deployment decisions.
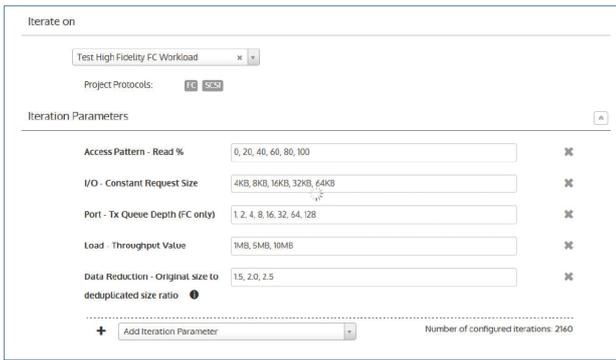
Figure 10: Input screen of Virtana SLT Workload Iterator; testing for the effect of varying 5 different parameters on performance.

In the Virtana SLT interface, this methodology is enabled by an iteration workflow (input screen above) that allows the user to iterate on any of the many workload characterization attributes exposed by Virtana SLT workload models (examples: load profile, block size, command mix, queue depth settings, etc).

The workflow can result in a suite of tests that stress the storage system under hundreds or even thousands of workload configurations, with automated test execution, aggregation of data and presentation of results.
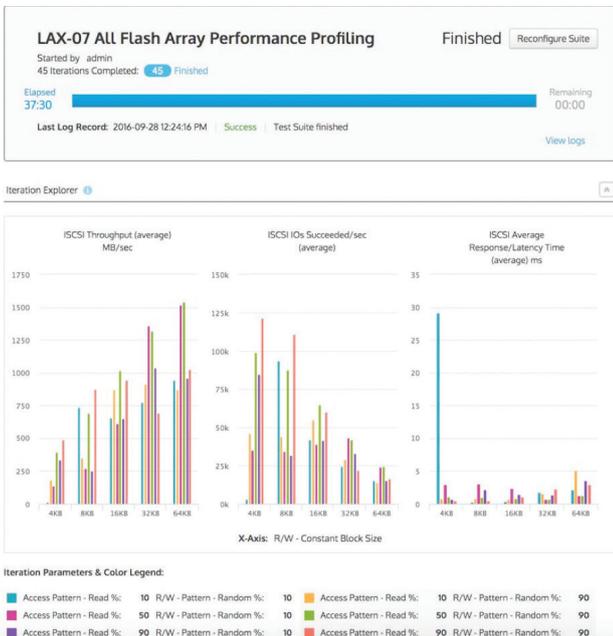

Figure 11: Extract of output report of Workload Iterator function, showing effect of access pattern, block size, queue depth, load throughput, and data reduction ratio on key performance metrics.

Virtana SLT Licensing and Packaging

Each Virtana SLT appliance, whether physical or virtual, requires activation.

Every Virtana SLT Workload Generator that Enterprise manages requires an add-on software license.

Virtana SLT works with all Virtana SLT appliances including the 1G Series, 10G Series, FC series, Unified Series, Virtana SLT (WorkloadWisdom) Series, and Virtual Series. For more information on these appliances, please refer to the Enterprise IT Solutions datasheet.

Virtana SLT is available in two implementations: It can be pre-configured on a physical appliance for superior performance and stability for faster time to value. It is also available as a Virtual Machine for flexible deployments on any server in your data center that meets specifications. The appliance is equipped with 10TB of storage for saving test projects and results.

Required Products

Workload Generators

Workload Generators are used to generate traffic based on workload models and access patterns that have been configured by Virtana SLT software.

There are both hardware and virtual versions of the appliances. The hardware appliances are purpose-built 2RU devices with a software and hardware architecture that has been specifically engineered to cost-effectively generate massive traffic loads that can test the performance and scalability limits of any storage subsystem, including the highest-end all flash or hybrid storage systems.

Figure 12: Virtana SLT Workload Generator, hardware version

Virtana Observability SAN Performance Probes

SAN Performance Probes are hardware-based monitoring devices that enable storage engineers and operations teams to capture network switch data and statistically analyze the workloads in real-time.

Using optical TAPs on 10G Ethernet and 8/16G Fibre Channel, this data can be captured and then further analyzed by the Workload Analyzer module of Virtana SLT to generate a highly accurate workload for replay in a test lab.

This capture/analyze/replay capability will dramatically accelerate storage performance problem identification and resolution.

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