

Fewer clicks, less time, less hassle.



CA® Infrastructure Management 2.0
improved speed and ease of management with up to

86%
fewer
clicks

11.4x
faster task
completion

in our tests compared to SolarWinds® Orion® tool set

In today's business environment of virtual workplaces, satellite offices, and cloud computing, infrastructure disruptions can cost a company tens or hundreds of thousands of dollars' revenue and lost IT productivity per hour. An effective infrastructure management suite lets network and systems managers, engineers, and other infrastructure and operations support staff resolve issues proactively and quickly, saving the business from lost time, money, and reputation that a catastrophic infrastructure degradation or failure could cause.

In our labs, Principled Technologies compared the user experience of two such management suites, CA Infrastructure Management 2.0 and the SolarWinds Orion family of network management tools.

Using the CA Technologies solution, our engineers resolved the issues in our simulated scenarios up to 11 times faster than when using the SolarWinds suite. The CA Technologies solution not only took less time, but also required up to 86 percent fewer mouse clicks depending on the task.

When support staff perform these tasks repeatedly in the course of their workdays, these time savings rapidly add up. Being able to diagnose and remedy problems as quickly as possible by using the tools at your disposal is essential to avoiding or minimizing the impact that infrastructure events can have on customers and business end-users. These factors make CA Infrastructure Management 2.0 an excellent choice for infrastructure management.



WHEN QUICK RESPONSE TIME IS CRITICAL

To prevent or mitigate the damage that network and service disruptions can bring, software capable of detecting issues quickly, or even detecting potential issues before they occur, can make all the difference. An effective tool must display large amounts of data in an easily digestible manner, so that the administrator can navigate to, investigate, and resolve the issue with as few clicks and as little time as possible. Products that have ample data, but no quick and efficient path to that data, become tedious and expensive to use as environments grow and scale over time.

To evaluate the CA Technologies and SolarWinds solutions, we performed a set of common use cases typical of a large environment dealing with multiple sites, with many types of managed devices, in which a network administrator must locate the source of a network or server performance issue. Our engineers familiar with the two products used each product's user interface to resolve each use case. We measured the number of clicks required to arrive at the solution or screen where the data was displayed, as well as the amount of time it took. For more information on the exact steps for each use case, see [Appendix A](#).

OUR FINDINGS

Use case scenario results

In our testing, we found that both sets of tools offered similar data in their respective feature sets, but the CA Technologies solution provided a far more efficient user experience for network and system managers and other support staff. As Figure 1 shows, the experience in CA Infrastructure Management 2.0 was from 2.3 to 11.4 times faster, and required from 68 percent to 86 percent fewer clicks, than the experience in the SolarWinds suite of products.

In three of the four cases using SolarWinds, our engineers determined that exporting data to an external spreadsheet for calculations would be a more efficient path than just using the SolarWinds Orion toolset to evaluate data displayed in multiple locations. We chose to use Microsoft® Excel®, which sped up the process in certain use cases. When we used Excel, we included the time it took to complete the task, but did not count clicks external to SolarWinds. As Figure 1 shows, the design of the CA Infrastructure Management 2.0 product, which uses unified views for optimized workflows for convenient data display, reduced clicks and navigation required in SolarWinds Orion.

	Use Case #1		Use Case #2		Use Case #3		Use Case #4	
Solution	Clicks	Seconds	Clicks	Seconds	Clicks	Seconds	Clicks	Seconds
CA Technologies	4	22	4	28	6	29	3	14
SolarWinds	21	52	18	226*	19	98*	23	160*
Advantage	80% fewer clicks	2.3X faster	77% fewer clicks	8X faster	68% fewer clicks	3.3X faster	86% fewer clicks	11.4X faster
*numbers indicate that additional external calculation was required.								

Figure 1: Click counts and times for our use cases, using the CA Technologies and SolarWinds solutions

What does this mean for you?

As your infrastructure scales up to tens or hundreds of thousands of monitored nodes, the time and complexity of performing tasks, such as the ones we used for our testing scenarios, will increase dramatically. The savings that are possible when using CA Infrastructure Management 2.0 can lead to the potential reduction of dozens or hundreds of person-hours during a month or year, depending on the size of your staff, your company's size, and complexity of your monitored infrastructure.

By providing an easy-to-use, powerful user interface, the faster workflow provided by the CA Technologies solution gives infrastructure and operations support staff the opportunity to respond faster and prevent or resolve small or large issues quickly, reducing the risks to critical business infrastructure on productivity.

WHAT WE TESTED

We used a combination of physical and simulated LAN and WAN environments to evaluate the features of CA Infrastructure Management 2.0 and the SolarWinds Orion family of network management products. To do so, we installed some components of each suite locally to have more flexibility in adding custom screens and administering the interface. Where we needed more extensive test data for use cases, we used software installed at each vendor's respective demo or lab environment.

We evaluated four use cases to simulate real-world scenarios encountered by network and system administrators and other support staff on a routine basis. Below we describe each of those use cases. In [Appendix A](#) we describe each use case and the click sequences and granular results for each use case. As is often the case, there were different possible paths to complete each scenario. Our goal was to select paths that favored each solution (for example, we allowed the use of a spreadsheet in the case of SolarWinds).

Use case scenarios

Scenario 1

Users complain of a network slowdown event in the past day. Isolate a network congestion event that occurred in the past day in each management software package's available views and pinpoint the problem host IP address and the offending network conversation, reporting both host and destination, using as few clicks as possible and no data entry. Change the dashboard-wide view to analyze the event at the dashboard level.

Scenario 2

You have been alerted to a utilization problem at a site. Evaluate the site's top 10 most utilized servers and all of their hosts' CPU and RAM utilization for the past hour and past 24 hours – minimum, maximum, and averages – in as few clicks as possible. Modify time ranges from the past hour to the past 24 hours via each UI to see differing time windows for this data.

Scenario 3

You are evaluating server capacity problems in your data center for growth purposes. Evaluate what servers in a certain rack are deviating from normal usage for the past month. Determine which

server of those is trending up the most in terms of CPU utilization for the past month. View details for that server's usage and evaluate past and future trend lines. Evaluate that individual host's CPU and RAM (minimum, maximum, and average) for the past month. Then modify time ranges for that host's detail page to view the prior quarter's numbers, to verify the capacity growth issues.

Scenario 4

Users on a particular server complain of slowdowns each business day between 11 a.m. and 3 p.m. Evaluate an individual host's usage pattern for the past month. Visually pinpoint particularly busy hours or blocks of time in a Calendar Heat Chart pattern, and see if the patterns match the user complaints. After doing so, confirm if it is a RAM or CPU issue during these times.

For more information on the scenario testing methodology, see [Appendix A](#).

CA INFRASTRUCTURE MANAGEMENT

CA Infrastructure Management 2.0 is a set of services and tools capable of monitoring, your full infrastructure and providing deep insight into potential issues.

What's new in CA Infrastructure Management 2.0

According to CA Technologies, CA Infrastructure Management 2.0 has enhanced capabilities, such as the following:

- **CA Performance Center.** A generation beyond CA Technologies' NetQoS Performance Center user interface, the new CA Performance Center provides a wide range of predefined, technology-specific dashboards (e.g., MPLS, Capacity Watch, Server Health, Network Health, VMware), new patent-pending metrics views, additional layers of granular data access and administration, and new integration options with the Web Services Admin API.

Using a single-pane layout, CA Infrastructure Management 2.0 provides graphical reporting of network, server and application performance, while granting insight into network traffic flows, availability, and capacity, using collapsible dashboard modules and flexible dashboard designs. CA Performance Center also features: intra-module search, intra-module paging controls, and allows for zooming charts through click & drag mouse control.

Additionally, CA Performance Center displays data in a more malleable and digestible form for system and network administrators and other operations staff/engineers. Using new data display modules, the administrator has a dense amount of information available with just a mouse hover, or just a single selection. We review some of those user interface advantages below.

In the patent-pending Gauge/Table combination and the Trend/Table combination, the administrator has a dense amount of information available with just a mouse hover – minimum, maximum, and average utilization, along with volatility indicators during the applicable period (see Figure 2).



Figure 2: New Gauge/Table combination modules display large amounts of information in CA Infrastructure Management 2.0 with no clicking required.

Similar to the Gauge/Table combination, the Trend/Table combination below offers an administrator a large quantity of information with just a mouse hover. There are no clicks required to view the usage pattern over a certain time period. Usage spikes and dips are easily spotted with no page navigation necessary.

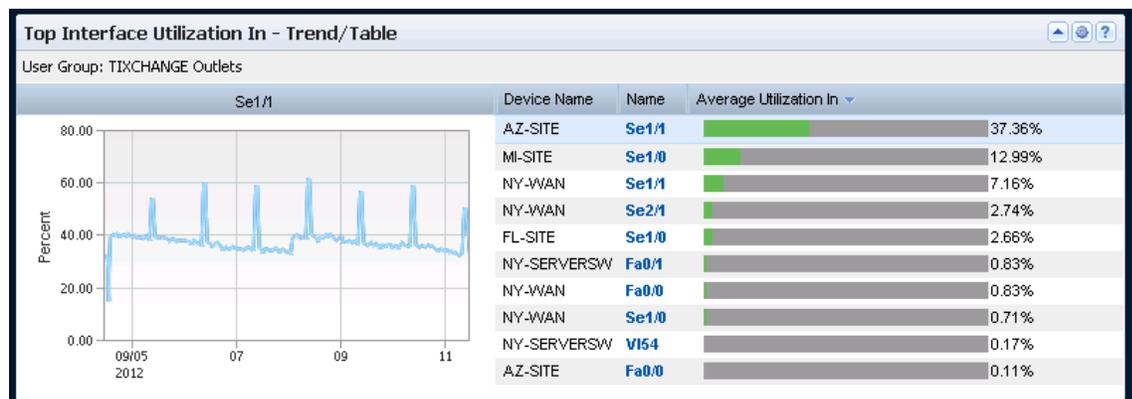


Figure 3: New Trend/Table combination modules display large amounts of information in CA Infrastructure Management 2.0 with no clicking required.

The patent-pending Calendar Heat Chart below offers an administrator a comprehensive view of the month at a granular one-hour interval. Visualizing inter-day and intra-day patterns is quick and painless. Additionally, the administrator has a quick method of isolating patterns that matter: Busy Hour, Business Week Pattern, Calendar Week Pattern, Repeating Hours by Business Day, and Repeating Hours by Calendar Day.

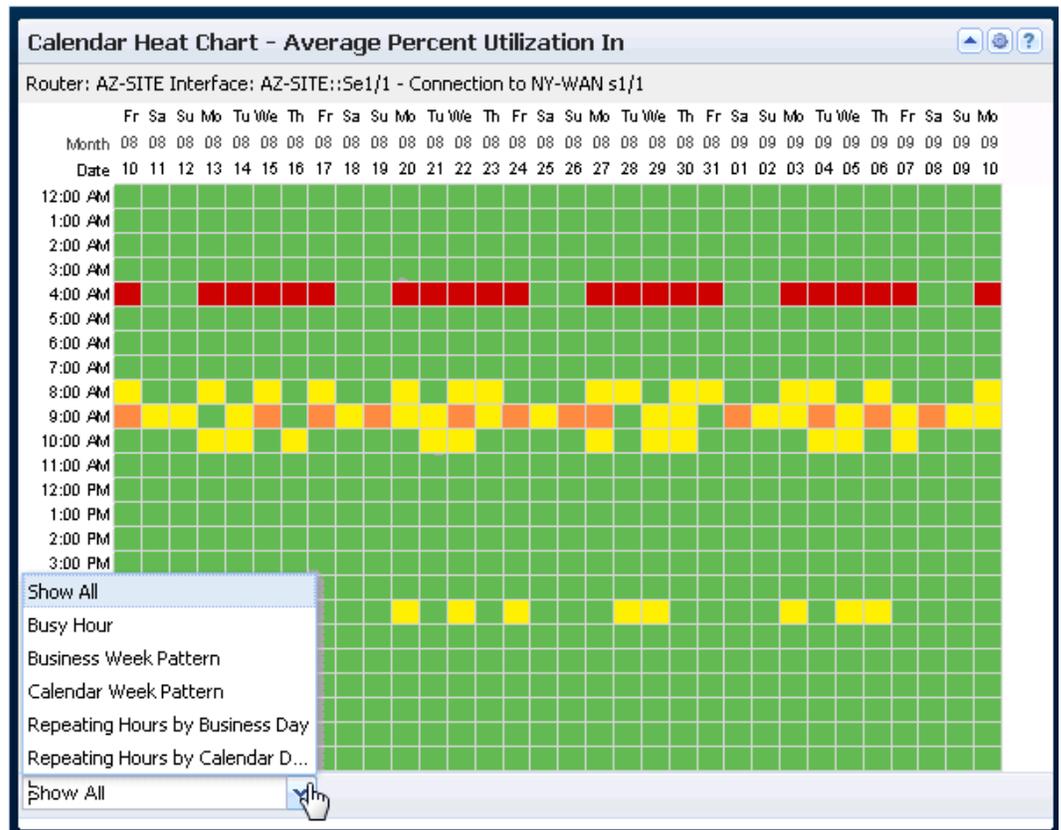


Figure 4: New Calendar Heat Chart module in CA Infrastructure Management 2.0.

- CA Data Aggregator.** A generation beyond CA Infrastructure Management 1.0's eHealth and NetVoyant products, the new CA Data Aggregator is powered by a highly scalable, high-performance architecture on a surprisingly small hardware footprint that includes a massive parallel-processing database and multi-threaded, linearly scalable polling. Touting inventory and component discovery, performance monitoring capabilities, and dynamic thresholding, Data Aggregator natively supports multi-tenancy for controlling role-based access to data. Self-certification of devices and systems is now possible, removing dependencies on time-consuming tasks or external certification services.
- Combined CA Data Aggregator and CA Performance Center.** CA Infrastructure Management 2.0's Data Aggregator is a chief data source for the CA Performance Center console. This presents Reporting, Administration, Data Collection and Normalization, Inventory and Component Discovery, and Threshold Monitoring all under a single user interface, and allows the CA Data Aggregator feature to be administered via CA Performance Center. The CA Performance Center also integrates and displays data from a variety of data sources such as: CA Infrastructure Management 2.0's CA Network Flow Analysis component; CA add-on components for VoIP, video and application performance management; and even CA Infrastructure Management 1.0's eHealth performance management product.
- CA Network Flow Analysis.** This was formerly branded as CA NetQoS ReporterAnalyzer, and, like the other components in CA Infrastructure Management 2.0, integrates directly with CA Performance Center, providing a unified view into the conditions of the monitored networks. In addition, CA Network Flow Analysis now supports installation of

the Super Harvester component on Red Hat Linux 5.x and localization for Japanese and simplified Chinese.

- **CA Application Delivery Analysis.** CA Application Delivery Analysis is an add-on component that enables administrators to monitor end-to-end application response times in an agentless environment. The service monitors application traffic and automatically establishes baselines from which alerts are derived, based on algorithmically created thresholds. CA Application Delivery Analysis calculates these baselines with awareness of time of day, week, and month, as well as comparing current versus historical performance for the hardware/software combination being monitored. CA Infrastructure Management 2.0 and CA Application Delivery Analysis work together to assist in proactive analysis and triage, as well as give insight into pre- and post-optimization performance levels.

SolarWinds Orion network management

SolarWinds network management suite is combined under the branding of Orion, with a number of individual modules that may be combined to increase functionality of the suite. In our testing we use SolarWinds Orion Network Performance Monitor, Orion NetFlow Traffic Analyzer, and Orion Server and Application Monitor.

IN CONCLUSION

Infrastructure and operations support time is valuable, and every second is critical when a performance, capacity or application response issue begins to manifest. A management, alerting, and root cause analysis system that allows staff to quickly locate and troubleshoot a problem is key to providing five-nines uptime SLAs, as well as keeping a business's own staff working at peak efficiency.

In our tests, we found that CA Infrastructure Management 2.0 outperformed the SolarWinds Orion tools in tests of ease of use and required-time-to-complete. The testing demonstrated timing wins for CA Technologies in our four simulated scenarios, by factors of 2.3 to 11.4 times over SolarWinds Orion.

When managing large-scale infrastructures, the ability to efficiently triage a large number of devices and network links is essential for maintaining high availability, consistent performance and routine business operations. This is particularly evident when calculating the aggregate time saved when performing the same operations multiple times in a given day. Over time, these aggregate figures can lead to significant savings of time and money for your organization.

APPENDIX A – TESTING METHODOLOGY

Below are four use cases designed to test CA Infrastructure Management version 2.0 versus SolarWinds products, namely Network Performance Monitor, Netflow, and Server and Application Monitor. We reviewed and tested each use case using a combination of software installed at Principled Technologies and at each vendor’s respective demo or lab environment.

We counted clicks inside each respective interface. We counted timings for the complete tasks. We did not count clicks inside Microsoft Excel. Where our engineers felt that the task could more quickly be accomplished in Microsoft Excel and would be realistic, we used Microsoft Excel to supplement the task workflow. In those cases, the Excel work time was included but not the clicks. This is similar to the method we used in a separate report comparing CA Infrastructure Management 2.0 with CA Infrastructure Management 1.0, where CA Infrastructure Management 2.0 did not require extra tools to supplement the workflow.

USE CASE #1 – WAN CONGESTION

Users complain of a network slowdown event in the past day. Isolate a network congestion event that occurred in the past day in each management software package’s available views and pinpoint the problem host/IP and the offending network conversation (host+destination) using as few clicks as possible and no data entry. Change dashboard-wide view to analyze event at the dashboard level.

CA Infrastructure Management 2.0

Start in Traffic Analysis, customized dashboard - 4 clicks, 22 seconds

1. Click “Last hour.”
2. Choose 24 hours.
3. Click, drag, and release “Interface Utilization In Trend/Baseline Detail with Events” to visual spike.
4. Click Apply to dashboard. Note non-business related destination in “Top Conversations (Bar) – Total” module.

For this scenario, we used a customized dashboard in CA Performance Center, consisting of the following views:

- Top Performance by Network (Bar Chart) – All Combined Metrics
- Interface Utilization In Trend/Baseline Detail with Events
- Top Engineering (Trend) – Transaction Time
- Top Conversations (Bar) – Total
- Top Hosts (Bar) - Total

SolarWinds

Start in the NetFlow tab – 21 clicks, 52 seconds

1. Click Conversations sub-tab.
2. Click “Last ### hours” button.
3. Select the Named time period radio button.
4. Click the drop-down menu.
5. Select 24 hours.
6. Click Submit.
7. Click the Graph type button.

8. Select area chart in order to view the data over the 24 hour time period. Note the network congestion spike time in graph.
9. Click the Last ### hours button.
10. Select the Absolute time period radio button.
11. Click the From date field.
12. Click the Applicable date.
13. Click Done.
14. Click the From time field.
15. Click the From time.
16. Click the To date field.
17. Click the applicable date.
18. Click Done.
19. Click the To time field.
20. Click the To time.
21. Click Submit. Note non-business related destination and offending IP address in “Top 10 conversations” module.

For this scenario, we used an out-of-box view in SolarWinds NetFlow.

USE CASE #2 – SERVER GROUP EVALUATION

There is a problem at a site. Evaluate this site’s top 10 most utilized servers and all of their hosts’ CPU and RAM utilization for the past hour and past 24hrs – minimum, maximum, and averages in as few clicks as possible. Modify time ranges via each UI to see differing time windows for this data.

CA Infrastructure Management 2.0

Start in Infrastructure Overview tab – 4 clicks, 28 seconds

1. Click Site Name.
2. Click Server Health tab. Hover over each server in the Top CPU Utilization Servers – Gauge/Table and note the minimum, maximum, and average. Hover over each server in the Top Memory Utilization Servers – Gauge/Table and note the minimum, maximum, and average.
3. Click Last hour.
4. Choose 24 hours. Hover over each server in the Top CPU Utilization Servers – Gauge/Table and note the minimum, maximum, and average. Hover over each server in the Top Memory Utilization Servers – Gauge/Table and note the minimum, maximum, and average.

SolarWinds

Start in the home tab – 18 clicks within SolarWinds, some external calculation required, 226 seconds

1. Click the Groups sub-tab.
2. Click the relevant group.
3. Click on the Node Aggregate Chart – Average CPU Load chart.
4. Click the Select a Time Period dropdown box.
5. Click Last 24 hours.
6. Click the Sample Interval drop-down menu.
7. Click Every 10 minutes.
8. Click Submit.

9. Back in the group view, click the Node Aggregate Chart – Average CPU Load View Options drop-down menu.
10. Click View Chart Data in Excel.
11. Click Open to open the file from the browser into Excel. Calculate the min, max, and average of each server for one hour (not counted in click count, but counted in times). Calculate the minimum, maximum, and average of each server for the past 24 hours.
12. Click on the Node Aggregate Chart – Percent Memory Used chart.
13. Click the Select a Time Period dropdown box.
14. Click Last 24 hours.
15. Click the Sample Interval drop-down menu.
16. Click Every 10 minutes.
17. Click Submit.
18. Back in the group view, click on the Node Aggregate Chart – Percent Memory Used View Options drop-down menu.
19. Click View Chart Data in Excel.
20. Click Open to open the file from the browser in Excel. Calculate the minimum, maximum, and average of each server for one hour (not counted in click count, but counted in times). Calculate the minimum, maximum, and average of each server for the past 24 hours.

For this scenario, we customized the view in SolarWinds Group Details by adding the following resources:

- Multiple Series Charts → Multiple Object Chart (customized to show Group CPU)
- Multiple Series Charts → Multiple Object Chart (customized to show Group RAM)

USE CASE #3 – SERVER GROUP AND INDIVIDUAL HEALTH HISTORY AND CAPACITY PLANNING EXERCISE

You are evaluating server capacity problems in your data center. Evaluate what servers in a certain rack are deviating from normal usage for the past month. Determine which server is trending up the most in terms of CPU utilization for the past month. View details for that server usage and evaluate past and future trend lines. Evaluate that individual host's CPU and RAM (minimum, maximum, and average) for the past month. Then modify time ranges for that host's detail page to view the prior quarter's numbers, to verify the capacity growth issues. We assume in CA Infrastructure Management 2.0 that a fully populated rack containing 2U servers has been preconfigured as a group.

CA Infrastructure Management 2.0

Start in Server Capacity Watch Lists dashboard – 6 clicks, 29 seconds

1. Click Last hour.
1. Choose Last 30 days.
2. Click the top deviating server under Top Deviations from Normal – CPU/Memory (Table) – CPU Utilization – Server.
3. Click the System Health tab. Note CPU and RAM utilization gauges and trend lines.
4. Click Last 30 days.
5. Choose Last 3 months. Note CPU and RAM utilization gauges and trend lines and where future trend line falls.

SolarWinds

Start in the home tab, group sub-tab. – 19 clicks within SolarWinds, some external calculation required, 98 seconds

1. Click the Node Aggregate Chart – Average CPU Load chart.
2. Click the Select a Time Period drop-down menu.
3. Click Last 30 days.
4. Click the Sample Interval drop-down menu.
5. Select Every hour.
6. Click Submit.
7. Click the View options drop-down menu on the Node Aggregate Chart – Average CPU Load chart.
8. Click View chart data in Excel.
9. Click Save to save the file from the browser. Import the data into a pre-configured Excel spreadsheet (timed, but no clicks measured). Analyze the server trend lines (timed, but no clicks measured).
10. Return to the group view on SolarWinds.
11. Click the server under Group Members that has the steepest trend line from the servers previously analyzed in Excel.
12. Click the Min/Max Average CPU Load chart.
13. Click the Select a Time Period drop-down menu.
14. Click Last 3 months.
15. Click Submit.
16. Click the Min/Max Average Memory Usage chart.
17. Click the Select a Time Period dropdown box.
18. Click Last 3 months.
19. Click Submit. Note CPU and RAM utilization gauges and trend lines and where future trend line falls.

For this scenario, we customized the view in SolarWinds Group Details by adding the following resource:

- Multiple Series Charts → Multiple Object Chart (customized to show Group CPU)
- Multiple Series Charts → Multiple Object Chart (customized to show Group RAM)

USE CASE #4 – EVALUATE USAGE PATTERNS VIA A HEAT CHART GRAPHIC

Users on a particular server complain of slowdowns each business day between 11 AM and 3 PM. Evaluate an individual host's usage pattern for the past month. Visually pinpoint particularly busy hours or blocks of time in a heat chart pattern, and see if the patterns match the user complaints. Next, confirm if it is a RAM or CPU issue during these times.

CA Infrastructure Management 2.0

Start in Infrastructure Overview dashboard – 3 clicks, 14 seconds

1. Using the global search form, enter the server name, and click Search.
2. Click the server name in the results screen.
3. Click the System Health tab. Scroll to the Calendar Heat Chart of CPU and Memory.

SolarWinds

Start in Summary View – 23 clicks within SolarWinds, some external calculation required, 160 seconds

1. Using the Search Nodes search form, enter the server name, and click Search.
2. Click the server name in the results screen.
3. Click the Min/Max/Average CPU Load chart.
4. Click the Select a Time Period dropdown box.
5. Click Last 30 days.
6. Click the sample interval drop-down menu.
7. Select Every hour.
8. Click Submit.
9. Click the View options drop-down menu.
10. Click View chart data in Excel.
11. Open the file from the browser into Excel.
12. Run the pre-created macro in Excel using keyboard shortcut to parse the data into a heat chart visual pattern.
13. Return to the SolarWinds console.
14. Click the Min/Max Average Memory Usage chart.
15. Click the Select a Time Period drop-down menu.
16. Click Last 30 days.
17. Click the sample interval drop-down menu.
18. Select Every hour.
19. Click Submit.
20. Click the View options drop-down menu.
21. Click View chart data in Excel.
22. Open the file from the browser into Excel.
23. Run the pre-created macro in Excel using keyboard shortcut to parse the data into a heat chart visual pattern.
Inspect the two tables and determine if the CPU or RAM utilization is causing the issue

For this scenario, we customized the view in SolarWinds Node Details by adding the following resource:

- ***New*** Node Charts → Min/Max/Average of Average CPU

ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
1007 Slater Road, Suite 300
Durham, NC, 27703
www.principledtechnologies.com

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

Principled Technologies is a registered trademark of Principled Technologies, Inc.
All other product names are the trademarks of their respective owners.

Disclaimer of Warranties; Limitation of Liability:

PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND, UNLESS OTHERWISE AGREED TO IN WRITING, AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

UNLESS OTHERWISE AGREED TO IN WRITING, PRINCIPLED TECHNOLOGIES, INC. SHALL NOT BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. UNLESS OTHERWISE AGREED TO IN WRITING, PRINCIPLED TECHNOLOGIES, INC.'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, SHALL NOT EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.'S TESTING.
