

Solution Guide

Performance Monitoring of VMware Environments

Insights by:

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at Galileo Performance Explorer

Galileo Performance Explorer® is the industry's first cloud-based suite of integrated Infrastructure Performance Management (IPM) agents with a unified dashboard and features powerful enough for all members of IT environment. It offers an easy-to-use solution that allows for detailed monitoring of servers, storage, SAN, and applications—saving you up to 80% in IT time and resources.

With Galileo for VMware®, you can identify issues within your VMware environment before they happen. Identify configuration issues, locate exhausted or underutilized resources, and isolate problems. Access valuable information, including:

- **VM Guest Statistics/Configuration Details**
- **Physical device information**
- **Processor and Memory information**
- **Host System Utilization (Cluster, Datacenter, and vCenter views)**
 - **Datastore capacity**
 - **CPU utilization**
 - **Memory utilization/over commitment ratio**
 - **Datastore, Disk, and HBA Performance**

This solution guide will list specific examples of why Galileo for VMware provides something for the everyday VMware administrator as well as top-level executives—allowing them to make fast technical and business decisions regarding their VMware infrastructure. We will show you the following advantages to your VM environment:

- **At-a-Glance views of Datacenter, Cluster, Host, and virtual machine (VM) level statistics using Galileo's custom dashboard capability**
- **Configuration and Capacity Data to allow you to view configurations, objects, and capacity from your dashboard**
- **Ability to drill down from the Cluster to Host level and into VM level statistics with a simple click**

vCenter Performance Companion

While not a VMware administration tool; Galileo stores, analyzes, and retrieves your VMware performance and historical configuration data better and faster than vCenter or any other product on the market.

Because VMware performance and configuration data is collected at one, two, three or five-minute intervals into Galileo—and is never purged or rolled up—it becomes an invaluable tool to use alongside of VMware administration for trending, performance analysis and capacity planning.

With Galileo, every VMware key performance metric is pre-charted and available at a glance. You can get to memory, CPU, disk, datastore, network, HBA, and other detailed information without building and waiting for the chart like you would in vCenter. With the included alerting features of Galileo, you are able to scan and report on all data points collected within seconds.

The speed at which Galileo retrieves data is unparalleled in the industry for a performance management tool of this type. Galileo is able to access one hour, one day, one week, or one-or-more years in an instant.

This pre-configured access and speed makes Galileo more appealing for exploring and evaluating performance data than performing the same tasks within vCenter.

Easy Deployment: In the Cloud within Minutes

With one agent and five minutes or less of installation time, Galileo for VMware is quick and easy to install/configure when compared to other products in the marketplace. Within a few hours, users have a full and complete picture of the entire VMware environment.

Galileo requires a small Linux VM and a vCenter user with read-level access to vCenter. In 20 minutes, you will begin to see your VMware statistics appear in the Galileo Performance Explorer cloud portal that is accessible from any internet browser—including your cell phone.

Galileo for VMware also brings awareness and deep insight of the VMware configuration topology. This is especially critical in environments that are outsourced and the customer wishes to maintain a pulse on the VMware architecture and management. Providing the ability for cross-team personnel to maintain awareness of configuration hierarchy while maintaining security and performance checks-and-balances is paramount. With Galileo for VMware, you can have one agent monitor multiple vCenter locations whether on-site or in the cloud.

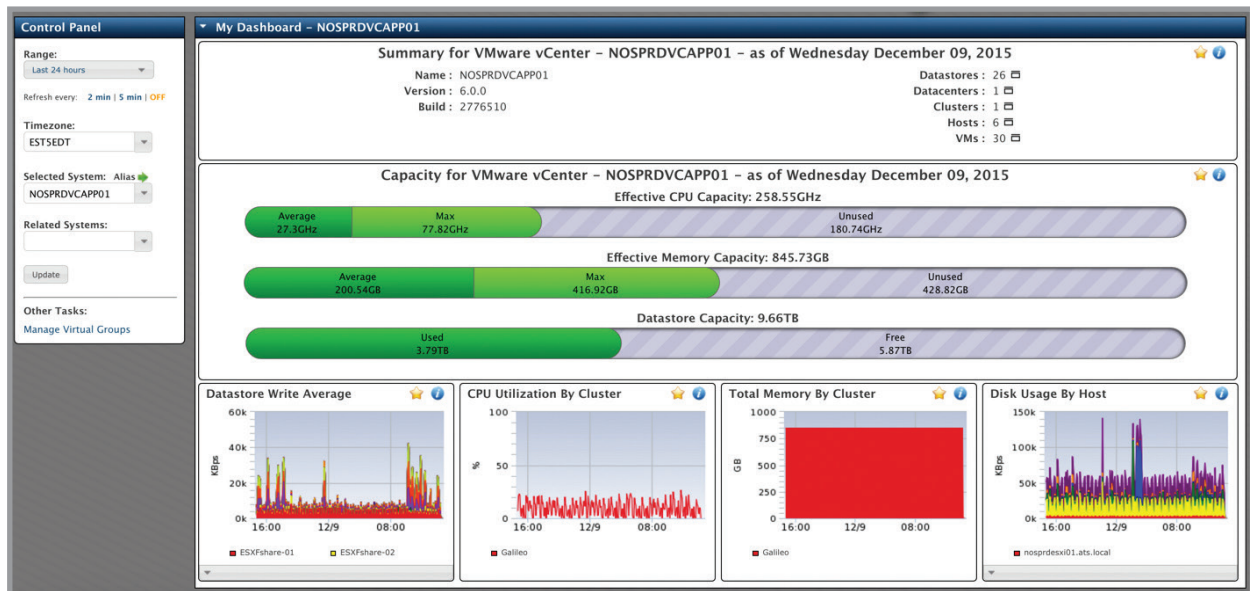


Figure 1: This screenshot shows the Galileo core portal where you will find deep historical metrics on various components in your VMware Environment.

What Users Say:

"There have been many ways Galileo has helped me, but the main reason was by bringing all my metrics into one location for quick review, I was able to quickly discover a potential problem (CPU ready warning) for one of our branch locations before getting out of hand. Also... for some reason, I just thought I'd try to access the data from my phone browser and I am stunned with how awesome it works. Very usable from my phone browser. Now that is a huge plus from my standpoint."

Ryan Snyder, Senior VMware Administrator, D&H Distributing

Deep Insights and Trending

With Galileo for VMware, administrators have the ability to quickly access VMware issues using predefined and customizable rules to alert on issues in your environment from CPU utilization, CPU ready time, Memory ballooning/swapping, Disk latency, and more. The default rules were created using VMware best practices taken from VMware experts who are top in their field. Using the traditional method for systems monitoring in VMware it can take countless hours using advanced charting in vCenter and using ESXTOP to create charts to develop reports on trending and vSphere performance. With the Alerting feature of Galileo, you can find issues in seconds compared to hours using the 20th century methods. See below how a customer quickly found an issue with Storage Host Disk Write Latency using Galileo Alerting.

In the main dashboard of Alerting; we see various cards for CPU, Memory, Network, Storage, and Configuration. Each card shows how many VMware clusters are affected for each alert being checked. In this example, we point to the Storage Card showing Host Disk Write Latency.

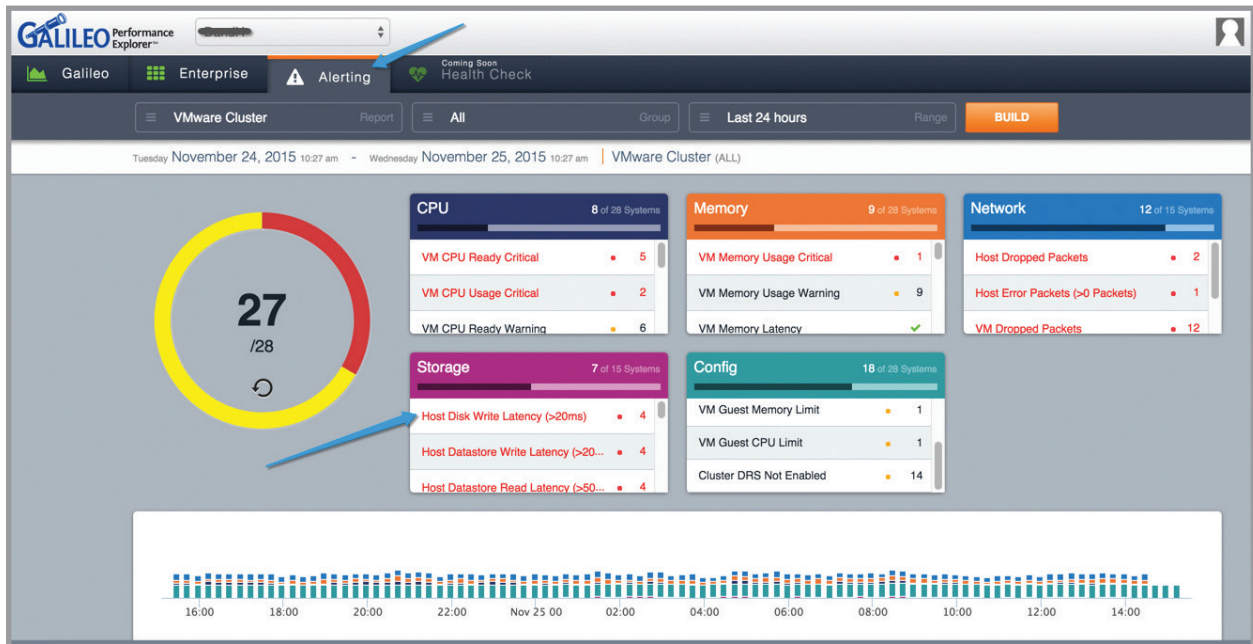


Figure 2: This screenshot of the Alerting function shows the Galileo for VMware alerting report and its dashboard view listing out different components and potential issues in your environment.

After moving down the page to the Storage section we see detailed insight into one of our VMFS datastores showing 42.7% of the time in the past 24 hours one of our disks attached to an ESXi host showing a large spike in Disk Write latency starting around 21:00 the night before averaging at about 1,500 ms (which any storage admin will tell you is a very high latency value). This prompts the question: What happened or happens each night at 21:00 to cause Host Disk Write Latency for this particular disk to spike in latency and remain there until late into the morning?

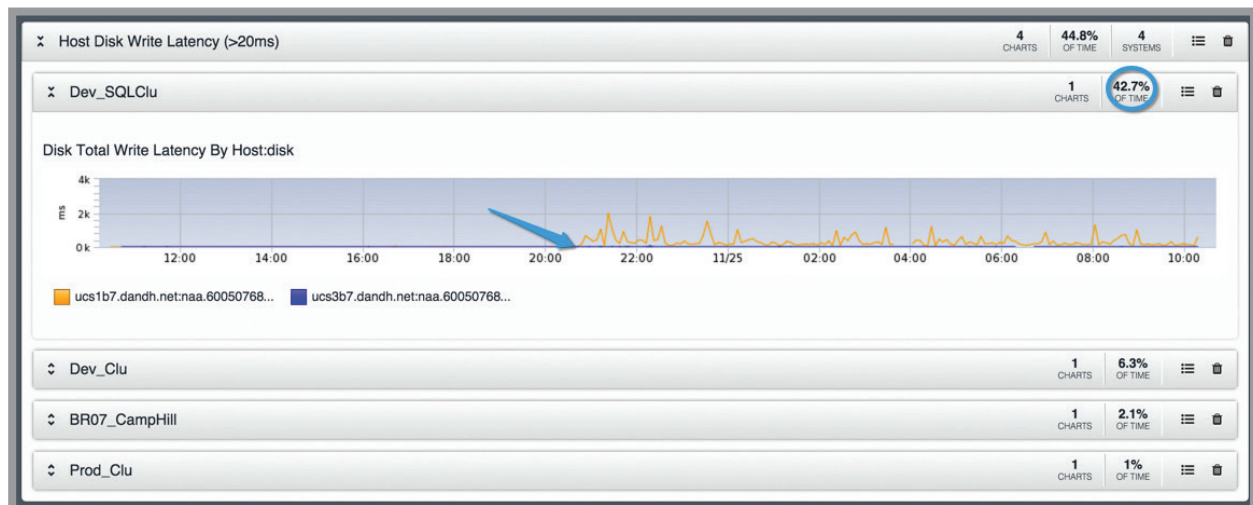


Figure 3: This screenshot shows the details view of the alert for Storage Disk Total Write Latency.

The next question asked is: Did this just start or has this been an ongoing issue? When we click the chart above, we see a popup window appear showing us the Galileo core chart for this particular problem. If we change the date range to show the last month, we see that this Disk latency started around 10/23 and has never been seen before. Now the search begins to find the issue and what change in the environment would have caused this on or around 10/23.

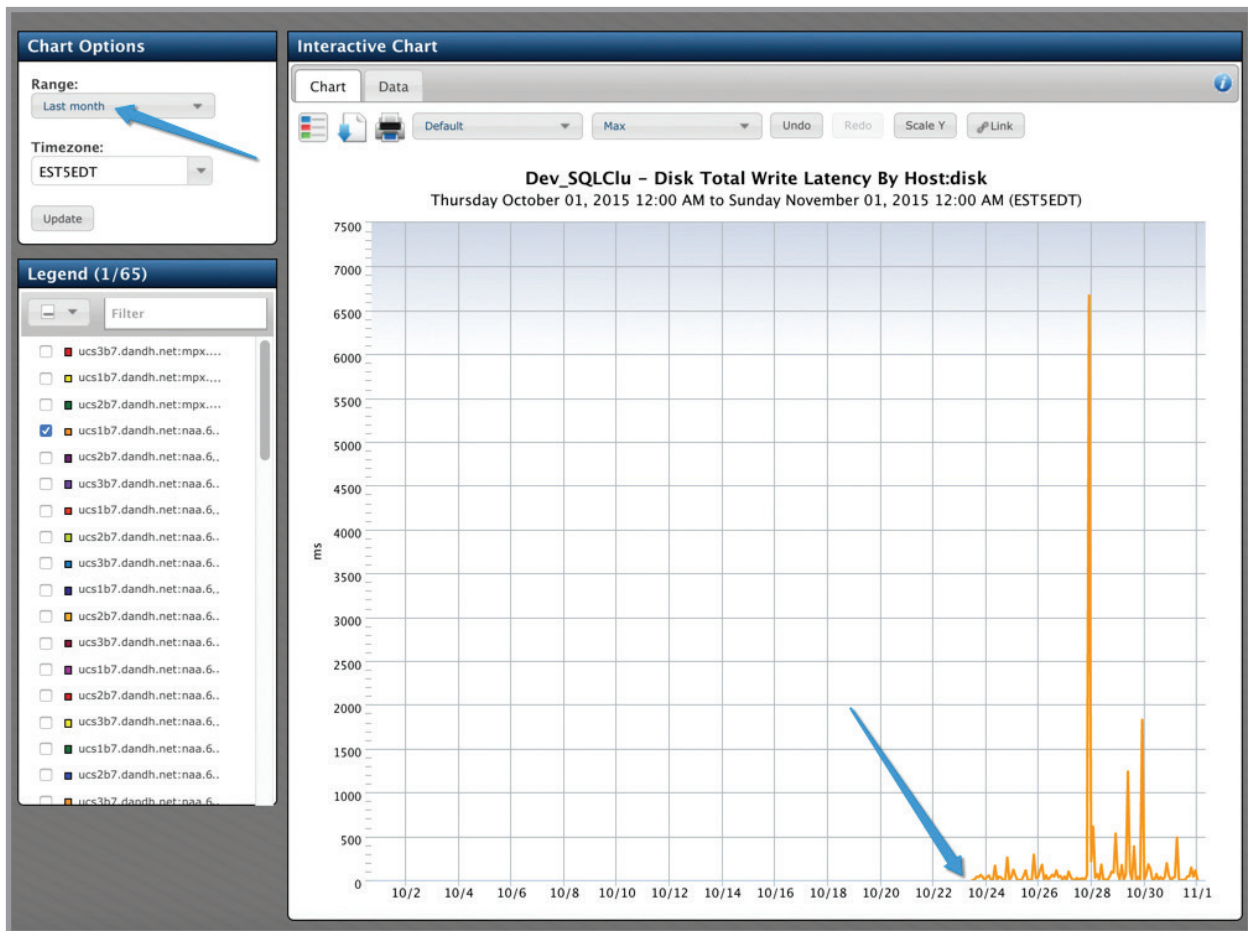


Figure 4: This screenshot shows the popup showing the Galileo core chart for Disk Total. Write Latency with a Last Month time range to see an issue started around 10/23 on this particular disk

What Users Say:

"I did not see this in vCenter, but I noticed it in Galileo because of the Alerting section. Also, being able to pull up metrics on my smartphone was important for me, such as pulling reports for managers, and trending for applications. These are all things that VMware admins can find today, but it either takes lengthy time to go through vCenter performance metrics or ESXTOP individually for each HOST, or creating your own scripts to try and gather everything."

Ryan Snyder. Senior VMware Administrator, D&H Distributing

No Rollup

Galileo for VMware keeps the same data granularity as all the other Galileo agents, and never rolls-up the data like vCenter, VMturbo, or vCOPs, which causes loss of critical data points and leads to ill-informed decisions. With vCenter at the default logging level each day five-minute data points are rolled up into 30 minute blocks, after a week those values are aggregated and averaged again after a month this happens again and after one year these values are purged completely from vCenter's database. The reason VMware keeps the default logging levels the way they do is to avoid needing more storage for the inventory database and to increase the performance of vCenter. This is why having a tool to retrieve and store these five-minute data points is so crucial to the efficiency and visibility of your VMware environment.

With Galileo for VMware, you can zoom in and zoom out on any period-of-time and get the precise five-minute data points not the averages using the same charting features current Galileo customers know and are comfortable with giving a single pane of glass for systems using Galileo for performance data collection. Customers do not have to spend endless hours configuring charts or searching for the data they want. In addition, you may not know what charts to create, so unless you are exposed to the data you would never know to go looking for it. In this way, Galileo can teach as well as inform using the preconfigured charts and the Help pop-outs.

The remainder of this section shows how Galileo kept six months of statistics, displaying at five-minute data points and vCenter no longer had any data. First, we will look at the vCenter logging level currently set. In addition, we will see how Galileo exposed a problem that happened after our vSphere 6 upgrade that vCenter had already purged out of its memory at our current logging levels.

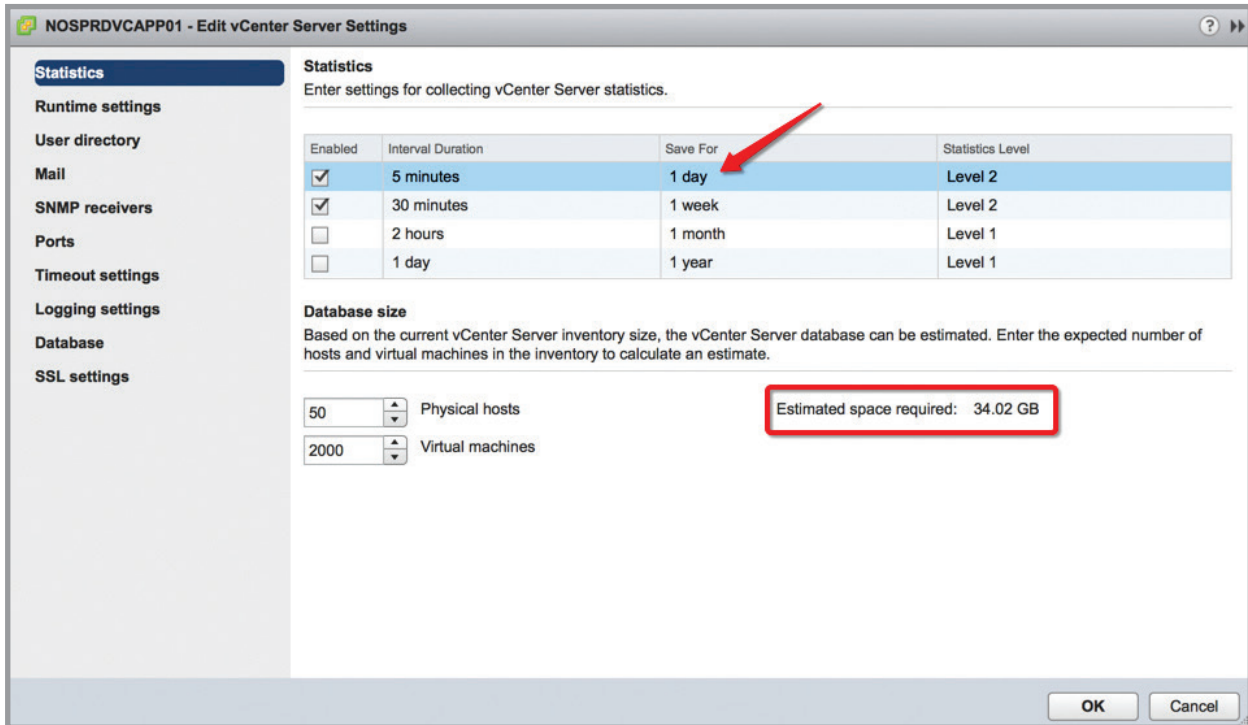


Figure 5: This screenshot shows the default logging level for our vCenter server and what is enabled as well as the estimated space required to store these statistics at their current levels.

Notice that we are currently only collecting five-minute intervals for a period of one day and 30 minute rollups of the five-minute data points for one week. Now—for arguments sake—let us say the current VMware environment does not have an external management tool and we want to start collecting the five-minute data points for five days and begin saving the one-day averages for three years at the Level 2 collection level. This will somewhat mirror the collection that Galileo is taking from vCenter, but keeps this data internal to vCenter. Look at what happens to the Estimated Space Required.

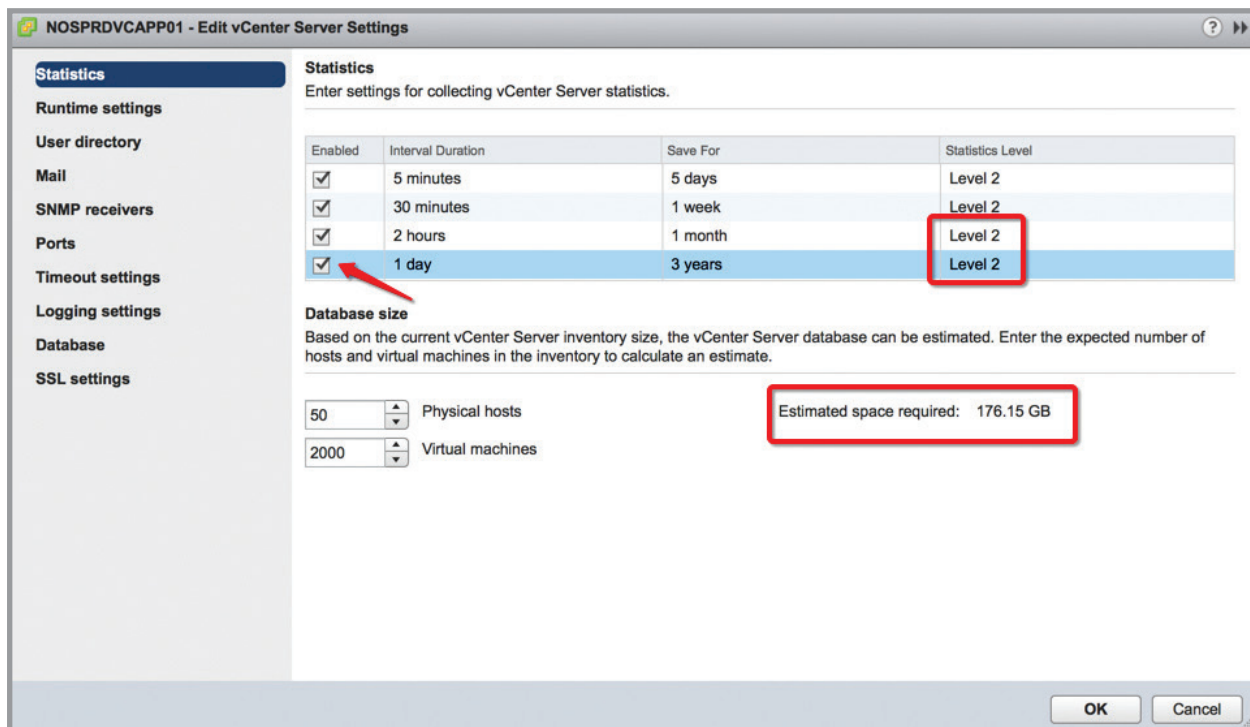


Figure 5: This screenshot shows what happens if we increase the amount of statistics that vCenter holds in its database.

Initially the Estimated Space Required was 34.02 GB. After increasing the vCenter logging level, it jumped to 176.15 GB. That is a five-time increase and now performance is almost certainly going to be degraded as a result. Bear in mind that—even at the increased logging level—these statistics are still not as granular as Galileo for VMware provides because the data held past the five-day mark is rolled up averages of the original five-minute data points. Another example shows our current environment and how we tried to get data for the past six months using both vCenter and Galileo. Remember that our current vCenter logging level only keeps 30-minute averages for one week at Level 2.

First, we need to modify a vCenter chart to show what we want. This can be tedious and—as described in the beginning of this section—is another pain point of trying to get fast performance information from vCenter. We are specifically looking at CPU Percentage Utilized for the past six months. Below is how we would currently do this using vCenter, which again is a multi-step process. Step #1 is to find the object (Host/VM/Cluster/etc) on which you want to monitor performance and go to Monitor Performance and click Advanced then Chart Options.

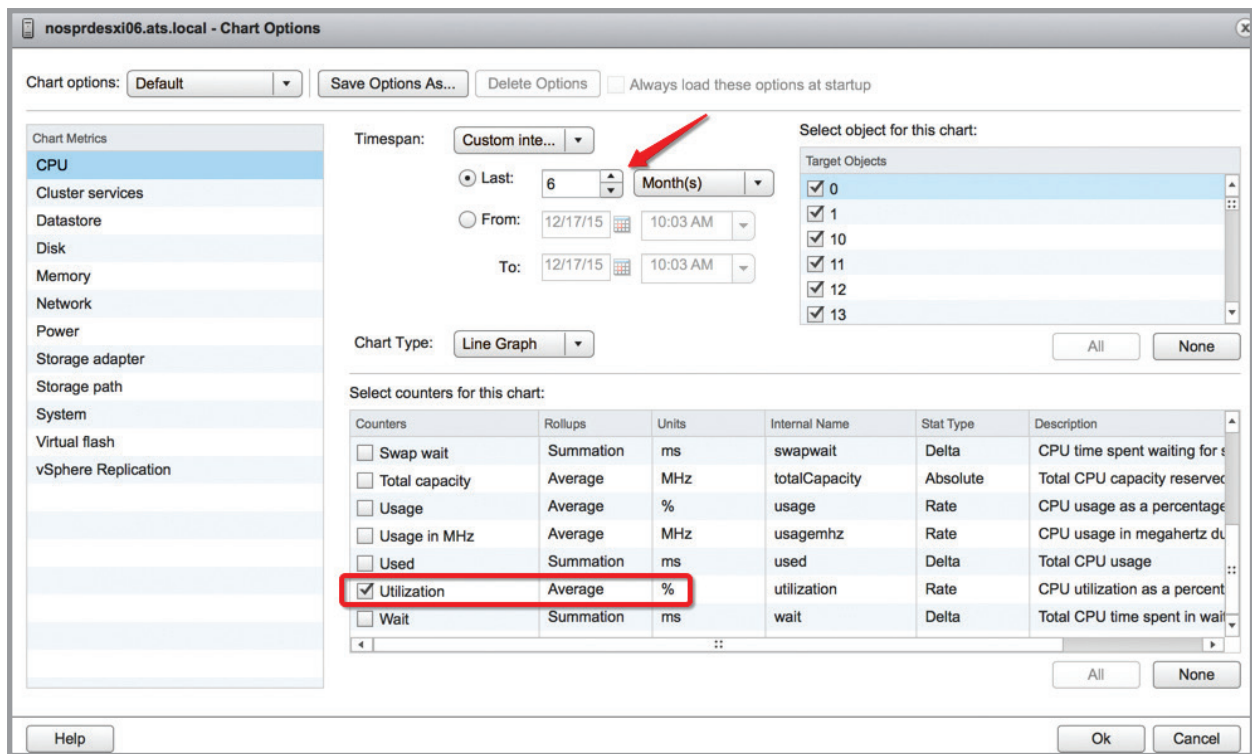


Figure 6: This screenshot shows how we create an advanced chart using vCenter’s built-in charting wizard.

Getting the chart to display was already an eight-step process, only to reveal that we have no data due to our current statistics logging level.

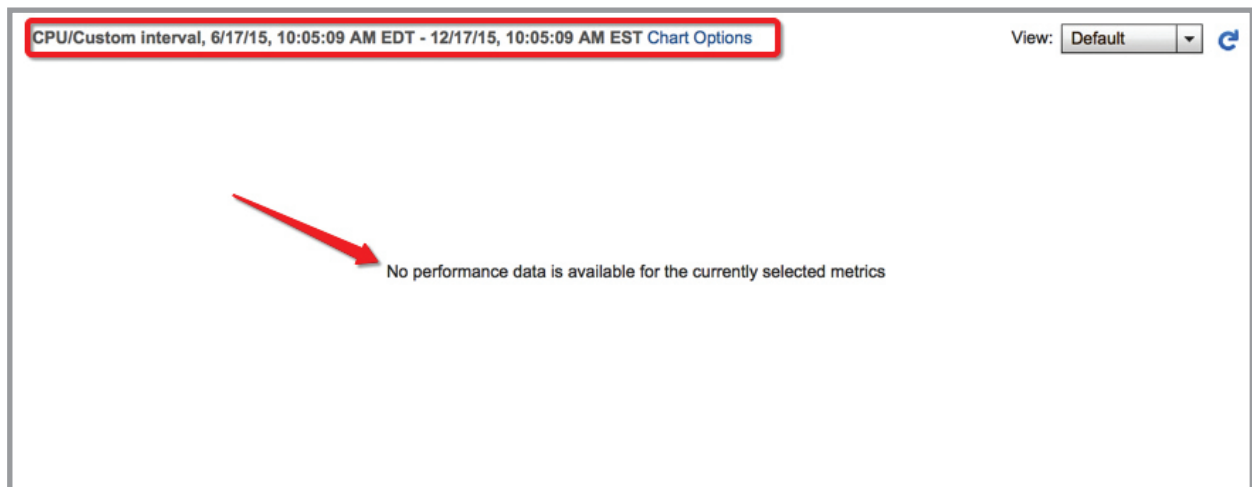


Figure 7: This screenshot shows that—because of our current collection levels—we would not be able to display data for the past six months.

Now, let us say we wanted to see memory for the same range as we were using in vCenter. We already know that we cannot see it in vCenter but for arguments sake that would be another eight-step process for 16 total steps to display only two charts. Below, we show how Galileo for VMware quickly displays charts for CPU and Memory using our Favorites feature all in just three steps.

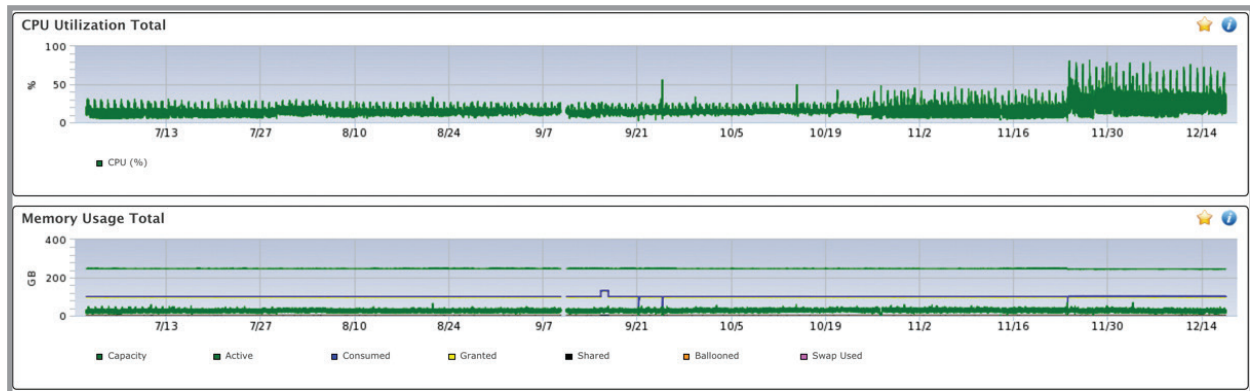


Figure 8: This screenshot shows how—using Galileo for VMware—we are able to show side-by-side memory utilization and CPU utilization for the past six months at five-minute data points, all with just three easy steps.

The charts above now bring up questions: What happened on this host around 11/20? Is there a new VM or an old VM that increased CPU stress on this host? Were changes made on the host side to cause this inflation of CPU utilization? Using vCenter, we would not have been able to have these insights. However, using Galileo, we can quickly see trend data by looking at the telescopic view or—said differently—a view of a large time span to quickly see trends upwards or downwards. Along those same lines, we now have the insight to drill into the CPU chart to get the microscopic or granular detail to determine at the five-minute data point at which we started to see a jump. By clicking the CPU chart, we can quickly highlight the section around 11/20 to start our search for the root cause.

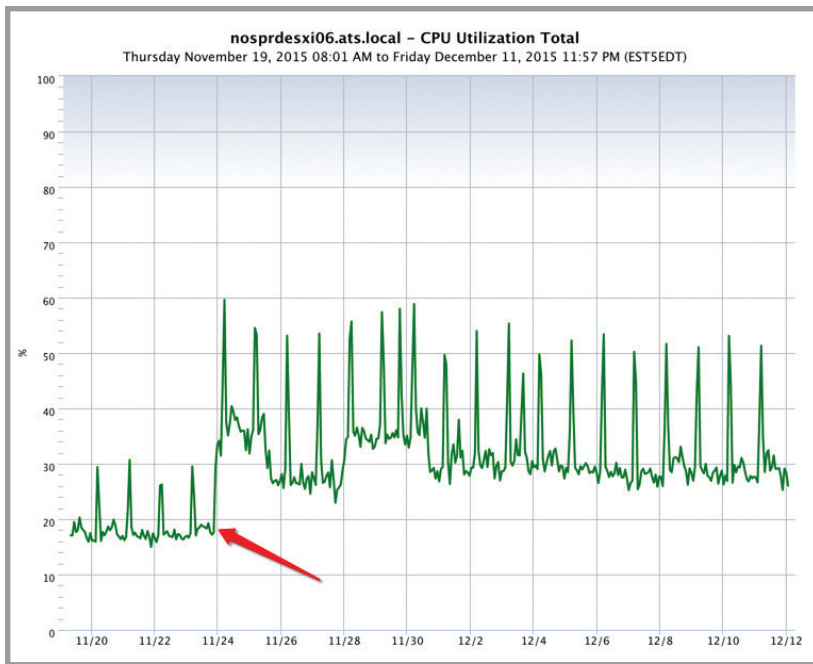


Figure 9: This screenshot shows Galileo for VMware drilling down to find when the peak on CPU began at 11/23 CPU jumped.

From the chart above, we were quickly able to see (in just five steps) that at a little before midnight on 11/23 we saw a jump in CPU that went from an average of just under 20% utilization to an average of a little over 30%. This is a 50% increase in just an hour. Taking this a step further, we also can see that percent available dropped by a small amount (below) at this exact time. After some asking, we determined that this was the exact time of our upgrade to ESXi version 6.

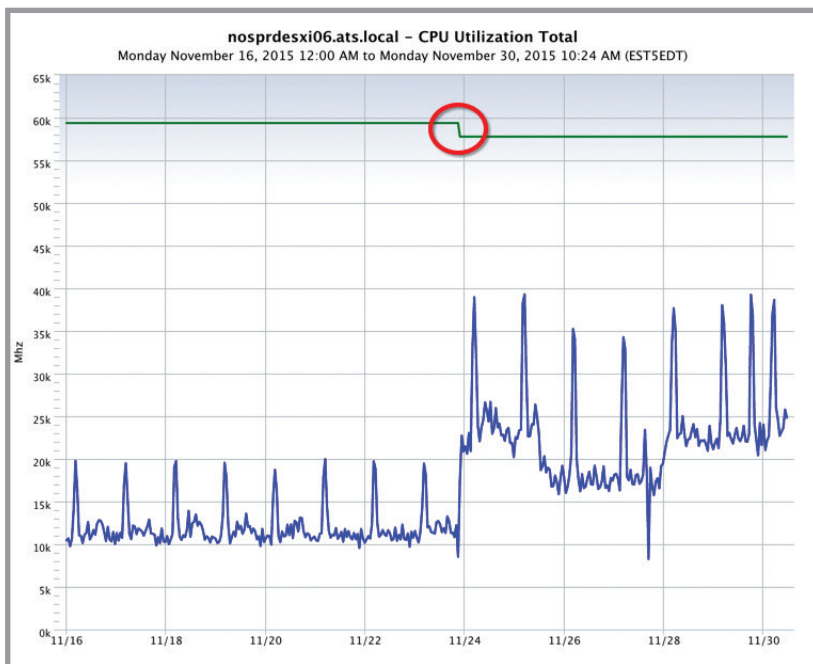


Figure 10: This screenshot shows that using Galileo we were quickly able to see that we had a drop in available CPU MHz for VM operations immediately following our upgrade to ESXi version 6.

This information exposed us to an issue. To make a long story short, we determined (using Galileo) that—over this time period—the VM running on this host did not increase or decrease in CPU utilization/MHz consumed. Therefore, we began to ask questions: Did the vSphere 6.0 upgrade change how the CPU scheduler processes the VM Worlds or processes? Is there now more overhead needed for the ESXi hypervisor? Was there perhaps an issue in version 5.5 in how CPU metrics are reported that was fixed in the version 6.0 release? While we would open a ticket with VMware to ask these questions, the issue would not have been found if not for Galileo for VMware, the historical metrics capabilities it provides, and its deep granular insight.

What Users Say:

"I had a problem that started weeks ago, but I don't know when it started. vCenter rolled up the data, so I couldn't accurately identify—they are not ready for the deep-level dive. The vCenter statistics are not kept as granular as the Galileo offering."

Ryan Snyder: Senior VMware Administrator, D&H Distributing

Enterprise Dashboard Summary

In today's ever growing data center it is critical to the company bottom line to know what resources are being used and if they are being used efficiently. By using Galileo's Enterprise Dashboard feature, we bring deep insight into the datacenter for the top-level executives. Bundled with our other Galileo agents for Storage, SAN, and OS; Enterprise Dashboards have generated a lot of buzz from upper management who now have a quick, easy way to monitor resources across the environment their admins manage every day.

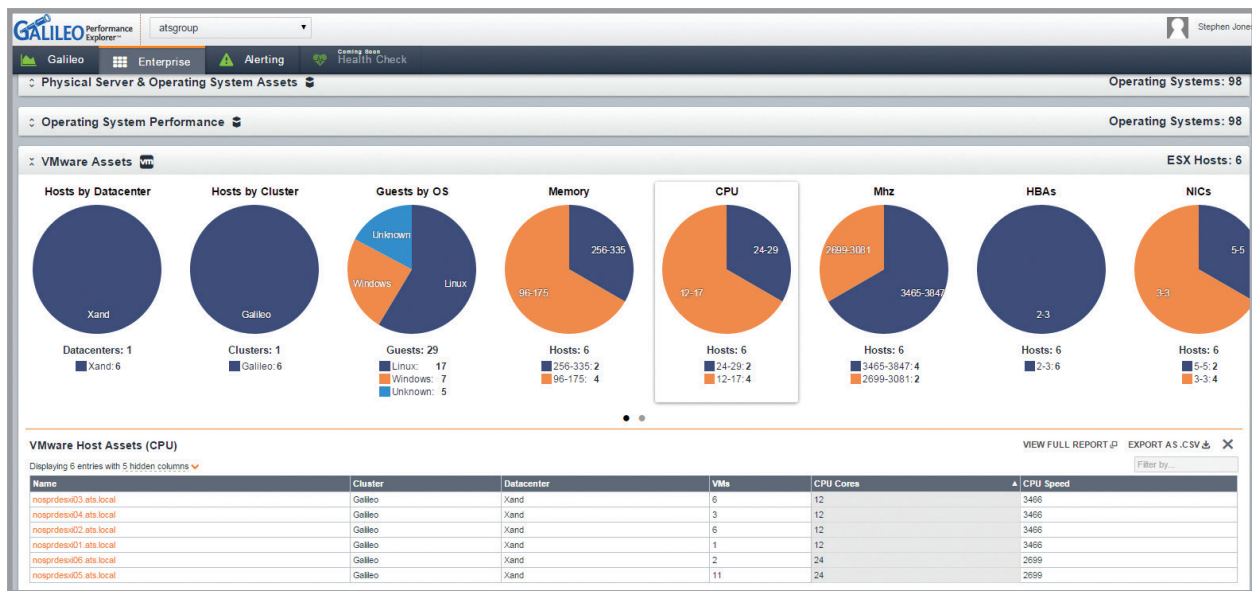


Figure 11: This screenshot shows the VMware Assets section of Galileo's Enterprise Dashboards view giving you an executive summary of your entire VMware environment.

With Galileo for VMware now included in Galileo's Enterprise Dashboard module, we can now see a rollup of every vCenter server environment managed by the VMware collection agent for a particular customer. We can quickly see high-level data such as VM Guest by Power State, VMware Tools Status, and Hosts by ESXi Version. VM Guest by Power State is particularly useful because as seen below there are 69 out of 105 VMs that are powered off.

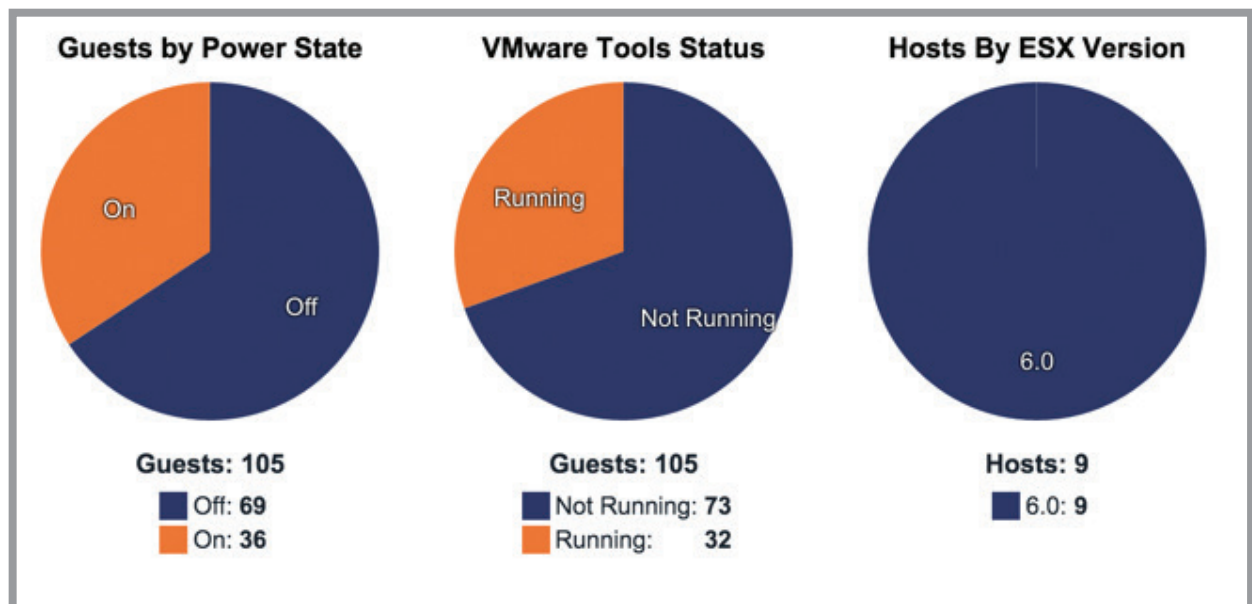


Figure 12: Charts representing Guests by Power State, VMware Tool Status, and Hosts by VSX Version.

If we click the Guests by Power State chart, we will see an exportable report showing varied information. If we apply a filter of Off, we will quickly get a list of all VMs powered off. This helps lay the foundation of an environment-wide clean up endeavor to decrease waste that plagues just about every VMware customer with whom we interact.

VMware Guest Assets (Guests by Power State) VIEW FULL REPORT EXPORT AS .CSV X

Displaying 69 entries with no hidden columns

Filter: **Off**

Name	Datacenter	Cluster	Host	Power State	OS	IP Address	Memory	VMware Tools Status	VMware Tools
lntest	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi03.ats.local	poweredOff	Microsoft Windows Server 2008 (64-bit)	192.168.240.243	16.0 GB	guestToolsNotRunning	guestToolsSupp
gvicahrhel02	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi02.ats.local	poweredOff	Red Hat Enterprise Linux 6 (64-bit)	-	4.0 GB	guestToolsNotRunning	guestToolsNotir
gvicahrhel01	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi02.ats.local	poweredOff	Red Hat Enterprise Linux 6 (64-bit)	-	7.9 GB	guestToolsNotRunning	guestToolsNotir
gvicordgalileotes01	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi02.ats.local	poweredOff	Microsoft Windows Server 2008 (64-bit)	-	4.0 GB	guestToolsNotRunning	guestToolsSupp
gvicaklfcm01	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi02.ats.local	poweredOff	Red Hat Enterprise Linux 6 (64-bit)	-	2.0 GB	guestToolsNotRunning	guestToolsNotir
gvicaklfcm02	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi02.ats.local	poweredOff	Red Hat Enterprise Linux 6 (64-bit)	-	2.0 GB	guestToolsNotRunning	guestToolsNotir
gvicprdc02	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi03.ats.local	poweredOff	Microsoft Windows Server 2012 (64-bit)	fe80::888a:6a93:7bed:8700	4.0 GB	guestToolsNotRunning	guestToolsSupp
Prasad_6	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi03.ats.local	poweredOff	Red Hat Enterprise Linux 6 (64-bit)	-	4.0 GB	guestToolsNotRunning	guestToolsNotir
Prasad_4	Datacenter GVIC v6	Cluster GVIC v6	gvicesxi03.ats.local	poweredOff	Red Hat Enterprise Linux 6 (64-bit)	-	4.0 GB	guestToolsNotRunning	guestToolsNotir

Figure 13: VMware Guest Assets, sorted by Power State.

Another equally important set of information shown in Galileo’s Enterprise Dashboard view are CPU Cores by Host and CPU Sockets by Host. These charts combined can show us quickly which hosts are potential candidates to be consolidated to new machines with higher Cores to Sockets count to decrease the overall cost of VMware licensing which we as VMware administrators know are licensed by socket not core and is extremely important information to save costs across the enterprise. This enables upper management to make reliable and cost effective decisions to help increase their bottom line without having their administrators spend hours creating reports to list out this information.

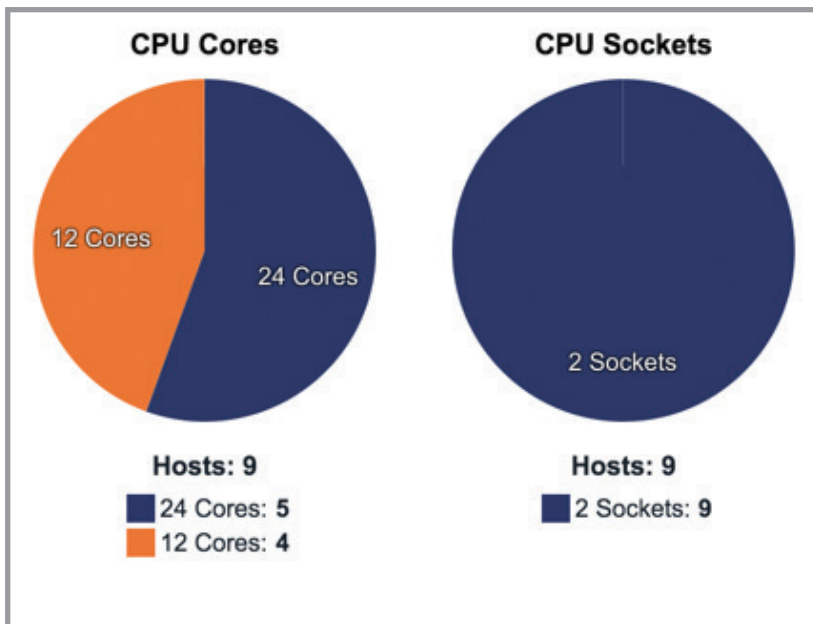


Figure 14: CPU Cores and CPU Sockets.

Peak and average CPU, Memory, IOPS, and Throughput are also available in the Enterprise Dashboard views. For example:

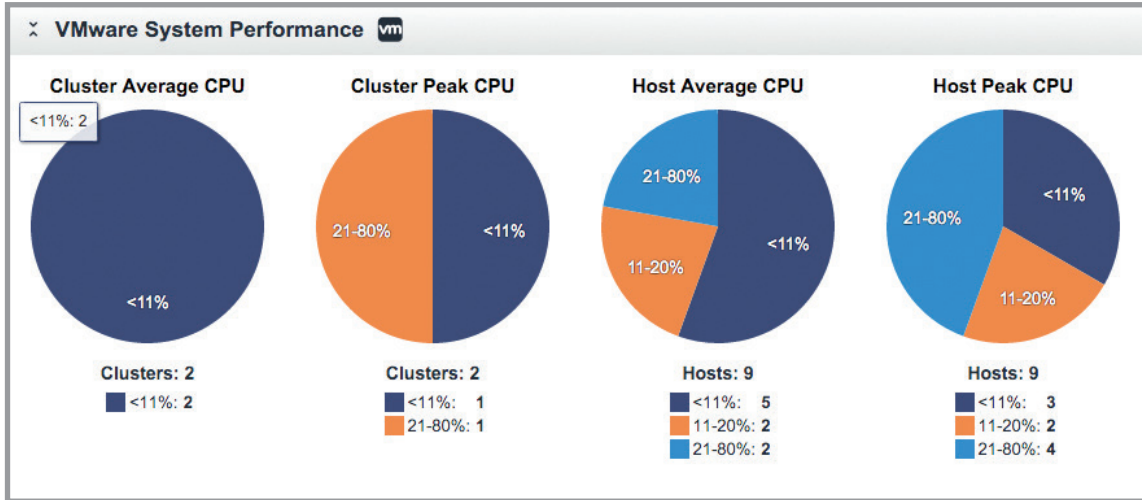


Figure 15: VMware System Performance; including Cluster Average CPU, Cluster Peak CPU, Host Average CPU, and Host Peak CPU.

Native OS Monitoring

With Galileo for VMware, you will also get the Windows/Linux agent bundled in with the VMware module—another huge plus. Here, you can see from the OS-perspective the performance seen from the native operating system and the VM performance as well to get deep insight into each VM guest. This will help point out ESXi overhead by showing the relationship between what vCenter sees for each VM guest and then what the guest operating system is reporting for various performance metrics including CPU Peak/Average Throughput, Disk Throughput/Transfers Peak/Average and more.

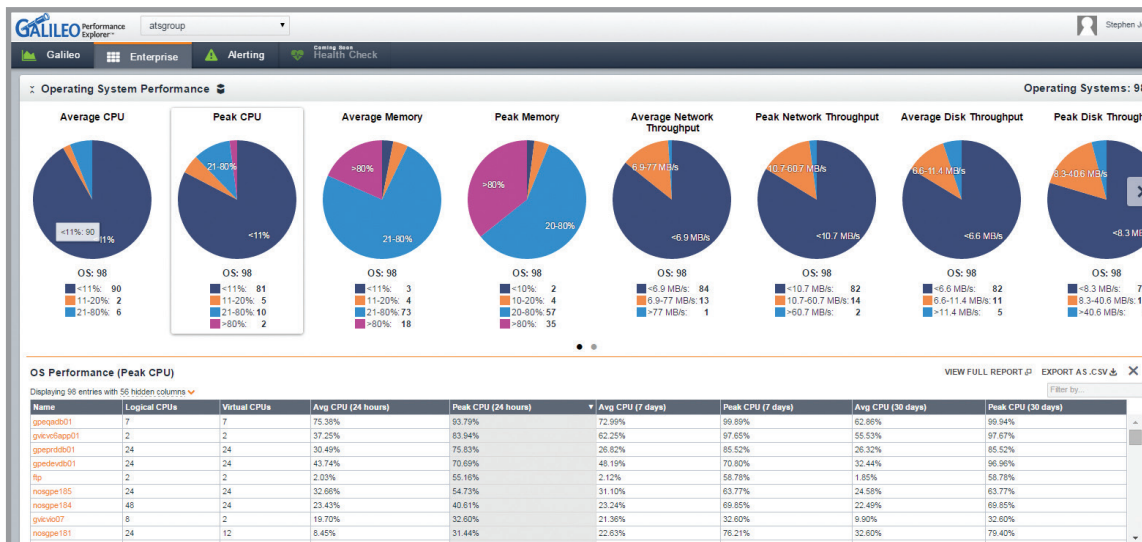


Figure 16: Operating System Performance.

Below is a screenshot of the Linux OS object (left) and corresponding VM Guest object (right). Over a seven-day period, we see from the OS level that CPU percentage utilized is spiking just below 50% each day. We also now have the insight to see User CPU percentage (Green), System/Privileged CPU percentage (Yellow), and Wait/Interrupt CPU percentage (Red). From the VM guest we see CPU percentage utilized spiking between 53-56% and simply shows what the ESXi hosts as CPU percentage utilized at the VM guest level not broken down like the Linux agent provides. With this information we see that this VM has ESXi overhead of about 6%.

See the following quote taken from the vSphere Resource Management Guide:

“An application is CPU-bound if it spends most of its time executing instructions rather than waiting for external events such as user interaction, device input, or data retrieval. For such applications, the CPU virtualization overhead includes the additional instructions that must be executed. This overhead takes CPU processing time that the application itself can use. CPU virtualization overhead usually translates into a reduction in overall performance.”

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By combining these two views of a single virtual machine, we can quickly determine if our overhead is too high on the host. We can then decide if this host should be upgraded to a pCPU that can better handle the instructions being sent from the guest OS vCPU or develop a better solution to run the application currently within this guest OS.

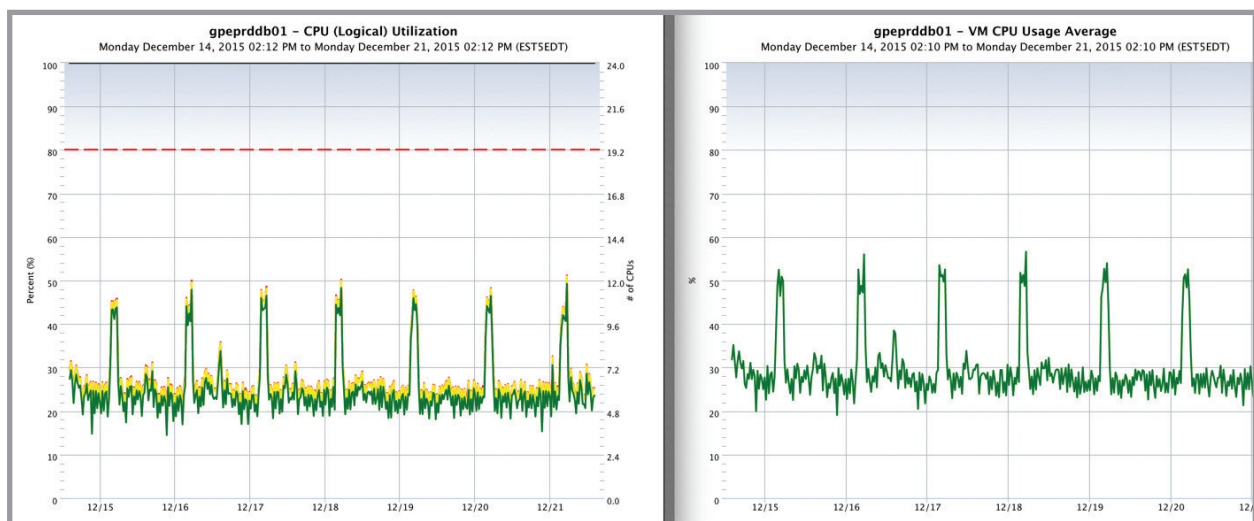


Figure 17: Comparison of CPU (Logical) Utilization to VM CPU Usage Average.

About the Authors

Brandon Scott and *Rich Davis* are infrastructure performance management experts at the ATS Group, innovators of Galileo Performance Explorer. Brandon, a lead systems engineer, and Rich, a senior developer have extensive, certified experience across IT environments including VMware, IBM, Brocade, and Cisco. Their expertise spans performance analysis, capacity planning, system implementations, upgrades/migrations, and backups/recoveries.

Galileo Performance Explorer

Galileo Performance Explorer® is the industry's first cloud-based and integrated infrastructure performance management (IPM) suite for servers, storage, SAN and applications. Designed by data center experts from real-world implementations, Galileo improves IT utilization and capacity planning with proactive, convenient performance monitoring that has proven easy to use. It delivers hundreds of analytical perspectives on server, storage, SAN and virtualization environments for key decision makers that go far beyond reactive alarms. Built on an innovative SaaS architecture, Galileo installs in minutes without onsite data or expensive hardware requirements. Automatic collection of real-time data, with quick, easy, graphical reporting via an intuitive web interface, offers access to custom dashboards with full drilldown into data details, anywhere, anytime.



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