

Virtual Instruments Solutions Overview

“With VirtualWisdom in our environment we were able to tune and optimize overall SAN performance and improve IO response time by 50%.”

Josh Morton, VP of Enterprise IT Services



Infrastructure Performance Analytics (IPA)

Enterprise IT infrastructure can be expensive, costly to maintain, and often difficult to scale. IT architects don't have a cost-effective method of determining the optimal infrastructure to support their various application workloads, nor do they have a uniform basis for understanding how the underlying infrastructure is performing once it is deployed. What is needed is an end-to-end infrastructure performance analytics solution that enables intelligent analysis of infrastructure options, and provides an authoritative understanding of performance, health and utilization of the infrastructure from the Virtual Machine, across the switching network, to the storage array. Virtual Instruments offers comprehensive infrastructure and workload performance analytics solutions that address these key challenges.

The Virtual Instruments Solution

There are 2 core platforms to the Virtual Instruments Infrastructure Performance Analytics (IPA) solution.

VirtualWisdom® is the industry's leading analytics platform for IT Infrastructure Performance Monitoring (IPM) for production environments. It empowers data center operations professionals to deliver on the complex requirements of their application infrastructure. The platform provides insights into the performance and availability of the end-to-end server to storage infrastructure—across physical, virtual and cloud environments. It intelligently correlates and analyzes an unmatched breadth and depth of data, transforming it into answers and actionable insights. This enables IT teams to guarantee performance-based service level agreements (SLAs), increasing the value of the infrastructure.

Load DynamiX Enterprise for Pre-production and lab environments empowers storage engineers and architects with the essential insights needed to optimize costs and assure storage infrastructure performance. The solution is comprised of workload analysis, workload modeling, and workload generation products that provide unparalleled insight into the relationship between workload behavior and storage performance. Load DynamiX Enterprise enables intelligent storage purchasing and deployment decisions and accelerates problem resolution. It gives you the data to confidently evolve your infrastructure with the most innovative storage technologies such as flash, hybrid, cloud, software defined and converged offerings.

The combination of Load DynamiX Enterprise and VirtualWisdom seamlessly provides intelligent analysis to help you optimize the entire infrastructure lifecycle from a cost, performance, and availability perspective. Key uses include:

- **Technology Evaluation:** Determine which technology (flash, hybrid, OpenStack, Ceph, Amazon S3, etc.) offers the highest performance or is the most cost-effective when running workloads that reflect your specific applications.
- **Product Evaluation:** Determine which storage system offers the highest performance, and which are the most cost-effective when running workloads that represent your specific applications.
- **Configuration Optimization:** Determine the optimal storage and switch price / performance configuration by varying and testing dozens of options like block/file size, compression/dedupe, tiering, and caching. Eliminate unnecessary over-provisioning.
- **Change Management & Validation:** Validate the effect on latency of application upgrades and device firmware updates on networked storage infrastructure before cutting over to production.
- **Troubleshooting:** Accurately identify and remediate root causes of outages and performance degradations, mitigating risk of unplanned downtime.
- **Proactive monitoring:** Guarantee application infrastructure performance and availability; avoid outages. Assign performance-based SLAs to your mission-critical applications, regardless of whether they are operating in physical, virtual, or cloud computing environments.
- **Infrastructure Auditing:** Identify emergent issues, reduce OpEx & CapEx by driving greater performance and utilization of your existing assets and delivering true ROI.
- **Data center migration and consolidation:** Benchmark performance in the lab to predict performance and monitor your new production infrastructure to guarantee performance.
- **Optimize workload across VMs:** Identify the optimal cluster and host to deploy a VM, based on available capacity and expected VM workload across CPU, Memory, I/O and Network. Users can address questions or situations like - "I've got a new workload, where's the best place to put it?"



Virtual Wisdom is the only IPM Platform that helps you proactively identify and resolve issues before they impact performance and availability.

Solutions: Problems that Virtual Instruments Solves

How to choose the right storage technology platforms, products, tiers and configurations

With nearly 40% of IT hardware budgets spent on storage and storage-related networking, using the right storage platforms is more critical than ever. There are not enough people, time, and resources to adequately perform accurate testing and evaluation of new storage products and new technologies. Legacy techniques aren't working. Data-informed decision-making is essential with technologies like software-defined storage, cloud storage, solid state, tiering, deduplication, and new protocols like Amazon S3, Ceph, OpenStack Cinder and Swift, all having the potential to dramatically affect both application performance and the cost of your infrastructure.

With Load DynamiX Enterprise, you can accurately model your production workloads and run them against your proposed platforms to determine the best performance solution for each workload tier. Once you determine your optimum technology, you can run those same workloads, at scale, against specific vendor offerings, and refine your price / performance analyses, allowing you to select the best vendor for each tier. And finally, you can automate thousands of "what if" tests to determine the headroom required for each workload, so you know before you buy, the specific configuration you need today and over the life of that new platform.

VirtualWisdom provides the ongoing, detailed real-time workload monitoring and analysis of your production systems required to further ensure that the right workload is running on the right tier of infrastructure. It also proactively identifies patterns, trends, and thresholds that signal emergent issues before they become performance impacting events.

How to Implement, Measure, and Report on Performance Based SLAs

In today's highly virtualized and cloud-based environments, delivering highly responsive applications and data is about more than just availability—it's about guaranteeing performance. It's even more important to be able to definitively measure and report on the specific performance being delivered, based on the application, line of business or tier of service. The visibility required to develop and deliver performance-based SLAs cannot be provided by individual device-specific data or polling-based "averages of averages"—it must be based on a comprehensive view of the end-to-end system and granular measurement of actual infrastructure response times.

VirtualWisdom is the only IPM platform that provides precise data on system-wide performance by measuring every transaction, in real time, on the wire. This enables you to establish accurate baselines and measure changes over time, based on the actual workloads and associated response times. With VirtualWisdom, you can confidently deliver and report on SLA performance, providing visibility and accountability at all levels of the organization.

How to Move From Reactive Troubleshooting to Proactive Problem Avoidance

Regardless of how well architected and implemented today's physical, virtual and cloud-based infrastructures are, it is inevitable that at some point you will have to react to performance or availability issues that catch you off-guard and are challenging to identify and resolve. This 'after the fact' approach to troubleshooting usually requires the involvement of multiple teams, many with different sets of data and information. In most cases, root causes are inferred or never definitively proven.

By using both Load DynamiX Enterprise and VirtualWisdom you can proactively identify and resolve most issues before they impact performance and availability. The unparalleled breadth and depth of system-wide metrics, combined with the power of entity-centric reporting, alerting and analytics, enables you to absolutely know the answer—before there is an impact. Don't guess, know — and avoid the problem before it keeps you and your team up all night!

The Fastest, Most Accurate Troubleshooting When You Need It

Troubleshooting storage infrastructure can be as much an art as it is a science, and when you are faced with an outage or slowdown to a mission critical application, everyone's job is on the line, because the business is on the line. It's "all hands on deck" and you need the best help you can find.

Virtual Instruments is the analytics solution used by the best troubleshooting detectives in the industry. Today's most common management solutions—such as Enterprise Management Frameworks, Storage Resource Managers, Virtual Server Monitors, Application Performance Monitors, and SAN Fabric Managers—all lack unbiased continuous real-time monitoring of application workloads across the end-to-end system. These legacy management products typically poll devices and average the metrics over long periods, which render them incapable of managing performance, and insufficient for identifying and resolving problems. The VirtualWisdom platform is the only solution that can non-intrusively optimize the

performance and availability of applications by measuring and correlating the actual workload data from the VM, Physical Server, Switch Fabric and Storage, enabling you to deterministically pinpoint root causes.

For nagging intermittent problems, Virtual Instruments also offers Load DynamiX Workload Sensors that capture and replay workloads for replay in a lab environment. Once solutions are proposed, Load DynamiX Enterprise allows you to model the application workload in the lab, reproduce the problem, and test the proposed solutions outside of your production environment. No more guesses; you'll know that your fixes will help and not hurt your production application performance.

Virtual Instruments Product Suite

The Virtual Instruments Platform is composed of a fully integrated combination of software and hardware probes, the VirtualWisdom Platform Appliance and Applied Analytics, the Load DynamiX Workload Generation Appliance and Enterprise GUI.

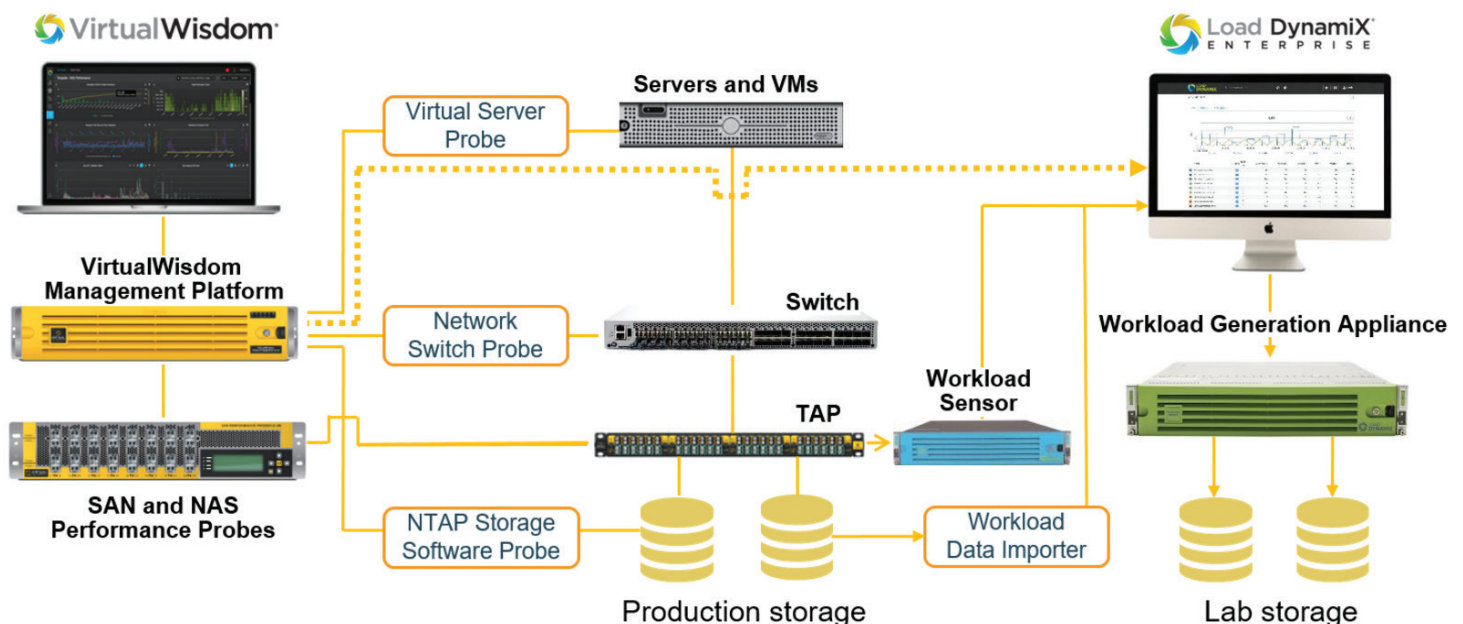
VirtualWisdom Platform

The intuitive VirtualWisdom platform and Applied Analytics interface increase the value of the VirtualWisdom solution to the entire organization,

from IT operations to line of business leaders. With it, teams perform comprehensive analysis, collaborate, and make informed decisions based on definitive insights about how applications and infrastructure are performing. The dynamic, entity-centric GUI enables multiple teams to quickly and confidently answer questions—and deliver the right information at the right time. This means regardless of function (application, server, storage, virtualization, etc.) and no matter what changes occur, you can collaboratively fine-tune infrastructure performance based on business, application, workload and SLA requirements.

Virtual Server ProbeVM Family

The ProbeVM Family of software-based probes collect and present hundreds of performance and utilization metrics from the associated physical server and hypervisor estate—including CPU utilization and status, memory utilization, disk I/O requests and capacity, as well as network requests and utilization. The VirtualWisdom ProbeVM family supports VMware vSphere®, IBM PowerVM®, and Microsoft Hyper-V® environments, presenting hundreds of performance and utilization metrics from across the virtual estate. The metrics are persisted and correlated with data from other VirtualWisdom probes and infrastructure data to build a complete picture of the end-to-end system for each virtual machine or physical server.



Storage Network Switch ProbeSW

This standards-based software probe leverages SMI-S and SNMP to collect extensive metrics from the Fibre Channel Switching infrastructure (regardless of manufacturer or type of switch), from director class to top of rack FCoE, embedded gateway or other FC Standard switching devices.

SAN Performance Probes

NAS Performance Probes

Our family of hardware-based SAN and NAS Performance Probes are the most advanced, high capacity line-rate data inspection and analysis devices available. They inspect, process and analyze every FC frame header and IP packet in real-time. They capture the true, unaltered, I/O profile of the actual application traffic, detecting application performance slowdowns and transmission errors by measuring every I/O transaction from start to finish. The SAN Performance Probe family consists of an (8G) 16-port model, an ultra-high-density (8G) 48-port enterprise edition, and a (16G) 24-port model suited for high-performance environments. The NAS Performance Probe is a full line rate 10G 16-port model. These product families deliver the full range of cost and density options customers require.

Array ProbeTAP

VirtualWisdom introduces ProbeTAP as the first of many storage array software probes that help provide additional visibility into how the storage array impacts the end-to-end system performance. ProbeTAP is an API-based NAS storage software probe that collects and correlates health and utilization data from the underlying NAS arrays (NetApp OnTAP8 Clustered Systems).

Load Dynamix® Enterprise

Enterprise includes an easy to use GUI for acquiring production workloads, analyzing workloads, modeling workloads, configuring tests and running complex performance validation scenarios against any file, block or object storage target via Workload Generation Appliances. Enterprise automatically generates useful reports that can be analyzed to make intelligent vendor-independent decisions about storage purchases, configurations and deployments.

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

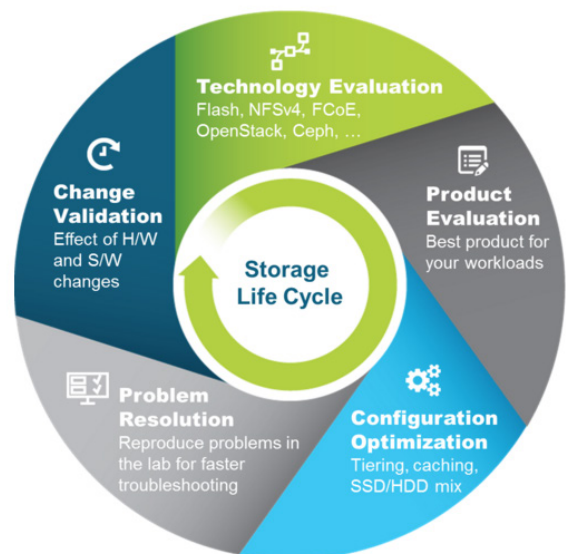
hardware architecture that has been specifically engineered to cost-effectively generate massive traffic loads that definitively test the performance and scalability limits of any storage subsystem, including the highest-end all flash or hybrid storage systems. Available in Fibre Channel and Ethernet versions, supported protocols include: SMB2.x, SMB 3.x, NFSv3, NFSv4.x, CIFS, iSCSI, Fibre Channel, OpenStack Cinder, OpenStack Swift, SNIA CDMI, HTTP, and Amazon S3.

Workload Sensors

The iSCSI and Fibre Channel Workload Sensors provide real-time analysis of your production SAN infrastructure, enabling the most granular, accurate performance profiling and modeling for lab performance testing. Additionally, they empower storage operations professionals to dramatically speed up troubleshooting through workload re-creation in a non-production lab environment.

SANInsight® TAP Patch Panel System

Traffic Access Points (TAPs) provide a passive, fail-safe access point to fiber optic network traffic on the TAPped link. This makes the light available for real-time performance monitoring, deep problem diagnosis and protocol layer analysis. TAPs are non-powered, non-mechanical devices that reflect a small portion of the signal through the TAP to another port, which provides a copy of the light to upstream, out of band probes and sensors. The passive TAP does not introduce latency or overhead, has no impact on application or storage I/O performance, and is integrated with several industry leading fiber optic Patch Panel Systems for simple deployment.



“

Virtual Instrument's time to detection and resolution is incredibly valuable. I don't want to understate that. The level of detail that we can get — there is just no other product out there that can give us that granularity.

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Engineering Lead



Microsoft

How VirtualWisdom is Different

The Industry's Best Analytics Platform for Infrastructure Performance Management

Today's most common management solutions— such as Enterprise Management Frameworks, Storage Resource Managers, Virtual Server Monitors, Application Performance Monitors, and SAN Fabric Managers—all lack continuous real-time monitoring of application workload across the end-to-end system. These legacy management products typically poll devices and average the metrics over 5–20 minute periods, which render them incapable of managing performance and insufficient for identifying and resolving problems. The VirtualWisdom platform is the only solution that can non-intrusively optimize the performance and availability of applications by measuring and correlating actual workload data from the VM, Physical Server, Switch Fabric and Storage. And VirtualWisdom goes beyond simple correlation reporting, providing intelligent, performance data and troubleshooting analytics that turn real-time data into answers quickly. The VirtualWisdom platform enhances your current management solutions with:

- A comprehensive view of the entire open-systems stack to find problems undetectable by software-only monitoring.
- Highly accurate and detailed continuous real-time, unbiased monitoring — for definitive insights.
- Pinpointing of root causes and impacts on infrastructure and application performance.
- Trending and analysis for proactively identifying emergent issues before they impact performance.
- Performance trending to identify hardware degradation, to enable preemptive component replacement before failure.
- Fibre Channel network statistics such as pending exchanges, to tune queue depths for maximum application performance.
- The ability to determine if configuration changes are affecting application and infrastructure performance by examining systemic latency.
- Heterogeneous support of all SAN and NAS devices, including VMs, storage switches, arrays, and network components.

How Load DynamiX Enterprise is Different

Load DynamiX Enterprise storage performance analytics solutions provide detailed workload analysis that enables the accurate emulation of production application workloads at extreme scale. This empowers storage professionals to optimize storage system deployments, find storage system limits before being deployed in production, and accelerate resolution of troublesome performance issues. We provide industry leading features in four primary areas:

First, we're designed for ease of use & deployment. The integrated solution for File, Block and Object testing includes:

- **Workload Acquisition :** Acquire workload profile data using the Workload Data Importer, which gathers historical data from storage arrays, automating what used to be a tedious, lengthy, mistake-prone practice to a program that runs in minutes. Or obtain your workloads from VirtualWisdom, for an even more granular set of I/O profiles.
- **Workload Analysis :** The Workload Analyzer statistically analyzes workload data and automatically creates pre-populated workload models.
- **Workload Generation :** The Workload Generation Appliance generates massive load based on the workload models to test the performance and scalability limits of any storage system.
- **Workload Analytics :** Assess throughput, IOPS and latency in easy to understand charts and reports.

With a single test solution, you develop, run, automate tests and analyze results.

Second, Load DynamiX Enterprise offers superior realism and scale. It supports meta-data and file system calls to better mimic real-world applications and it supports temporality, to reflect the bursty nature of traffic. The high performance Workload Generation Appliance scales to emulate the largest production loads on the largest all flash storage arrays.

Third, consistency and repeatability of results. Because its appliance based, you can do apples to apples comparisons over time and in any geographic location. A test run this week in London will give you the same results if you run the test in 6 months in Atlanta.

Fourth, it's a lab-in-a-box that lowers overall testing costs. Instead of racking and stacking tens of servers and hundreds of VMs, you simply add a single, purpose-built device. Customers moving from DIY, shareware based tools report that they can do 10 – 100X the number of tests they used to do.

Virtual Instruments Services

In addition to our global 24x7 product support services, Virtual Instruments offers a variety of services that help customers augment their existing IT staff with highly trained infrastructure performance management specialists. Key offerings include:

QuickStart Platform Installation and Training Services

Platform installation, project management, initial configuration and user introduction are packaged into the initial implementation. Training classes are available to enhance the user experience.

Critical Infrastructure Audit (CIA)

The CIA service includes delivery of best practices, baseline reporting, advanced analysis and alert investigation. In many cases, this service is delivered in direct support of large scale migration and consolidation projects. This service can be delivered as a stand-alone solution that is inclusive of a dedicated, targeted deployment of the VirtualWisdom Platform, or as auxiliary services in a currently installed account.

PROWisdom

PROWisdom is the logical extension to the QuickStart Services. It delivers workshops on use cases, roles and report analysis, to support fast and effective operationalization of your VirtualWisdom Platform.

Virtual Instruments Managed Service (VIMS)

The Virtual Instruments Managed Services program offers customers a dedicated and knowledgeable team of Virtual Instruments subject matter experts (SMEs). Managed Services deliver monthly health, utilization and performance reports, track progress against key KPIs and help customers proactively manage their Virtual Instruments environments. They are focused on improving the performance and availability of customers' mission-critical applications by augmenting their existing staff.

Virtual Instruments-as-a-Service (VlaaS)

VlaaS is a flexible deployment of the VirtualWisdom or Load DynamiX Enterprise platform delivered as an operating expense or subscription. VlaaS is delivered and designed around the characteristics of your environment. All Virtual Instruments software and hardware devices can be deployed in the customer or service provider data center (or both) without incurring upfront capital expenses.

Virtual Instruments Load DynamiX Labs

VI's Load DynamiX Labs is the most comprehensive storage performance validation & testing service provider in the industry. Using our world class in-house testing lab or your own testing facility, we provide a variety of professional services including product benchmarking, performance profiling, workload modeling, and vendor-agnostic proofs of concept (POCs).



I can't say enough good things about Load DynamiX Enterprise. The solution helped us choose the right storage technologies for both optimal performance and price.



Principal Architect





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