

PERFORMANCE MONITORING MADE EASY WITH STORAGE RESOURCE MONITOR

By: James Honey

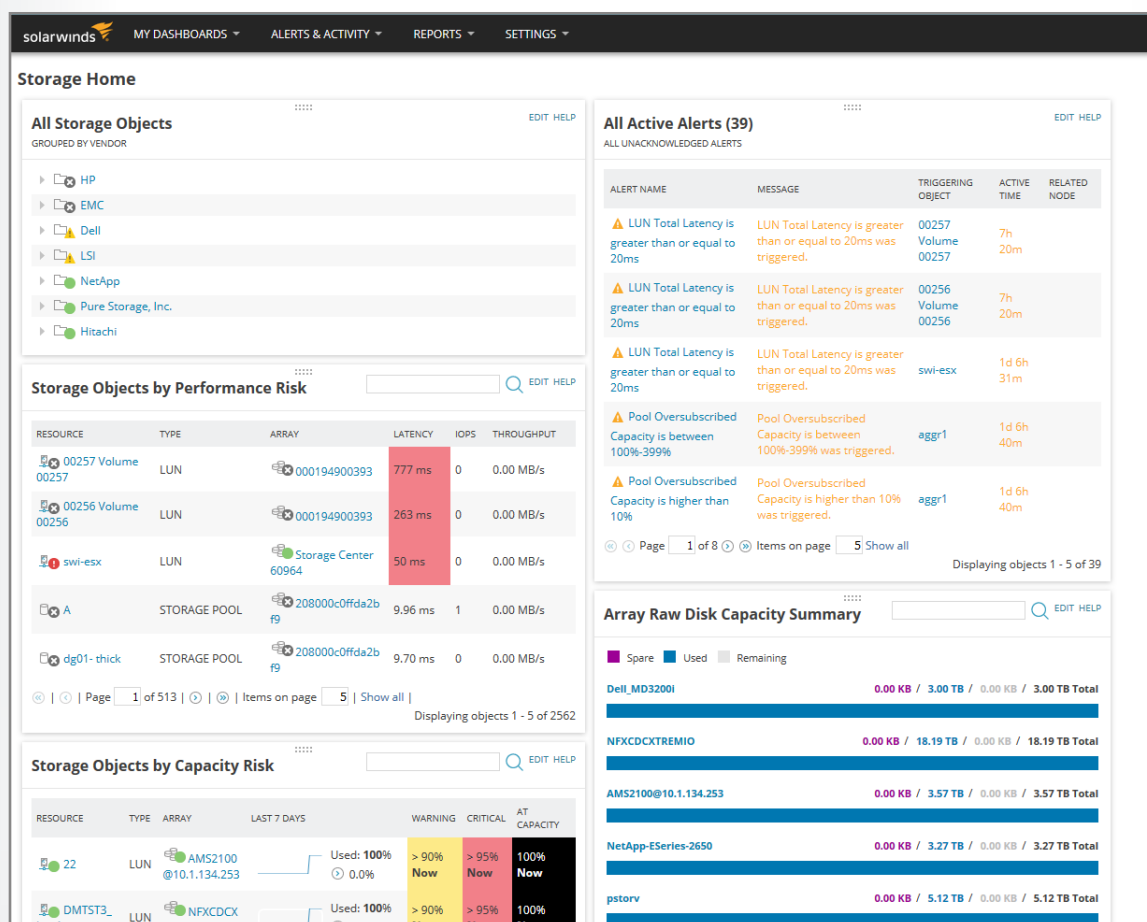


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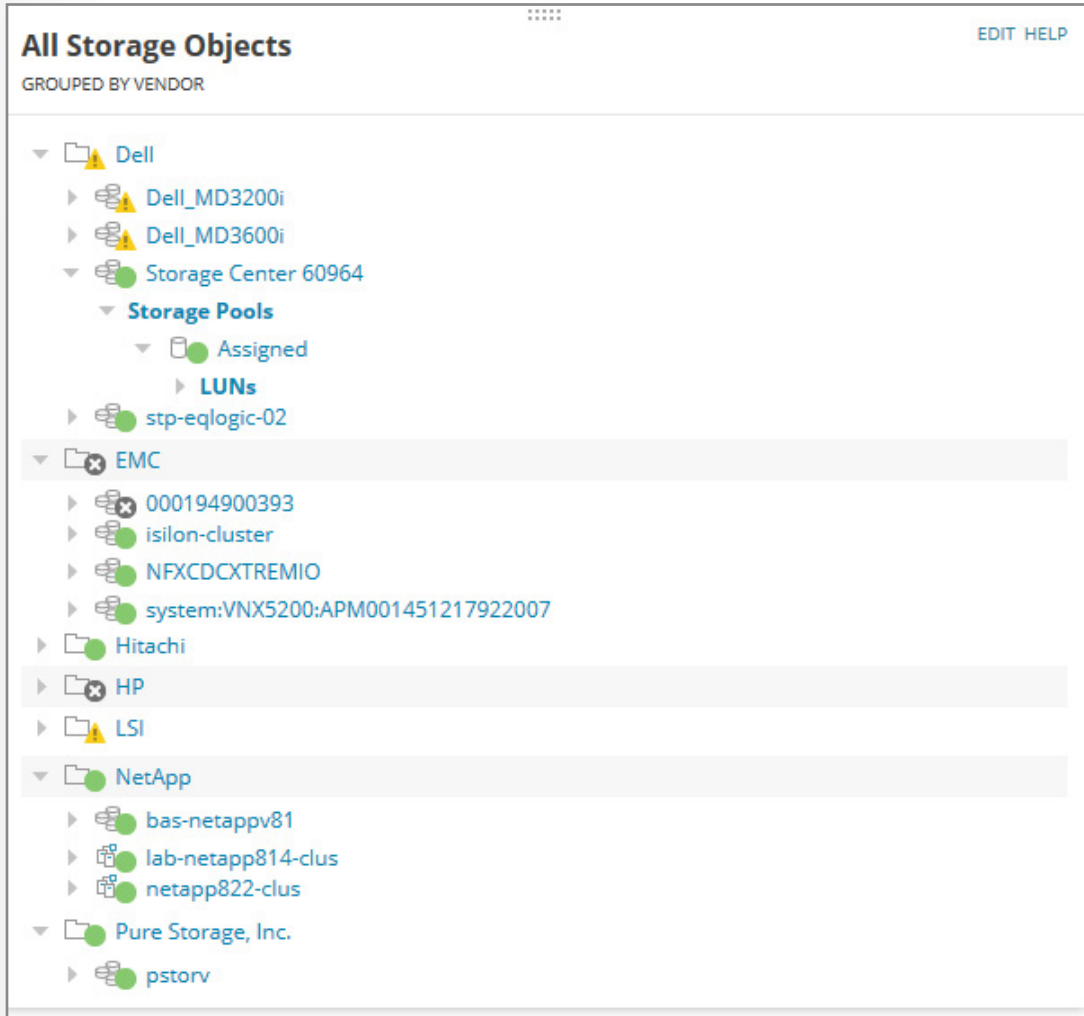
Managing storage is a constant dance of making sure resources are available for the applications that need them, and making sure resources are constantly in use, because having wasted resources in addition to no resources can be a problem. [SolarWinds® Storage Resource Monitor](#) helps make this dance a little less complicated. This paper will not only show the different parts of Storage Resource Monitor in relation to storage performance, but how each of these parts can give you the information you need to monitor your environment and maximize one of your largest IT investments.

To start, we will address some basic information regarding storage performance and how Storage Resource Monitor (SRM) presents the data. Based on [customer feedback](#), one of the best things about SRM is that users are able to quickly view and understand their storage performance problems. To start you will see what initial performance information SRM provides, and ways to interpret the data. Depending on your environment, there will always be different ways to interpret performance data, so your mileage will vary.

The image below is the SRM Summary dashboard. In one simple view you get a list of storage devices being monitored, alerts, events, and performance and capacity summaries.



The **All Storage Objects** widget will not only show you all the storage devices, but also point to devices that are having problems using easy-to-see green, yellow, and red notifications. To get to the exact cause, you can drill down into the array data until you get to the specific storage resource with the problem.



A faster way to recognize performance problems is with either **All Active Alerts** or **Storage Objects by Performance Risk**.

The **Storage Objects by Performance Risk** will give you a summary of performance problems sorted by latency. Like most things, high latency is not an ideal situation. However, the definition of “high” varies by environment and application. In addition to latency, IOPS and throughput are shown, and you can tailor the thresholds for the individual resources to be more specific to your requirements. Using this information allows you to troubleshoot your top performance problems by latency at the main screen immediately.

RESOURCE	TYPE	ARRAY	LATENCY	IOPS	THROUGHPUT
tex-esx-02_Lun13	LUN	CLARiiON	100 ms	8	0.10 MB/s
St.Petersburg ESX i 5.5 Cluster Lun12	LUN	CLARiiON	64 ms	9	0.27 MB/s
lab-dem-sql-lun0 1	LUN	CLARiiON	62 ms	92	14.75 MB/s
swi-esx	LUN	Compellent Storage Center	51 ms	0	0.00 MB/s
St.Petersburg ESXi 5.5 Cluster Lun0	LUN	CLARiiON	46 ms	4	0.11 MB/s

Page 3 of 536 | Items on page 5 | Show all |
 Displaying objects 11 - 15 of 2680

In addition to the performance information on the SRM Summary Dashboard, the Performance Dashboard lets you see additional performance data points. It includes the performance objects by risk and information for **LUNs by Performance** and **NAS Volumes by Performance**. Any of these sections will allow you to instantly dig into the specific storage resource that is experiencing performance problems.

Performance Dashboard

Storage Objects by Performance Risk

RESOURCE

TYPE

ARRAY

LATENCY

IOPS

THROUGHPUT

SYD-2K3-FCHBA E MC

SYD-2K3-FCHBA E MC

SYD-2K3-FCHBA E MC

SYD-2K3-FCHBA E MC

SYD-2K3-FCHBA E MC

LUN

LUN

LUN

LUN

LUN

CLARiiON+APM000 71600268

CLARiiON+APM000 71600268

CLARiiON+APM000 71600268

CLARiiON+APM000 71600268

CLARiiON+APM000 71600268

1076 ms

801 ms

667 ms

667 ms

534 ms

0

0

0

0

0

0.00 MB/s

0.00 MB/s

0.00 MB/s

0.00 MB/s

0.00 MB/s

1076 ms

801 ms

667 ms

667 ms

534 ms

Page 1 of 234

Items on page 5

Show all

Displaying objects 1 - 5 of 1168

All Storage Objects

GROUPED BY VENDOR

IBM

NetApp

EMC

Dell

All Active Alerts (44)

ALL UNACKNOWLEDGED ALERTS

ALERT NAME

MESSAGE

TRIGGERING OBJECT

ACTIVE TIME

RELATED NODE

DEMO LUNs Minimum IOPS

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

LUN Total Latency is greater than or equal to 20ms

DEMO LUNs Minimum IOPS was triggered.

LUN Total Latency is greater than or equal to 20ms was triggered.

LUN Total Latency is greater than or equal to 20ms was triggered.

LUN Total Latency is greater than or equal to 20ms was triggered.

LUN Total Latency is greater than or equal to 20ms was triggered.

CDC_ESX_FC_VMF502

LUN 13 - Ticket 110757

SYD-2K3-FCHBA EMC

SYD-2K3-FCHBA EMC

SYD-2K3-FCHBA+EMC

1m

4d 13h 32m

5d 1h 47m

5d 1h 47m

5d 1h 47m

Page 1 of 9

Items on page 5

Show all

Displaying objects 1 - 5 of 44

Event Summary

TODAY

82 LUN Critical

25 LUN Warning

LUNs by Performance

LUN

STORAGE POOL

IOPS (TOTAL)

LATENCY (TOTAL)

THROUGHPUT (TOTAL)

CDC_IS CSI_TEST_VMF501

CDC_IS CSI_DEV_VMF502

CDC_IS CSI_VMF506

CDC_IS CSI_VMF503

CDC_ESX_FC_VMF501

Virtual P ool

Virtual P ool

Virtual P ool

Virtual P ool

Virtual P ool

1855

860

650

598

458

0.62 ms

0.76 ms

0.45 ms

0.46 ms

0.58 ms

10.80 MB

31.13 MB

20.64 MB

15.16 MB

17.10 MB

Page 1 of 215

Items on page 5

Show all

Displaying objects 1 - 5 of 1071

NAS Volumes by Performance

VOLUME

STORAGE POOL

IOPS (TOTAL)

LATENCY (TOTAL)

THROUGHPUT (TOTAL)

/ifs

vol0

vol0

Virtual Pool

agg0

agg0n2

821

52

50

Unknown

0.02 ms

0.06 ms

434.62 KB

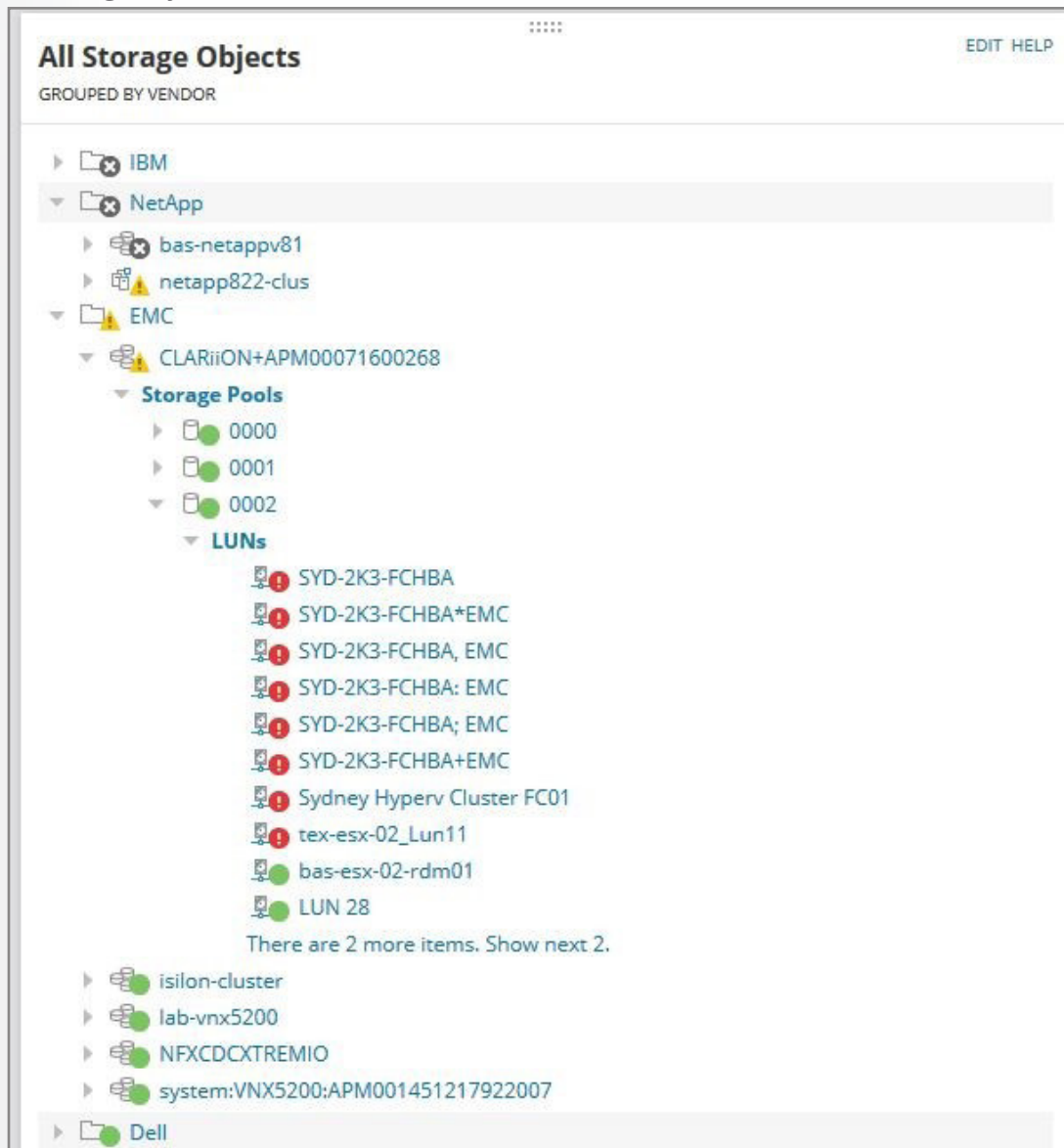
41.46 KB

24.51 KB

This data allows you to instantly address performance problems. To see overall performance at the array and/or storage pool level, SRM gives you access to that data in just one or two clicks. For array-specific performance information, select an array in the **All Storage Objects**. The **Array Details** screen will show detailed information for that array. Clicking once more in the **All Storage Objects** section will show the storage pools and allow you to select the **Storage Pool Details** screen for each pool. Going even lower will show all the LUNs assigned to each pool.

Selecting a LUN will bring up the **LUN Details** screen. Each of these screens will present specific performance information as it relates to that storage resource.

All Storage Objects

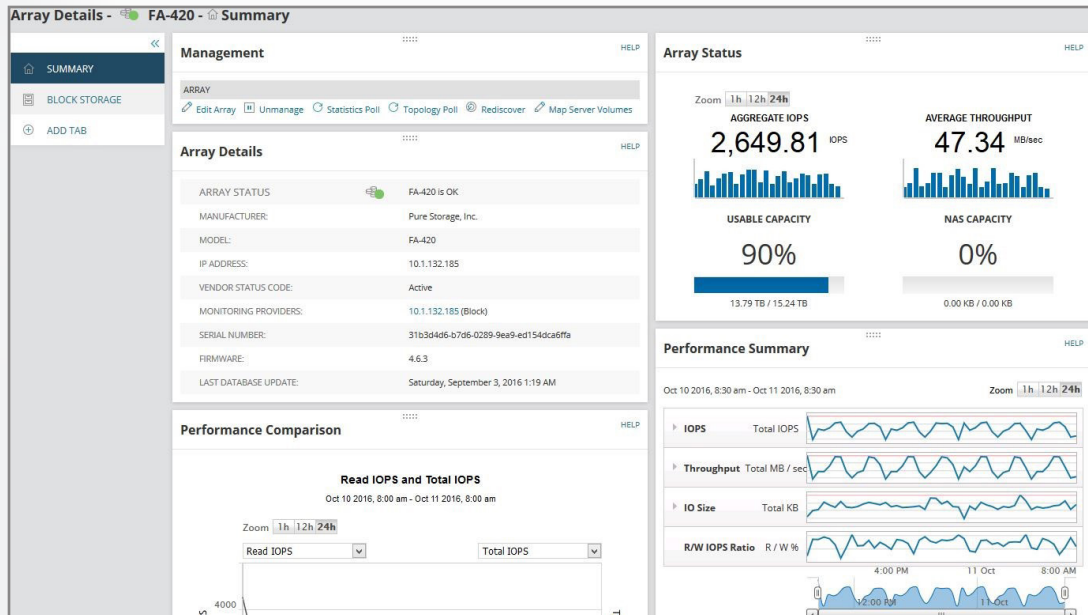


All Storage Objects EDIT HELP

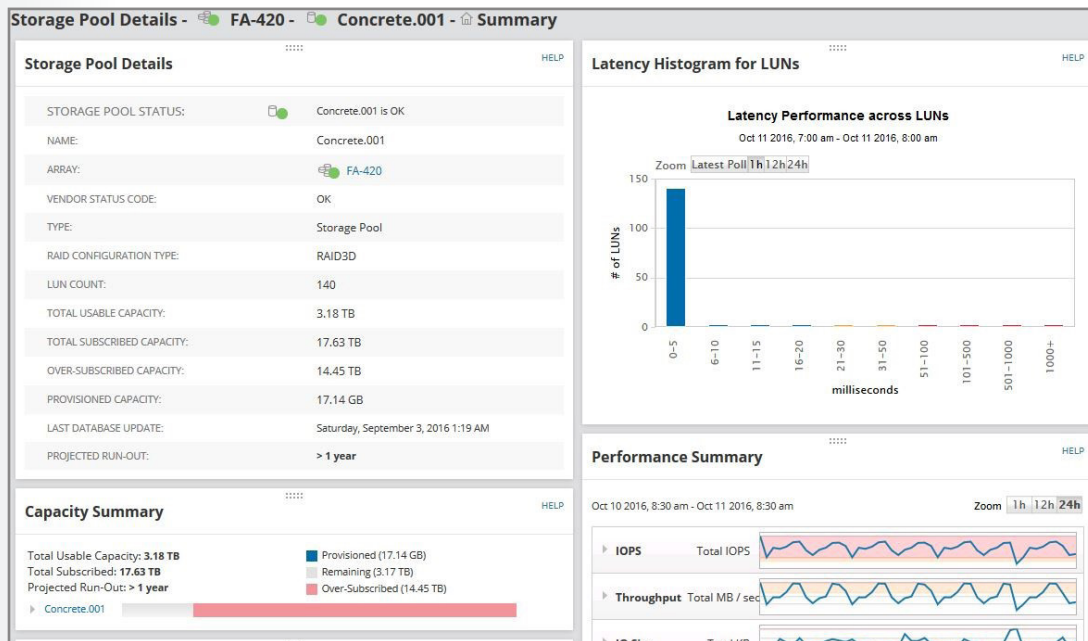
GROUPED BY VENDOR

- IBM
- NetApp
 - bas-netappv81
 - netapp822-clus
- EMC
 - CLARiiON+APM00071600268
 - Storage Pools**
 - 0000
 - 0001
 - 0002
 - LUNs**
 - SYD-2K3-FCHBA
 - SYD-2K3-FCHBA*EMC
 - SYD-2K3-FCHBA, EMC
 - SYD-2K3-FCHBA: EMC
 - SYD-2K3-FCHBA; EMC
 - SYD-2K3-FCHBA+EMC
 - Sydney Hyperv Cluster FC01
 - tex-esx-02_Lun11
 - bas-esx-02-rdm01
 - LUN 28
- There are 2 more items. Show next 2.
- isilon-cluster
- lab-vnx5200
- NFXCDCXTREMIO
- system:VNX5200:APM001451217922007
- Dell

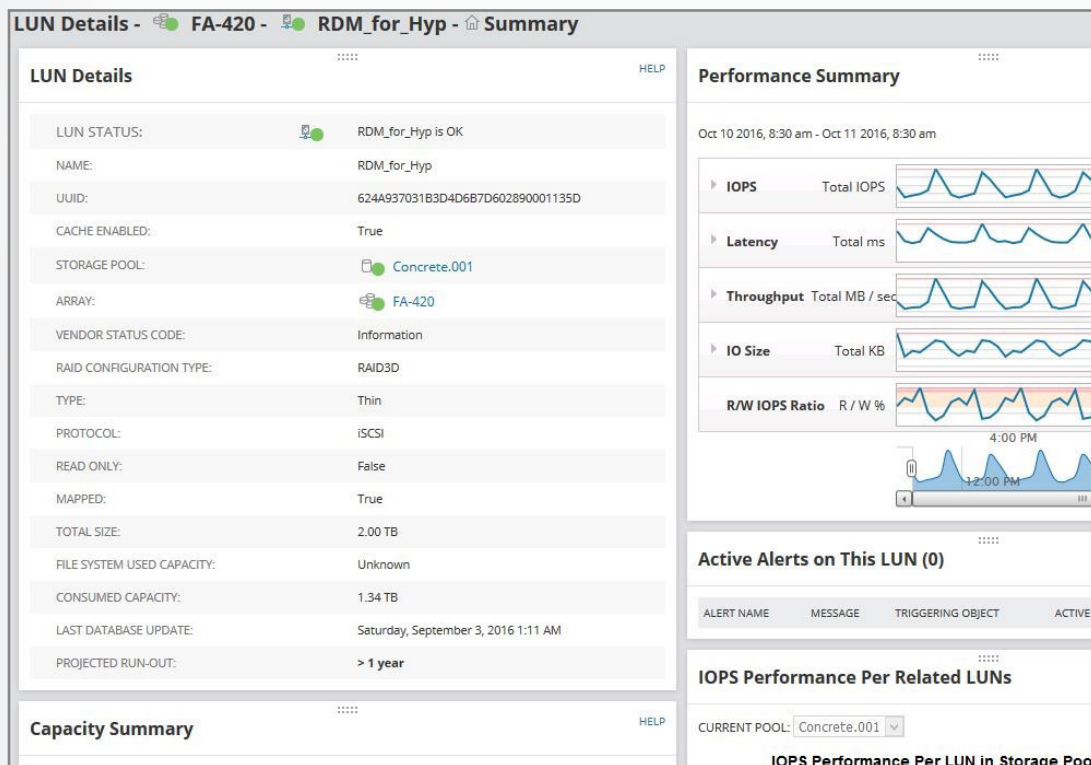
Array Details



Storage Pool Details



LUN Details



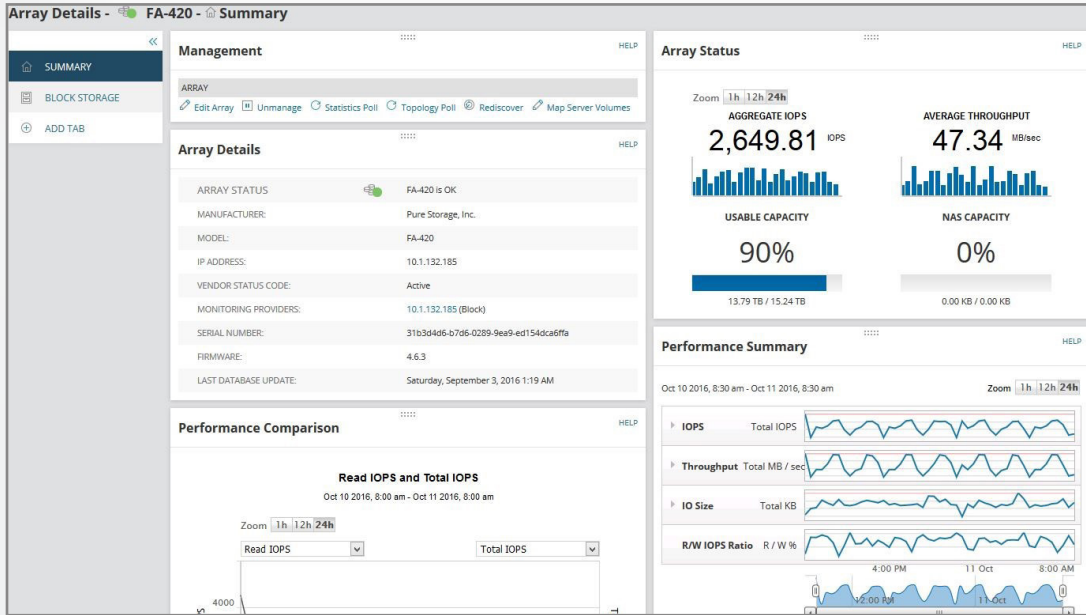
Now, what do these high-level performance views do for the end-user? Right from the start, you can instantly discover, identify, and start troubleshooting performance problems. The goal is that the critical problems are up front, and the need to check each storage device one by one for problems is eliminated. In addition, having the ability to customize the dashboards and information is critical to tailoring the monitoring to your needs.

DRILLING INTO THE DETAILS

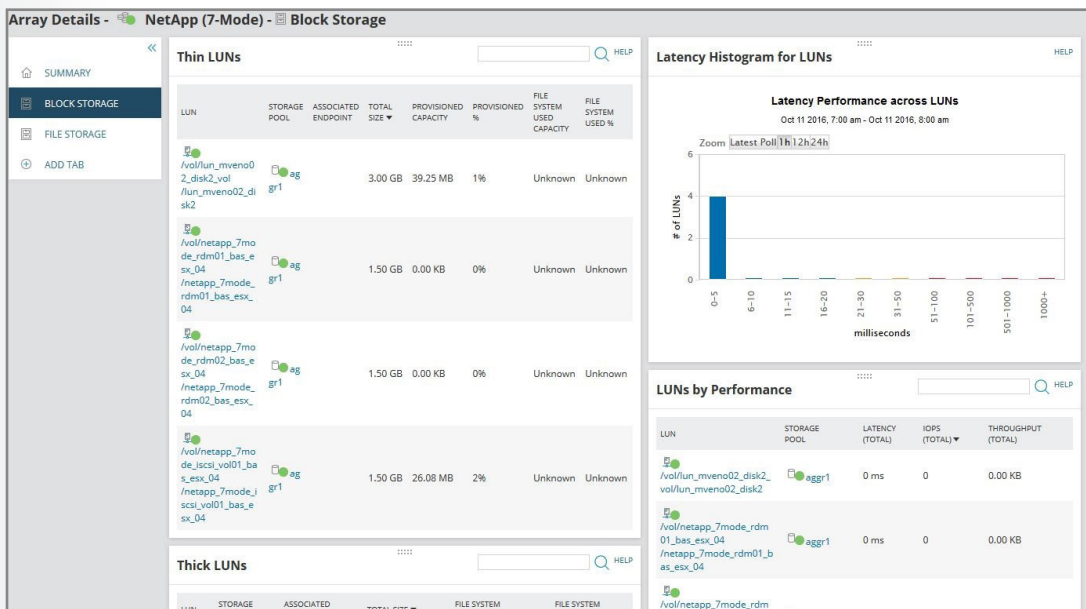
Having a high-level view of storage performance is good for a quick overview, or understanding how things are operating. To take your monitoring to the next level, having access to details is critical. Now that we have reviewed the top level storage dashboards and performance data points that SolarWinds Storage Resource Monitor provides. This section will cover performance monitoring at the array, storage pool, and LUN/Volume level.

The **Array Details** screen is usually the first stop when looking at your storage performance. This is a great starting point for when you want to get a look at the overall performance for a storage array. Having this information is ideal when you want to compare the expected performance of an array versus how the array is actually performing. In addition, you can get an understanding of read/write performance ratios in relation to the overall performance.





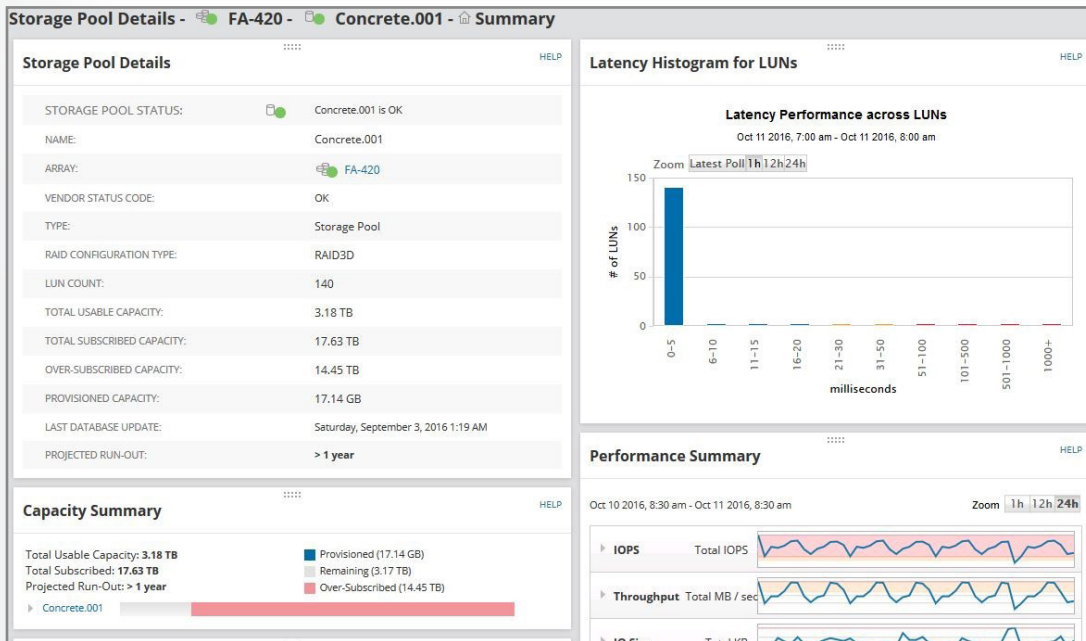
The **Block Storage** and **File Storage** tabs allow you to quickly get into the underlying performance information for the device's storage pools and LUNS/Volumes. Each of these tabs will show you latency summaries and performance summaries for the individual resources. At a glance, this will let you see if you have any latency issues at the LUN/Volume level, and what your highest performing LUN/volumes are by IOPS, throughput, or latency.



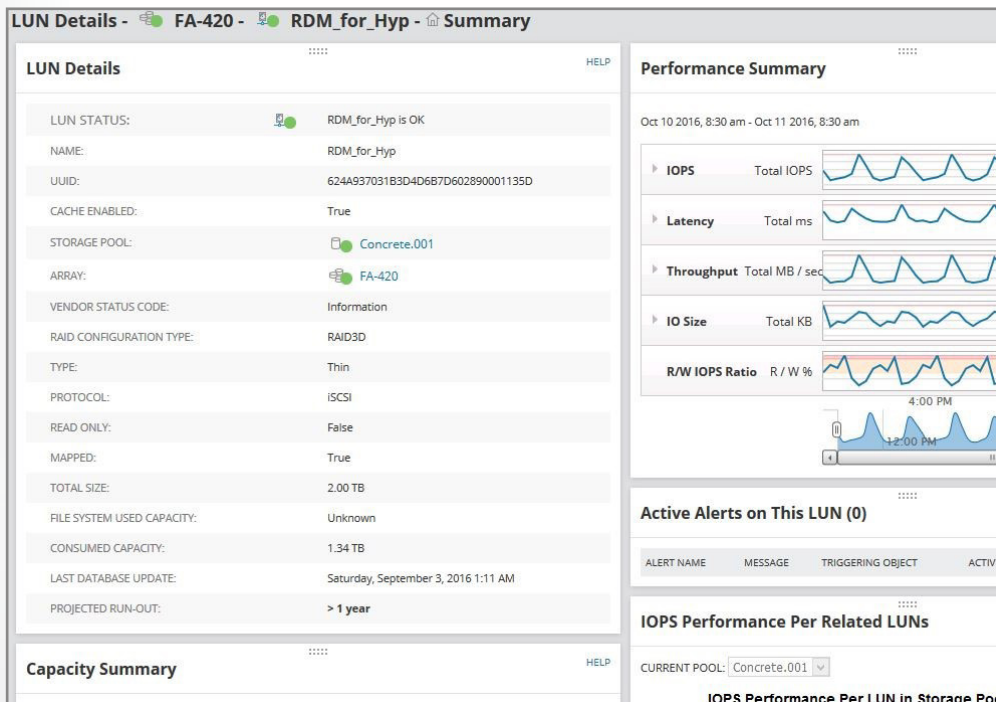
Storage Pool Details provide storage administrators the ability to understand performance at a pool/RAID level. Depending on how storage resources are assigned to applications, this can provide the ability to understand performance for similar applications. For example, a VM farm can be created for different instances of the same application. Having the applications tied to the same pool of storage with different LUNs is ideal as you have the same pattern of



read/write ratio without running into instances where different read/write ratios are involved. This can cause application performance problems if the disk is having to store random data in one instance and sequential the next.



The **LUN and Volume Details** screen is where you can see performance at the lowest level. This is where you can tie application performance directly to the assigned storage, and where the power of SRM really comes into play. Not only can you see the individual LUN performance, you can also see it in relation to other LUNs in the same storage pool. Did a LUN in the same pool spike performance? Are all the LUNs in the same pool experiencing high latency? These are the kinds of questions the LUN Details screen can help answer.



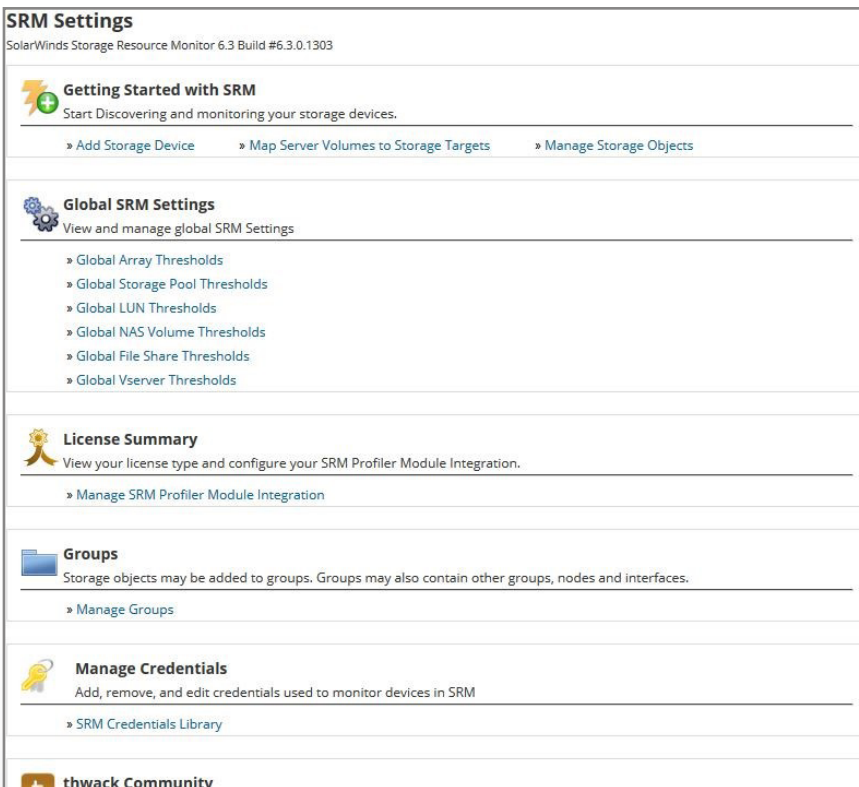
As you can see, the more in-depth you go with Storage Resource Monitor, the more information and comparisons become available. All of the information presented is critical to understanding your storage performance and how it affects your overall environment. In the next section we will cover thresholds and alerting and how with the right settings and planning you can make Storage Resource Monitor not just an important monitoring tool, but a critical one.

THRESHOLDS AND ALERTING: WHERE THE MAGIC HAPPENS

Above we talked about how SRM presents high level performance information and then we dove into the details around storage performance from the array, pool, and LUN/Volume detail. Now let's look at using thresholds and alerting to maximize your storage monitoring. This is where you can make Storage Resource Monitor adapt to your environment, while also showing what performance information matters to you.

Thresholds

Setting thresholds is a key step in making sure your data center runs efficiently. When you start Storage Resource Monitor the first time, there are pre-set thresholds based on general best practices. This will work in most situations, however there are solutions that require something more specific. There are applications in your environment that require low latency, and if any of them deviate from that, it would cause major headaches. There are other applications that require a specific amount of IOPS, and any dip will slow the business down and lead to your inbox being filled with not-so-nice requests for information. Having your thresholds set properly can help you avoid so-called fire drills. The SRM Settings section is where you can set global thresholds for key storage resources.



Thresholds can be set for IOPS, throughput, I/O size, capacity, and latency (LUN and volume specific). In addition, some of these can be set by read, write, or total, so you can even customize for applications that are heavy on read or heavy on write performance.

SRM Array Thresholds			
Configure Array thresholds for all Orion modules			
IOPS (TOTAL)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	Arrays with Total IOPS above the currently set val
Warning Level	900000	1 IOPS to 562949953421312 IOPS	Arrays with Total IOPS above the currently set val
IOPS (READ)			
Critical Level	1000000	Configure Storage Pool thresholds for all Orion modules	
Warning Level	900000		
IOPS (WRITE)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	Storage Pools with Total IOPS
Warning Level	900000	1 IOPS to 562949953421312 IOPS	Storage Pools with Total IOPS
IOPS (OTHER)			
Critical Level	1000000		
Warning Level	900000		
THROUGHPUT (TOTAL)			
Critical Level	1024		
Warning Level	1000		
THROUGHPUT (READ)			
Critical Level	1024		
Warning Level	1000		
THROUGHPUT (WRITE)			
Critical Level	1024		
Warning Level	1000		
SRM Storage Pool Thresholds			
Configure Storage Pool thresholds for all Orion modules			
IOPS (TOTAL)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	Storage Pools with Total IOPS
Warning Level	900000	1 IOPS to 562949953421312 IOPS	Storage Pools with Total IOPS
IOPS (READ)			
Critical Level	1000000		
Warning Level	900000		
IOPS (WRITE)			
Critical Level	1000000		
Warning Level	900000		
IOPS (OTHER)			
Critical Level	1000000		
Warning Level	900000		
THROUGHPUT (TOTAL)			
Critical Level	1024		
Warning Level	1000		
THROUGHPUT (READ)			
Critical Level	1024		
Warning Level	1000		
THROUGHPUT (WRITE)			
Critical Level	1024		
Warning Level	1000		
SRM LUN Thresholds			
Configure LUN thresholds for all Orion modules			
IOPS (TOTAL)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	LUNs with Total IOPS above the currently set val
Warning Level	900000	1 IOPS to 562949953421312 IOPS	LUNs with Total IOPS above the currently set val
IOPS (READ)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	LUNs with Read IOPS above the currently set val
Warning Level	900000	1 IOPS to 562949953421312 IOPS	LUNs with Read IOPS above the currently set val
IOPS (WRITE)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	LUNs with Write IOPS above the currently set val
Warning Level	900000	1 IOPS to 562949953421312 IOPS	LUNs with Write IOPS above the currently set val
IOPS (OTHER)			
Critical Level	1000000	1 IOPS to 562949953421312 IOPS	LUNs with Other IOPS above the currently set val
Warning Level	900000	1 IOPS to 562949953421312 IOPS	LUNs with Other IOPS above the currently set val
THROUGHPUT (TOTAL)			
Critical Level	1024		
Warning Level	1000		
THROUGHPUT (READ)			
Critical Level	1024		
Warning Level	1000		
THROUGHPUT (WRITE)			
Critical Level	1024		
Warning Level	1000		
LATENCY (TOTAL)			
Critical Level	20	1 ms to 10000 ms	LUNs with Total Latency above the currently set val
Warning Level	10	1 ms to 10000 ms	LUNs with Total Latency above the currently set val
LATENCY (READ)			
Critical Level	20	1 ms to 10000 ms	LUNs with Read Latency above the currently set val
Warning Level	10	1 ms to 10000 ms	LUNs with Read Latency above the currently set val
LATENCY (WRITE)			
Critical Level	20	1 ms to 10000 ms	LUNs with Write Latency above the currently set val
Warning Level	10	1 ms to 10000 ms	LUNs with Write Latency above the currently set val

Using global settings allows you to tailor monitoring for your data center, but, as you know, there are also applications that differ from the others that need special attention. If that's the case, Storage Resource Monitor has you covered. Under each details screen (array, pool, and LUN/Volume), you can adjust the thresholds for that specific resource. Pool 1 needs to maintain 500 IOPS and I need to know when it goes below it. You can set the threshold to warning when IOPS are less than or equal to 600, and critical when IOPS are less than or equal to 550. LUN 2 has to maintain latency of 50ms. You can set the threshold to warning when it hits 40ms, and critical when it hits 50ms. The thresholds you set for the individual resources will translate to the summary screens we talked about before, so you can see at-a-glance if the required performance needs are being met.



Storage Pool Details - lab-vnx5200 - 0001 - Summary

Storage Pool Details MANAGE EDIT HELP

STORAGE POOL STATUS: 0001 is OK

NAME: 0001

ARRAY: lab-vnx5200

VENDOR STATUS CODE: OK

TYPE: **Edit Properties**

RAID CONFIGURATION TYPE: R

LUN COUNT: 2

TOTAL USABLE CAPACITY: 2

TOTAL SUBSCRIBED CAPACITY: 2

OVER-SUBSCRIBED CAPACITY: 0

PROVISIONED CAPACITY:

LAST DATABASE UPDATE: F

PROJECTED RUN-OUT: >

Edit Properties

Edit properties for the following selected objects

- 0001

Name: 0001

Alerting Thresholds

IOPS(Total) ☒ Override Orion General Thresholds

Warning: Less than or Equal to 600 IOPS = 600 IO/s

Critical: Less than or Equal to 500 IOPS = 500 IO/s

IOPS(Read) ☐ Override Orion General Thresholds

[USE DYNAMIC BASELINE THRESHOLDS](#)

[Latest Baseline Details](#)

Thresholds calculated using baseline data allow for more accurate alerting. [Learn more](#)

LUN Details MANAGE EDIT HELP

LUN STATUS: File_lab-vmx5200_16_d7 is OK

NAME: File_lab-vmx5200_16_d7

UUID: 60060160937A3B00A060EE74BBEE411

CACHE ENABLED: True

STORAGE POOL: 0001

ARRAY: lab-vnx5200

VENDOR STATUS CODE: OK

RAID CONFIGURATION TYPE: RAID-10

TYPE: Thick

READ ONLY: False

MAPPED:

TOTAL SIZE: **Latency(Total)** ☒ Override Orion General Thresholds

Warning: Greater than 10 ms = 10 ms

Critical: Greater than 20 ms = 20 ms

[USE DYNAMIC BASELINE THRESHOLDS](#)

[Latest Baseline Details](#)

Thresholds calculated using baseline data allow for more accurate alerting. [Learn more](#)

Alerting

So now you're thinking, "Thresholds are great, but if something happens when the custom thresholds are reached, I need to be alerted." In addition to custom thresholds, setting custom alerts will make sure you know when something goes wrong quickly. Like before, the standard alerts in SRM will get you going, however custom alerts help make sure you understand if all of your resources are performing as required. Creating custom alerts can be done for groups of resources with the same performance profile or for specific resources that have a very unique requirement.



Active Alert Details - ⚠ DEMO LUNs Minimum IOPS - on 🖨 CDC_ESX_FC_VMFS02

Management

MANAGE ALERTS EDIT HELP

[Acknowledge Alert](#)
[Edit Alert Definition](#)
[Turn Off this alert definition](#)

Alert Status Overview

EDIT HELP

CURRENT STATUS	ACTIVE TIME	SEVERITY
Triggered	21m	Serious

MESSAGE
DEMO LUNs Minimum IOPS was triggered.

MORE DETAILS

Trigger time: **10/11/2016 8:48 AM**

Triggered by: 🖨 **CDC_ESX_FC_VMFS02**

Alert Definition: **DEMO LUNs Minimum IOPS**

Escalation: No Actions Defined

Acknowledged by: Not yet...

[ACKNOWLEDGE](#)

Alert Definition Details

EDIT ALERT DEFINITION EDIT HELP

History of this alert on this object

LAST 7 DAYS

This alert on this object was already triggered

EVENT
⚠ Alert Triggered DEMO LUNs Minimum IOPS
Alert Reset
⚠ Alert Triggered DEMO LUNs Minimum IOPS
Alert Reset
⚠ Alert Triggered DEMO LUNs Minimum IOPS

⏪ ⏩ Page 1 of 22 ⏪ ⏩ Items on page

Other Objects currently experiencing this alert

OBJECT NAME	ALERT
🖨 CDC_ESX_FC_VMFS03	Show
🖨 CDC_ESX_FC_VMFS04	Show

Top 10 Objects by trigger count

OBJECT NAME	WAS TRIGGERED
🖨 CDC_ESX_FC_VMFS02	215

You can set a single alert for a specific storage resource, or set an alert for multiple resources that share a common performance profile. There is the ability to customize everything from a specific team to handle the alert, to setting that the condition has to exist for a period of time. You can even set the alert to be enabled only during a certain time of day. Setting a custom alert for a specific time helps avoid the unwanted alerting noise during expected downtime and/or planned degraded performance.



Alert Definition Details EDIT ALERT DEFINITION EDIT HELP

Name:
DEMO LUNs Minimum IOPS

Description:
No description specified

Type of Property to monitor
LUN

Severity:
Serious

Evaluation Frequency of alert:
Every 30 seconds

Alert Custom Properties: (1)
ResponsibleTeam: Not specified

Scope of this Alert:
LUNs Custom Properties - FC_DEMO_LUNs - is equal to - DEMO_Luns

Trigger Condition:
At least one child condition must be satisfied (OR)
IOPS (Total) Threshold - Warning Value Reached - is equal to - 1
IOPS (Total) Threshold - Critical Value Reached - is equal to - 1

Reset Condition:
When the trigger condition is no longer true

Time of Day schedule:
Alert is always enabled

Trigger Action:
No trigger action specified

Reset Action:
No reset action specified

By using thresholds and custom alerts, Storage Resource Monitor has you covered when monitoring storage performance for all your applications. Along with dashboards and storage resource details, you can easily stay ahead of your storage performance needs and track when more resources are needed.



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