Performance Analyzer for the VMAX3 Family
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Introduction
Business Challenge

About

BIG Telco Company is a major Telco company in the United States with strong presences throughout the World. They also have significant development shops in India and Bolivia. They are greatly diversified across communications infrastructure as well as the newer Wireless Infrastructure around the United States and Canada. BIG Telco also has begun establishing themselves in Hosting Facilities and has recently invested millions into a state of the art datacenter located in the Middle East.

One of BIG Telco's key strategies is to keep internal costs low as possible while providing its customers with the performance they need. Each customer can require large amounts of data that may be kept for several years.
Solution

VMAX 400K with FAST Advanced Suite

BIG Telco's IT team have selected VMAX 400K with the Advanced FAST Suite as their storage solution for customer's critical applications.

This solution provides the following:

- **Performance and Cost**: Using Service Level Objectives, BIG Telco's storage team are able to provision storage on VMAX 400K and provide an accurate Service Level Objective quantified by response time that sets the end users expectation the VMAX 400K uses FAST internally to meet the workload demands of the application and tune the underlying storage to meet the response time objectives set by the storage team.
- **Management**: Unisphere for VMAX with Performance Analyzer allows the team to monitor the customer critical applications to ensure they meet performance requirements.
Key Components
Unisphere for VMAX with Performance Analyzer

Unisphere for VMAX with Performance Analyzer. Allows you to manage and monitor your VMAX arrays from an intuitive web interface. The Performance Analyzer component of Unisphere for VMAX performance statistics from your VMAX arrays.

The Unisphere for VMAX interface consists primarily of three main components Monitor, Analyze and Charts.

The monitor view provides a high-level view of your storage environment, and will help the storage admin get an at-a-glance overview of their Arrays. The monitor view will also help guide the storage admin intuitively identify and diagnose any performance problems, enabling them to quickly switch to deeper level analysis views of the data they are interested in. The user can use the built in dashboards or construct their own custom performance dashboards to get the information they need quickly and schedule reports so that they have the information at their finger tips.

The Analyze view is a navigation engine, which allows drill down analysis on the deeper levels towards deeper analysis providing low-level view of the various storage objects (groups, volumes, etc.). The storage administrator can use these views to see Real Time analysis to see what is happening in the array right now across all major array components, or they can dive into root cause analysis to see what individual storage groups and volumes are driving activity on the array. There is also a Trending and Planning section which can be used to predict patterns in performance growth and help with planning for future storage and performance needs.

The Charts View enables the storage administrator to delve deep into any of the Key Performance Indicators that they are interested in and create charts for deep analysis.
Lab Overview
Lab Environment

Before we begin with the Performance Analyzer for the VMAX Family labs, here is a summary of the key components found in the lab environment.

The environment for this lab includes the following:

- 1 Windows 2008 R2 Server serving as the user's desktop
- 1 Windows 7 VM with Unisphere for VMAX with Performance Analyzer installed
Lab Scenario

Thomas is a Storage Administrator for BIG Telco. One of Thomas' tasks is to review his customer's application storage use and performance.

Thomas has recently overseen the install of the VMAX 400K platform in one of BIG Telco's Data Centers. As the Storage Administrator, Thomas has been tasked with evaluating the performance of a customer's DSS application which has recently been migrated to the new Storage Platform.

High level tasks:

1. Login to Performance Viewer
2. Explore the performance analyzer
3. Review Historical Performance Data
4. Get a holistic overview of Arrays Performance and create user Dashboards
5. A deeper dive into performance analyzer
6. Review Heatmaps
7. View Diagnostic Data

The following Labs will guide Thomas through each step.
Labs

Thomas has put together the following test plan to evaluate the performance of BIG Telco's new VMAX 400K.

This lab includes the following labs:

**Lab 1**: Introduction to Performance Viewer
- Logging into Performance Viewer
- Exploring the Performance Analyzer

**Lab 2**: A Historical Perspective
- Array Level Performance and User Dashboards

**Lab 3**: A Deeper Dive
- Storage Group Performance
- Monitoring Drive activity and Tiers
- Exploring the Charts View

**Lab 4**: The Big Picture
- Heatmap
Lab 1: Introduction to Performance Viewer
Logging into Performance Viewer

The Following steps will guide you through logging into the Unisphere for VMAX Performance Viewer.

Launch the Unisphere for VMAX viewer

Click on the Unisphere for VMAX icon on the desktop
If you receive a certificate warning click on Continue to this website (not recommended)
Enter User Name and Password

1. Enter User smc (lowercase)
2. Enter Password smc (lowercase)
3. Click Login button
Select Array 197200067

Click on Performance to Enter the Performance View for Array 197200067

Once logged into the Performance Viewer, we are initially brought into the Monitor View of Performance Analyzer. From here we get a high level view of the key array components and their utilization.

Next we will restrict the Performance data to a specific time range where we know the DSS application was under normal load conditions to investigate it's performance.
Review the Heatmap

Click on Heatmap to Enter the Heatmap View for Array 197200067

Review the Major array components

1. Front End (FA) Port Utilization
2. Back End (DA) Port Utilization
3. Drive Utilization across tiers.

At this point you should be able to tell if any key array component is being over utilized during the observed period. Anything over 50% might be something you want to investigate further.
Exploring the Performance Analyzer

This section aims to familiarize you with the different components of Unisphere Performance Analyzer. At the end of this lab you should feel comfortable with navigating through the Unisphere for VMAX GUI for high level array performance information.

The Monitor Tab

The monitor tab has a number of inbuilt dashboards to help the Storage Administrator gather useful performance data from their arrays.

1. The Monitor Tab
2. User can Switch between Utilization, Heatmaps, Workload, Storage Groups, and Alerts.
3. The Category dropdown lets the user refine the type of dashboard they are interested in viewing.
4. At any time the user can navigate to the analyze view where they can build deeper level custom charts on Key Performance Indicators (KPI) that they are interested in.
Storage Groups Dashboard

The storage group dashboard is a good place to start and see which Storage Groups/Applications are doing the most work on the system.

1. Clicking on the Host IO/sec column will sort storage groups by busiest to least busy.
2. Note the Green Check Mark, this tells the user that there are no issues with these components in relation to their storage groups.
The Workload Dashboard

The workload dashboard gives a good at a glance of how much workload is going on in the entire array. We are shown

1. How many host and back end IO's the system is processing over the observed time frame
2. The throughput of the system in Host MB/sec
3. How much cache is in use
4. Optionally the thresholds for the Cache can be displayed to see if the system is hitting any limits
5. How many requests are being served by front end and backend. (This is different to IO/s as it includes internal requests such as fast movement)

Heatmap and Alerts.

Heatmap is discussed in a later lab so we will not look at it right now. The Alerts tab will show you if any performance thresholds have been breached or if there is any problems with the system.
Lab 2 - A Historical Perspective
Lab 2 Lab Overview

In this lab you will help Thomas analyze historical data from the time the VMAX was installed at BIG Telco to help verify that their key production application DSS is running as expected on the new array. The application DSS workload changed around 11:00 AM on Feb. 24th, 2014, so your analysis will start with the metrics collected from that day.

Historical Analysis Time Range

For the historical analysis portion of the lab you will use the 3-hour period below:

October 29 2014 5pm to October 29th 2014 9pm

Set the time range by clicking the calendar icon in the top right corner.
Restrict the time Range to 3 hour window Start October 29 5pm to October 29th 9pm

<table>
<thead>
<tr>
<th>Available Data</th>
<th>Symmetrix ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wed Oct 29 2014 07:04:00 AM - Thu Oct 30 2014 07:04:00 AM</td>
<td>000197200067</td>
</tr>
<tr>
<td>Tue Oct 28 2014 12:00:00 PM - Thu Oct 30 2014 05:00:00 AM</td>
<td>000197200067</td>
</tr>
</tbody>
</table>
Array Level Perspective & User Dashboards

In this section, you will assist Thomas with evaluating the array's overall performance at the end of the lab. We will look at how to create a custom dashboard for quick and easy access to the metrics that may be of interest on a day to day basis.

Verify the Time Range

1. Click on the Analyze Tab to begin looking at historical data for Root Cause Analysis.
2. To verify the time range is set correctly for the analysis, examine the active time range on the right-hand side of the window. If it does not match the picture, refer to the previous section.

Examine the Array Level Metrics

The table section of the Historical view includes a number of key metrics averaged over the selected time range.

*Note values may differ from screenshots below.
**Getting Help**

To view the definitions for the historical metrics:

1. Click the **Help** icon.
2. If you receive a certificate warning, click the **Continue to this website** link.

---

**Search Help**

1. Click the **Search** button at the bottom left hand side of the screen.

---

**Enter Search Criteria**

To locate the definitions for historical metrics:

1. Enter **Historical Metrics** in the search box and click the **Search** button.

---

**Search Results**

To view the definitions for the historical metrics:
1. Click the first title in the search results.

*Note Title may differ from what is show on screenshot below.

Close Help

When you are finished looking at the Historical Metric Definitions:

1. Close the Help browser.
Graph Host I0s/sec

1. Select the **Charts** tab in the top left of the window
2. Ensure the Array is highlighted as shown
3. In the KPI Metric search window type the first few letters of the Metric you are interested in, e.g. Host as shown
4. Select the metric you which to chart
5. Click on the Chart Icon to draw the chart.

**Note:** We should be in Charts View and the Symmetrix ID **000197200067** should already be selected in the table. Experiment with this feature to graph multiple metrics. The search facility makes it easy to find the metrics you are interested in. Before selecting array - you need to pick a custom time select from Oct 2014. For this Purpose lab it is recommended choosing Oct 29 1pm - 5pm as shown
Data Points

To view the hourly individual data points:

1. Run the mouse over the line in the graph.
Change the Chart Style

To change the chart style to a bar format:

1. Click the **Change chart properties** icon,
2. Select **Chart Style** and **Bar** from the pop-out menus.

This allows you to see each data point as an individual bar.
Graph Cache Write Pending

To graph the % Cache WP metric:

1. Search for the % Cache WP metric in the KPI search tab,
2. Click the Graph icon to draw the chart as before.
Add Thresholds to the % Cache WP Chart

1. Select the Chart Options Dropdown from the Top Right of the % Cache WP Chart
2. Select Display Thresholds
Explore the Save Options

Unisphere for VMAX will allow you to save the charts you have created for export. It also allows you to save them as Dashboards for easy access to frequently used metrics.

Explore the various options.
Save a Dashboard

Select the Save dashboard and give it a name

Clear the Canvas

To close all of the open charts, click on the **Remove all charts** icon.
Locate and Access your Dashboard

1. Select Monitor Tab
2. Select User Dashboards
3. Select your Dashboard and it will be shown in the right hand column.

**NOTE:** In the full version of Unisphere for VMAX custom dashboards can be scheduled to run on a schedule dictated by the administrator and automatically sent via SNMP to designated email addresses.

**Lab Summary**

This Lab has explored graphing the KPI metrics from the Analyze view of Performance Analyzer at the array level, we looked at creating and graphing multiple Key Performance indicators (KPI) and saving to a dashboard for easy access.
Lab 3 - A Deeper Dive
Storage Group performance

In this section you will be assisting Thomas with evaluating a Storage Group DSS which contains a customers Data warehouse application.

Time Range

1. Verify we are still in Historical View
2. Examine the active time range on the right hand side of the window. If it does not match the picture, then refer to Set the Time Range at the beginning of this lab.
Exploring the Storage Groups from the Summary Tab

1. Click on the Summary Tab
2. Ensure array 197200067 is selected
3. From the Category Dropdown select **Storage Group**

**Note:** The Storage groups are automatically ranked in order of activity with the most active at the top.

Note the Green Tick boxes at each of the KPI indicated, these indicate that the storage group is in good health. At The point Marked 5, the average response time for the DSS group is showing with a green tick meaning it is meeting it's Service Level Objective. Red X would indicate a problem and you can drill down to take you to the potential root cause.
Select the Storage Group DSS

To display the Storage Groups:

1. Click the **IO Profile** Tab

Review the data here. From this screen Thomas can gather a lot of information about the IO Profile of the DSS storage group. Average IO size, Read and Write response time as well as the IO mix and how many IOs were executed during the time period observed. These graphs tell a story in themselves about how the application is behaving. If there was a problem this could be compared with different period and Thomas could work out if the IO profile of the application had changed significantly.

---

Obtaining workload Information

To Find out more information about the workload

1. Select the **Workload Tab** in the table

   While holding down the Shift key,

2. Maximize the Hits and Misses Graph
**Note:** From one to four VP Pools may be contained in a VP Tier.

Maximize the hits and Misses Chart

Maximizing the hits and misses graph gives us a lot of information about how the workload is comprised

1. Number of Random Read Misses for this Group shows how much read activity has to go to the backend.
2. Random Read hits makes up a large portion of this host's workload
Device Capacity

Minimize the Hits and Misses graph and expand the Device Capacity Graph

This view shows how the capacity for the application is changing over the observed period. We have 2 lines on this graph, the red line showing Total Capacity for the group (potential capacity), and the Blue line showing Allocated capacity (how much is actually in use).

Close or minimize this window.

Determine the Active Devices in the Storage Group

To determine which devices are servicing the storage group's IO

1. Select the Navigate to Analyze on the bottom left of the screen
Select Dashboards

From the Dashboards view Storage Group Category and select the DSS storage group as shown above.
Select DSS Group

Note: We have just switched to the Root Cause Analysis View from the Monitor View

1. Note the Green check Mark at the Read and write Response Time. This tells you that the storage group is meeting it's response time objective
2. Select the DSS Storage Group

TIP: Ensure that the Time Window is still set to October 29 13:00 - 17:00 if this has changed for any reason be sure to select or you will see differences from the guide.
Busy Devices

We can now see the devices that are making up the DSS storage group. Key Performance indicators across the time range are displayed in the table however we can easily navigate to

1. Hold the Shift Key and select all devices
2. Click the create Charts in the bottom left of the screen

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Host IOs/sec</th>
<th>I/O BE Reqs/sec</th>
<th>Read RT (ms)</th>
<th>Write RT (ms)</th>
<th>% Hit</th>
<th>% Writes</th>
<th>% Read Miss</th>
<th>Raid Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>D001</td>
<td>N/A</td>
<td>13788.9</td>
<td>2454.1</td>
<td>0.6</td>
<td>1</td>
<td>86</td>
<td>16</td>
<td>16.7</td>
<td>TDEV</td>
</tr>
<tr>
<td>D002</td>
<td>N/A</td>
<td>15629.7</td>
<td>2433</td>
<td>0.6</td>
<td>1</td>
<td>86</td>
<td>16</td>
<td>16.7</td>
<td>TDEV</td>
</tr>
<tr>
<td>D01E</td>
<td>N/A</td>
<td>10954.6</td>
<td>2485.9</td>
<td>0</td>
<td>0.9</td>
<td>77.6</td>
<td>16</td>
<td>26.7</td>
<td>TDEV</td>
</tr>
<tr>
<td>D01B</td>
<td>N/A</td>
<td>10843.6</td>
<td>847.6</td>
<td>0</td>
<td>1</td>
<td>77.4</td>
<td>16</td>
<td>26.9</td>
<td>TDEV</td>
</tr>
</tbody>
</table>
Graph HOST IO's and Read Response Time

As we have done in Previous lab you can select multiple metrics and graph, Here we have drawn 2 charts for HOST IO/sec and Resd Response Time

TIP: you can select multiple metrics and graph in a single action, hold Ctrl or Shift key to select multiple.

Lab Summary

This lab aimed to show how we can gather information about an applications performance and quickly drill down to the devices that comprise the group. With Unisphere for VMAX we can quickly switch between views and gather detailed information in only a few clicks.

Take some time and experiment with the options available to you, you can save and export chart data, and you can also save as a dashboard which in the full Unisphere can be scheduled.
Monitoring Thin Pool activity

In this portion of the LAB we will explore the disk tiers of the VMAX400K array and verify that everything is working within expected parameters. We will be able to verify if any component is stressed.

Navigate to the Pre-Configured Thin Pool Dashboard

Unisphere for VMAX has a number of built in dashboards to highlight frequently accessed information about key array components such as disks and underlying thin pools.

To access the Thin Pool Dashboard:

1. Click Monitor
2. Select Dashboards
3. Select Thin Pool from the category dropdown

Explore the metrics shown on this dashboard

4. Once you have finished exploring the metrics then navigate to analyze as indicated
Create Charts for the 3 Internal thin Pools.

<table>
<thead>
<tr>
<th>ID</th>
<th>BE Regs/sec</th>
<th>BE MBs Transferred/sec</th>
<th>BE Response Time (ms)</th>
<th>Allocated Capacity (GB)</th>
<th>Total Capacity (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG2_PBA_F</td>
<td>7271.4</td>
<td>11.5</td>
<td>0</td>
<td>0</td>
<td>619</td>
</tr>
<tr>
<td>DG1_PBA15K</td>
<td>2734.7</td>
<td>16.1</td>
<td>0</td>
<td>0</td>
<td>1048.1</td>
</tr>
<tr>
<td>DG2_PBA10K</td>
<td>7.8</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>903.5</td>
</tr>
</tbody>
</table>

1. Select all internal pools by holding shift key and clicking with the mouse
2. Create Charts

Performance Analyzer for the VMAX3 Family
Graph

1. Select all internal Thin Pools
2. Select Multiple Metrics - Ingress Tracks, Egress Tracks, and BE Reqs/sec (hold Ctrl or shift to select multiple)
3. Click Graph Icon
4. Select one Chart per Metric
5. Click OK

The resulting graphs will give you an idea of how FAST is moving data on the back end, the ingress tracks show tracks moving into a tier from fast whereas egress tracks show tracks moving out of a tier. This is the normal operation ans shows FAST doing work under the covers. The BE Reqs/Sec metric will show you which pools are servicing the majority of the IO. In this case you will note that it is DG3_FBA_F which is the Flash tier on this array.
Exploring the Charts View

Unisphere for Performance Analyzer is very flexible in terms of the metrics you can graph. It is possible to graph any combination of Key Performance Indicators and save to a custom dashboard. In this lab we will explore graphing of multiple metrics and generating the charts.

Create Charts with Multiple Metrics

Through the Charts View in Unisphere for VMAX it is possible to build a view of the system with multiple metrics and pull together to create a custom workspace giving the storage admin a custom view of the system. In this instance we will draw some charts showing the Host IO, Response Time, and FE Port utilization.

1. Select Storage the Storage Groups
2. Select the Oracle and DSS storage groups
3. Select Host I/Os/sec
4. Graph The Metric
5. Repeat steps 1-4 for Response time and FE port utilization for ports 1D:28 and 3D:28 HINT: At step 1 Choose FE Ports instead of storage groups from the instance dropdown
6. Save the Dashboard -Give it a unique name
Access your Custom Dashboards

1. Access the monitor Tab
2. Select and View the Custom Dashboard
3. Save and Export the Charts.

Notes:- In full version of Unisphere for VMAX we can schedule Dashboards to be run and emailed or archived and stored.
Lab 4 - The Big Picture
Lab 4 Lab Overview

In this lab, you will introduce Thomas to the dashboards available in Performance Analyzer. After this brief introduction, you will demonstrate the process of creating a custom dashboard.

Monitor Time Range

For the Monitor portion of the lab you will use the 24-hour period below:


Navigate to the Monitor Page

To navigate to the Monitor Page:

1. Hover your mouse over the **Performance** button,
2. Select the **Monitor** option from the menu

Calendar

To set the time range for the analysis:
1. Click the **Calendar** icon to the far right of the window.

![Calendar Icon]

**Complete the Time Window**

To complete the Time Selection dialog:

1. Click the small **calendar icons** to set the start date to **Oct 29th, 2014 07:04** and end date to **Oct 30th, 2014 07:04**
2. Use the **arrow controls** to adjust the start and end times to 07:04 am
3. When you are finished with the adjustments, click the **OK** button to continue.

![Time Selection Dialog]
Heatmap

In this section, you will introduce Thomas to the Heatmap. The Heatmap is a color coded pictorial representation of the components in the array. As a component’s utilization increases, the hotter or more red the color becomes.

View the Heatmap

To display the Heatmap,

1. Select the Heatmap option under the EMC Views

Examine the Heatmap

Examine the Heat Map and verify the busiest components.

Since we are looking at a VMAX3 array the Heatmap is different from anything you may have seen with previous generations of arrays. We have Pools of CPU used for different emulations and only a single instance of each emulation. Front-End (FA), Infrastructure Manager (IM), Enginuity Data Services (ED), and Disk Adapter (DA) and Remote Adapter (RA)

(Hint: DSS application used for generating load is configured to use FA ports 1D:28 and 3D:28)

1. The CPU Core for the IM is slightly busier than the rest (This is normal)
2. FA CPU cores are all green 10-30%
3. Disk Utilization across all disk groups are not showing any stressed components
4. Each Front End Port is not showing any stress (click the left most port on director 1 to examine utilization of port 1D:28 over the 24 hour period).
Display the Front End Chart

To display the front end chart for one of the busy directors: Step 4 in previous lab should display the chart as shown.

1. Double click the FA-8E control.

Examine the Chart

Examine the front end chart's metrics and discuss with Thomas the idea of adding additional ports from FA-3D and FA-4D to spread the workload as wide as possible across front end ports and increase available paths.
Experiment with creating your own charts from the summary tab. Select the FE Port category as in previous labs, and build a chart similar to the Screenshot below graphing both % Busy and Host IOs/Sec on a single chart. Note the multipathing is largely symmetrical across both ports suggesting a good balance on the host side.

Examine Additional Dashboards

As time permits, examine the remaining default Dashboards that EMC provides in Performance Analyzer.
Conclusion
Conclusion

Congratulations! With your help Thomas was able to monitor the overall performance of the VMAX 400K, analyze an individual customers application performance, and identify potential performance bottlenecks.

Takeaways

As you depart, we hope you'll take away the following:

Performance Analyzer is divided into the following sections.

- **Monitor View** - contains both custom and pre-defined dashboards, which are collections of charts related to a specific function or feature. The monitor view also includes a Heat Map that provides a color coded overview of the array's performance.

- **Analyze View** - contains Real Time, Root Cause and Trending and planning of performance metrics.

- **Charts View** - Allows for the creation of charts of any Key Performance Indicator for deep dive analysis. Users can build virtually any combination of Key Performance Indicators to create custom dashboards which can be scheduled to run as reports.