LOAD DYNAMIX ENTERPRISE 5.0
The industry’s only collaborative workload acquisition, modeling and performance validation solution for storage technology vendors

Load DynamiX Enterprise is a browser-based software solution that provides advanced workload profile acquisition, simplified workload modeling, comprehensive test administration, and a detailed performance reporting framework.

Available as part of an integrated appliance or as a virtual machine, Load DynamiX Enterprise (LDX-E) offers a shared performance testing and validation platform that can be leveraged by QA, support, field, performance and development engineers.

Load DynamiX Enterprise (LDX-E) is 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 Load DynamiX Workload Generation Appliances. Its intuitive, web-based GUI is built for all user levels to provide an advanced networked storage performance validation solution that incorporates a sophisticated workload modeling methodology. Load DynamiX Enterprise controls multiple Load DynamiX load generation appliances that groups of users can utilize on a global or local basis. Intuitive to use, Load DynamiX Enterprise comes pre-configured with a test platform, protocol test suites, and test content.

Load DynamiX Enterprise offers two primary benefits:

- **Deeper understanding of storage system behavior** through its highly realistic and granular workload modeling. This results in finding performance and scalability issues faster and a more comprehensive characterization of storage system performance.

- **Superior testing and engineering productivity** due to its simple user interface, automated testing, and highly collaborative environment. It dramatically simplifies the manageability of the testing resources and the overall performance testing process.

Key Benefits

Ultimate collaborative testing solution that improves team productivity:

- Novice and expert users can leverage the power of Load DynamiX appliances
- Tests and results can be shared within and across teams with a centralized view

Get the most out of your performance engineering, QA and support teams.
Load DynamiX Enterprise provides:

- A **simple interface** for acquiring workload profiles from production systems, and configuring and running complex performance validation scenarios that complements your existing Test Development Environment (TDE) in the lab
- A convenient and effective way to share Load DynamiX appliances, ports, and test content with all results in a centralized repository
- A **centralized way** to manage and track testing resource usage by individuals and teams
- An **easy methodology** to characterize production workloads with high fidelity and analyze test results.

**Attaining a Deeper Understanding of Storage System Behavior**

Load DynamiX Enterprise offers a variety of facilities to enable an in-depth understanding of storage system performance behavior and limits that is unparalleled in the industry. In addition to our ability to perform extreme load generation to massive scale, key capabilities include the Workload Iterator, the ability to generate Composite Workloads, support for advanced test beds, the ability to generate compressible and deduplicable data content streams, and support for industry leading workload profile acquisition and analysis solutions.

**The Workload Iterator**

The Workload Iterator is a powerful feature of Load DynamiX Enterprise 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.
**Figure 2:** Set-up GUI to configure 60 iterations of varying concurrent workers (sessions), request size, and queue depths

**Running the Workload Iterator**

Once the Iteration suite is defined, the Workload Iterator will automatically execute every permutation, and provide the user with a summarized real-time report. Each permutation runs independently, and the permutations are executed sequentially one by one until all permutations are completed.

During run time, a summary table is presented in real-time, allowing the user to monitor the progress and the key performance indicators such as throughput, IOPS and latency for each iteration. In addition, the user has the ability to view a detailed dashboard by clicking on the status of a particular iteration, giving full insight to each permutation.
Figure 3: Portion of summary table showing real-time storage testing results including key performance metrics for each workload iteration.

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 Load DynamiX Enterprise 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 emulation of production environments, such as commonly found in virtualized infrastructures.
Advanced Test Beds
LDX-Enterprise supports an advanced Test Bed facility where one can easily create multi-protocol Test Beds. This also supports the ability to run workloads across multiple test ports. It also supports the Test Bed Extractor utility, which enables running imported TDE Projects over different Test Beds by automatically extracting information relevant to a Test Bed (e.g. source address(es), destination address(es), Shares, LUNs, etc.) from the imported TDE Project.

Compression and Deduplication
Fiber Channel and iSCSI workloads support simple testing of data compression and deduplication with three simple parameters: compression percentage, deduplication percentage and the number of unique duplicates. LDX-Enterprise calculates the complex data compression percentages and data replication algorithms behind the scenes and generates compressible and deduplicable data content patterns.
Workload Acquisition and Analysis

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

Load DynamiX Workload Data Importer module

The Workload Data Importer software module of Load DynamiX Enterprise 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, there was no fast and simple way to analyze and characterize production workloads and their changing behaviors. The Load DynamiX Workload Analyzer is a software module of Load DynamiX Enterprise 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 Workload Sensors. It creates a detailed workload profile that can be used to automatically generate a highly accurate workload model. If used with a Load Dynamix Workload Generation Appliance, these workload models can then be applied to any file, block or object storage system to fully evaluate its performance or to be used to efficiently troubleshoot performance problems.

Figure 5: Data reduction inputs to generate compressible and deduplicable content

“Storage technology vendors can actually test their systems with workloads that closely model real-world applications and determine the strengths and weaknesses of their networked storage arrays.”

Howard Marks
Chief Scientist
Deep Storage, LLC.
Figure 6: Workload Analyzer Access Pattern Analysis
Superior Testing and Engineering Productivity

Load DynamiX Enterprise dramatically increases the testing productivity of QA, performance and development engineers. Customers typically run 10X more tests when using LDX-Enterprise as opposed to relying on freeware tools and the stacks of servers that are time-consuming to configure, maintain and analyze. In addition to the productivity-enhancing Workload Iterator described above, LDX-E offers the following features.

Choice of Standard Output Views

You may choose to view reports as a summary table, a time-based line graph, or as a histogram.

Figure 7: Example above of summary table, response time delivered by the storage array / infrastructure to I/O requests

Figure 8: Example above of time-based graph, response time delivered by the storage array / infrastructure to I/O requests
Figure 9: Example of a response time histogram delivered by the storage array / infrastructure to I/O requests

Simple Collaboration

Share Load DynamiX resources such as appliances, 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 Load DynamiX appliances.

Sample Workload Models

Pre-configured Protocol Workload Models Library
The following sample workload models are shipped with LDX Enterprise: iSCSI, FC, NFSv3, NFSv4.1, SMB2.0, and Object storage. 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.
Pre-configured Application Workload Models Library
Load DynamiX Enterprise provides a set of customizable workload models that are characterized and pre-configured for specific applications, such as OLTP, VDI, and various NFS and SMB workloads including OLTP database, file server, 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.

High Fidelity Workload Models
Load DynamiX Enterprise supports a granular way to model workloads. In addition to varying the command mix, the solution also supports the ability to model directory structures, file size distribution, folders, block size distribution (figure 10) and I/O direction.

Simple Test Execution
Load, run and configure tests with a simple “push button” interface. Load DynamiX Enterprise allows storage and network administrators to configure and execute tests without requiring protocol expertise or proficiency with the Test Development Environment (TDE).

Figure 10: Partial menu of pre-populated protocol workload models

Figure 11: Easily model block size distributions with slider bars.
**Historical Data Capture and Presentation**
Recall any output results and statistics from previous test runs for comparison and analysis.

**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 potential 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 Load DynamiX Enterprise into a test automation harness and also integrates with build servers.

**Usage Tracking**
Administrators of Load DynamiX appliances can now see periodic metrics on actual usage of each device or groups of devices, such as: port utilization, number of tests actually used, test duration, and total port hours. Such capability helps your company’s test and QA managers determine if the appliances are being used to their full capacity.

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<thead>
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<th>Port Utilization %</th>
<th>Past year</th>
<th>Past month</th>
<th>Past week</th>
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<table>
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<th>Past year</th>
<th>Past month</th>
<th>Past week</th>
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<td>60</td>
<td>2</td>
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<table>
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<th>Total Test Duration</th>
<th>Past year</th>
<th>Past month</th>
<th>Past week</th>
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<tr>
<td></td>
<td>4 months</td>
<td>4 months</td>
<td>2 minutes</td>
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<table>
<thead>
<tr>
<th>Total Port Hours</th>
<th>Past year</th>
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<th>Past week</th>
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<tbody>
<tr>
<td></td>
<td>4 months</td>
<td>4 months</td>
<td>3 minutes</td>
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Figure 12: Administration screen of appliance usage tracking.

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"Using Load DynamiX has improved our testing coverage, reduced our testing time, and eliminated the need to buy additional servers."

_Terry Schwartz_
QA Manager
F5 Networks
Deployment Options

Load DynamiX Enterprise is available in two implementations: It can be pre-configured on an appliance for superior performance and stability for faster time to value. It is also available as a Virtual Machine for flexible deployments. The appliance is equipped with 10TB of storage for saving test projects and results (equivalent to 30 x 24 hours of use for an 8 port appliance). External storage can be used for additional space.

Licensing and Supportive Platforms

Each Load DynamiX Enterprise appliance, whether physical or virtual, requires activation. Every Load DynamiX load generation appliance that Enterprise manages requires an add-on software license. Load DynamiX Enterprise works with all Load DynamiX appliances including the Load DynamiX 1G Series, 10G Series, FC series, Unified Series, Enterprise Series, and Virtual Series. For more information on these appliances, please refer to the Product Appliance datasheet.

Complementary products

Workload Generation Appliances

Workload Generation Appliances are used to generate traffic based on workload models and access patterns that have been configured by Load DynamiX Enterprise 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.

Load DynamiX can simulate the faster and badder client — it’s great, like turning on a fire hose.”

Colin Hutchison
Test Architect
Oracle
Workload Sensors

Load DynamiX Workload Sensors are hardware-based sensor devices that enable storage engineers and operations teams to capture network switch data and statistically analyze the workloads in real-time. Using the switch SPAN ports or optical TAPs on 10G Ethernet and Fibre Channel switches, this data can be captured and then be imported into the Workload Analyzer module of Load DynamiX Enterprise for further analysis and 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.

Load DynamiX Enterprise Architecture

- Acquire
- Model
- Generate
- Analyze

Load DynamiX Enterprise

Workload Performance Analytics
- Workload Analysis
- Workload Modeling
- Workload Validation

Management
- User Admin
- Sensor & Test Bed Mgmt.
- Workload Library

Workload Acquisition

Workload Generation

Workload Data Importer

Workload Sensors

Workload Generation Appliances
About Load DynamiX

Load DynamiX empowers storage and network technology vendors with the insight they need to maximize the performance, scalability and reliability of their products. Load DynamiX accelerates time to market and helps prove the value of your products to prospective customers.

Addressing file, block, and object storage performance validation, Load DynamiX load generation appliances and software products have the unique ability to stress today’s most complex flash and hybrid storage systems to their limits.

Select Load DynamiX Technology Vendor Customers