

Dell EMC CloudIQ: A Detailed Review

A Proactive Monitoring and Analytics Application for Dell EMC™ Storage Systems

Abstract

This white paper introduces Dell EMC CloudIQ, a cloud-native application that combines machine intelligence and human intelligence to provide storage administrators with intel they need to take quick action and more efficiently manage their Dell EMC environment so that users can get back to other business needs. Supported on PowerMax (including VMAX), PowerStore, PowerScale (including Isilon), PowerVault, Dell EMC Unity (including Unity XT), XtremIO, SC Series, VxBlock, and Connectrix switches.

June 2020

Revisions

Date	Description
December 2016	Initial release
August 2017	Updated with additional functionality
June 2019	Updated with support for PowerMax/VMAX, SC Series, XtremIO, Connectrix and VMware
June 2020	Updated with support for PowerStore, PowerScale, Isilon, PowerVault and Converged Systems

Acknowledgements

Author: Derek Barboza

Support: Susan Sharpe, Sara Morgan

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Executive Summary

With our busy daily lives, it is important to find easier and faster ways to manage IT infrastructure. With CloudIQ, Dell EMC seeks to simplify the user experience when it comes to proactively monitoring the Dell EMC storage environment. With support for PowerMax (including VMAX), PowerStore, PowerScale (including Isilon), PowerVault, Dell EMC Unity (including Unity XT), XtremIO, SC Series Storage Systems as well as VxBlock Converged Systems and Connectrix switches, Dell EMC is providing a single interface to simplify the user experience in every possible way.

CloudIQ is designed to deliver faster time to insights¹ for customers, such as:

- up to 10x faster to predict capacity approaching/almost full¹
- up to 16x faster to identify HA problems¹
- up to 50% fewer steps to identify anomalies in system performance¹
- up to 1.4x faster to identify a “noisy neighbor” LUN¹
- up to 42x faster to find reclaimable storage¹

This white paper describes the CloudIQ features that are presented in a consolidated user-friendly interface through any HTML5 browser as well as iOS and Android mobile apps.

As a Software-as-a-Service solution, CloudIQ delivers frequent, dynamic, non-disruptive content updates for the user. CloudIQ is built in a secure multi-tenant platform to ensure that each customer tenant is properly isolated and secure from other customers.

Audience

This white paper is intended for Dell EMC customers, partners, and employees who are interested in understanding CloudIQ features and how to monitor the following Dell EMC systems: PowerMax (including VMAX), PowerStore, PowerScale (including Isilon), PowerVault, Unity (including Unity XT), XtremIO, SC Series Storage Systems, VxBlock Converged Systems and Connectrix switches.

¹ *Based on an April 2020 Principled Technologies Report commissioned by Dell EMC, "Dell EMC CloudIQ streamlined the user experience in five cloud-based storage preventive management tasks", compared to HPE InfoSight with an HPE Primera array vs. CloudIQ with a Dell EMC Unity array. Actual results may vary. Full report: <http://facts.pt/m8a5u3v>

Terminology

CloudIQ Collector – A small virtual machine distributed as a vApp that enables collection of VMware and Connectrix data. The Collector retrieves information from the target objects (vCenter or switches) and sends the collected data back to CloudIQ via Secure Remote Services Gateway. For VMware, the Collector communicates to vCenter using the VMware API and requires a user with read-only privileges. For Connectrix, the Collector communicates to the individual switches via REST API and utilizes a non-privileged user. A single collector can be used for both VMware and Connectrix.

Secure Remote Services (formerly named ESRS) provides the remote connectivity that enables Dell EMC Unity, XtremIO, PowerMax/VMAX and PowerScale/Isilon Storage Systems, VxBlock Converged Systems as well as the CloudIQ Collector (for Connectrix) to connect to CloudIQ. Secure Remote Services allows Dell EMC to securely transfer files, such as logs and dumps, from the systems. There are two types of Secure Remote Services: **Integrated** and **Centralized**.

Integrated Secure Remote Services is embedded in Unisphere for Dell EMC Unity arrays. It is recommended for Unity customers who do not want to utilize a centralized gateway server. Secure Remote Services communication uses ports 443 and 8443 (HTTPS) and needs unrestricted access to the Global Access Servers (GAS).

Centralized Secure Remote Services connects the system to a Secure Remote Services gateway server installed on a customer site. It allows for HA capabilities when multiple SRS VE servers are installed. Secure Remote Services Centralized communication uses ports 443 and 9443 (HTTPS) and needs unrestricted access to the Global Access Servers (GAS).

SupportAssist – Provides the remote connectivity that enables Dell EMC SC Series, PowerStore and PowerVault Series systems to connect to CloudIQ and to send associated data packets for performance, capacity, and health monitoring. SupportAssist allows Dell EMC to securely transfer files, such as alerts, performance stats, and capacity/configuration information from the systems.

Unisphere – The graphical management interface that is built into Dell EMC storage systems for configuring, provisioning, and managing the systems' features. For Dell EMC Unity, and PowerMax/VMAX, systems, Unisphere connects to CloudIQ via Secure Remote Services; for SC Series, it connects via SupportAssist.

PowerVault Manager – The graphical management interface for PowerVault storage systems. Connectivity to CloudIQ is established in the Settings section of PowerVault Manager via SupportAssist.

PowerStore Manager – The graphical management interface for PowerStore storage systems. Connectivity to CloudIQ is established in the Settings section of PowerStore Manager via SupportAssist.

Web UI – The graphical management interface for XtremIO storage arrays. Web UI is part of XMS – XtremIO Management Server, which connects to CloudIQ via Secure Remote Services.

1 CloudIQ Overview

CloudIQ is a cloud-native application that provides for simple monitoring and troubleshooting of your Dell EMC storage and Connectrix switch environment. It leverages machine learning to proactively monitor and measure the overall health of storage systems and SAN switches through intelligent, comprehensive and predictive analytics. CloudIQ is available at no additional charge for products with a valid Pro-Support (or higher) contract. CloudIQ is hosted on Dell infrastructure which is highly available, fault-tolerant and guarantees a 4-hour Disaster Recovery SLA.

CloudIQ provides each customer an independent, secure portal and ensures that customers will only be able to see their own environment. Each user can only see those systems in CloudIQ which are part of that user's site access as defined in Dell EMC Service Center. Customers register their storage systems with their Site ID. For SC Series and PowerVault systems, a new site ID is created, named after the system ID, for each system selected to be viewed in CloudIQ).

The discussion below elaborates on the various features and functionality in CloudIQ. Some details will vary by product type. For specific details per product type, consult **Online Help**, which is updated with each new feature added into CloudIQ.

1.1 Key Values of CloudIQ

Improve Productivity – CloudIQ helps users improve productivity of your IT resources, staffing and equipment, with Providing a Single Pane-of-glass view of your environment that Extends view into virtual infrastructure with our VMware integration, Trusted Advisor access for added oversight, and Immediate time-to-value with easy access

Reduce Risk – CloudIQ makes daily storage administration tasks easier by helping you identify potential vulnerabilities before they impact your environment. Leveraging a suite of advanced analytics CloudIQ helps answer key questions Storage Administrators deal with regularly, using features such as: Proactive Health Scores, Performance Impact Analysis & Anomaly Detection, and Workload Contention Identification..

Plan Ahead – CloudIQ helps you stay ahead of business needs with Short-term Capacity Full Prediction and Capacity Anomaly Detection, as well as Longer-term Capacity Forecasting – Leverage subject-matter expertise to identify potential risks before they impact the environment and machine learning to pinpoint deviations for faster resolution.

1.2 CloudIQ Requirements

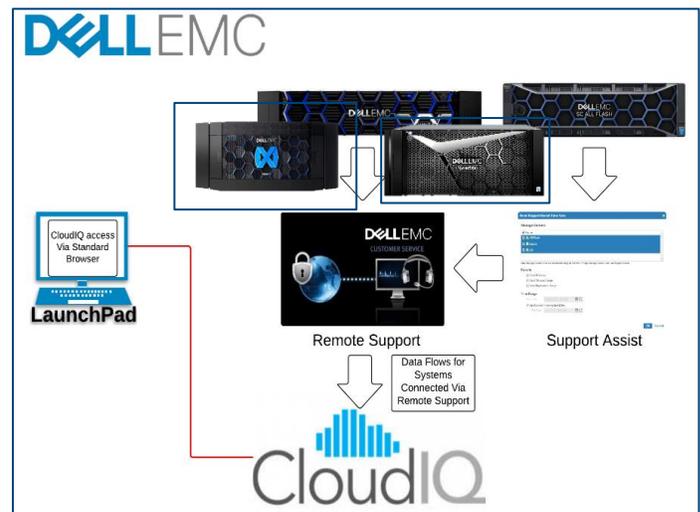
CloudIQ is available to all customers with the following Dell EMC systems:

Type of Data	Product Models	Minimum Code Version
Dell EMC Unity	XT, All Flash, Hybrid, and/or UnityVSA – Professional Edition	Unity OE 4.1 and later
PowerStore	PowerStore X and PowerStore T	PowerStoreOS 1.0 and later
SC Series	SC All Flash and SC Hybrid	7.3.1 and later
PowerMax/VMAX	VMAX 10K, 20K, 40K, 100K, 200K, 400K, 250F, 450F, 850F, 950F; PowerMax 2000, 8000	Unisphere 9.0.1.6 Unisphere 9.0.2.10

Type of Data	Product Models	Minimum Code Version
		and later is recommended
XtremIO	X1 and X2	XMS 6.2.0 and later
PowerScale/Isilon	Gen 5 and Gen 6	OneFS 8.2 and later
PowerVault	PowerVault ME4	Firmware GT280R004 and later
Converged Infrastructure	VBlock 340, 350, 540, 740 VxBlock 340, 350, 540, 740, 1000	VxBlock Central 2.5 and later VMware 6.5 and later
Connectrix B-Series	Connectrix Brocade	FOS 8.2.1a and later
Connectrix MDS Series	Connectrix Cisco	NX-OS 8.2(2) and later, except for NX-OS v8.3(1)
VMware	-	ESX 5.5 and higher (some metrics available at 6.0+)

1.3 CloudIQ Data Collection

Details on configuring Dell EMC storage, Connectrix and VMware for CloudIQ can be found in Appendix A of this document. After the Dell EMC storage systems or Connectrix switches have established connection to CloudIQ, data will be collected and available to the user in the CloudIQ user interface. Dell EMC storage is connected through Secure Remote Services (Dell SC Series, PowerStore and PowerVault establish a connection through SupportAssist). Connectrix and VMware data is collected by a local collector and sent through Secure Remote Services to CloudIQ.



The frequency with which data is updated in CloudIQ varies based on the type of information and the type of system. The following table shows the types of data and the frequency with which CloudIQ updates this information for Dell EMC Unity systems; collection for other systems is comparable:

Type of Data	Sample Update Frequency
Alerts	5 minutes
Performance	5 minutes
Capacity ¹	1 hour
Configuration ¹	1 hour
Data Collection ²	Daily

1. Connectrix and VMware collect these at 5-minute intervals

2. Daily “all-in” collection

CloudIQ maintains up to 2 years of historical data for systems that are actively being monitored. The details of the data retention are as follows:

Alerts: 2 years

Configuration: 2 years at hourly intervals

Performance Data:

	5 Min Interval	Hourly Interval	Daily Interval
System level	100 days	2 years	2 years
Object level	22 days	90 days	2 years

1.4 CloudIQ Features

CloudIQ makes it faster and easier to analyze and identify storage issues accurately and intelligently, by delivering:

- Centralized monitoring of performance, capacity, system components, configuration, and data protection. CloudIQ also provides details about Converged and Storage Systems, Storage Pools, Block and File Storage Objects, Connectrix switches and VMware environments.
- Predictive Analytics that enable intelligent planning and optimization of capacity and performance utilization.
- Proactive Health Scores for monitored storage systems and SAN switches. CloudIQ identifies potential issues in the storage environment and offers practical recommendations based on best practices and risk management

1.4.1 Centralized Monitoring

CloudIQ allows you to improve your storage health by providing instant insight into your Dell EMC storage environment without the maintenance of installed software. A helpful Overview Page summarizes the key aspects of the storage environment so that the user can quickly see what needs to be addressed and provides hyperlinks to easily navigate to more detailed views. Some examples of these summaries include Proactive Health Scores, Capacity Predictions, Performance Anomaly & Impact Detection and Reclaimable Storage. These and others are discussed in detail below.

1.4.2 Predictive Analytics

CloudIQ's advanced predictive analytics differentiate it from other monitoring and reporting tools.

1.4.2.1 Performance Anomaly & Impact Detection

Using machine learning and analytics, CloudIQ identifies performance anomalies (supported across all storage platforms). It compares current performance metrics with historical values to determine when the current values deviate outside of normal ranges. This provides timely information about the risk level of the storage systems with insights into conditions and anomalies affecting performance.

In addition to performance anomalies, CloudIQ goes one step further and identifies performance impacts (currently for Unity, PowerMax, and PowerStore systems). CloudIQ analyzes increases in latency against other metrics such as IOPS and bandwidth to determine if the latency increase is caused by a change in workload characteristics or by competing resources. In the case where an impact is identified, CloudIQ also identifies the most likely storage objects causing the resource contention. This enables the Storage Administrator to narrow the focus of troubleshooting specifically on when actual impacts to performance may have occurred.

1.4.2.2 Capacity Trending and Predictions

CloudIQ provides historical trending and both short- and longer-term future predictions to provide intelligent insight on how capacity is being used, and what future needs may arise.

- Short-term Capacity Full Prediction – Utilizes a daily analysis of capacity usage to help users avoid a short-term data unavailability event by starting to predict, within a quarter, when the capacity is expected to reach full.
- Capacity Anomaly Detection – Utilizes an hourly analysis of capacity usage to identify a sudden surge of capacity utilization that could result in data unavailability. This helps to avoid the 2:00am phone call resulting from a sudden capacity utilization spike due to a potentially runaway query or rogue actor in the environment.
- Longer-term Capacity Forecasting – Helping users more intelligently project capacity utilization going forward so that they can plan future capacity requirements and budget accordingly.

1.4.3 Proactive Health Score

The Proactive Health Score is another key differentiator for CloudIQ, relative to other monitoring and reporting tools. CloudIQ proactively monitors the critical areas of each storage system and SAN switch to quickly identify potential issues and provide recommended remediation solutions. The Health Score is a number ranging from 100 to 0, with 100 being a perfect Health Score.

The Health Score is based upon the five categories shown in the table to the left. Some examples of how Proactive Health mitigates risk are:

Category		Sample Health Issues
	Components	Physical components with issues: faulty cables, fans, etc.
	Configuration	Non-HA Hosts connections
	Capacity	Pools or Clusters that are over-subscribed and reaching full capacity
	Performance	Storage Groups not meeting their SLO
	Data Protection	Recovery Point Objectives not meeting native replication and snapshot policy

Note:

The Components and Data Protection categories do not apply for PowerMax/VMAX systems.

The Performance and Data Protection categories do not apply for PowerVault ME4 Series systems.

Only the Components category is currently used for Connectrix switches.

1.5 CloudIQ UI Layout

This section discusses the layout of the user interface.

1.5.1 Navigation Pane

The left navigation bar is designed to provide clear visibility into CloudIQ functionality to streamline access to information. The top-level menu selections are task-oriented, directing the user to the appropriate section of the user interface to access the desired information. The navigation bar consists of the following selections:

Overview – Access the overview page that provides high-level summary information as well as some detailed information about the health of the storage environment, allowing the user to quickly identify potential risks. This includes the Proactive Health Score, predictions on when pools and clusters will reach full capacity and system performance impacts.

Health – View the multi-system System Health page for Storage and SAN showing the proactive health scores across the environment. View an aggregated list of all health issues as well as system alerts and available system updates.

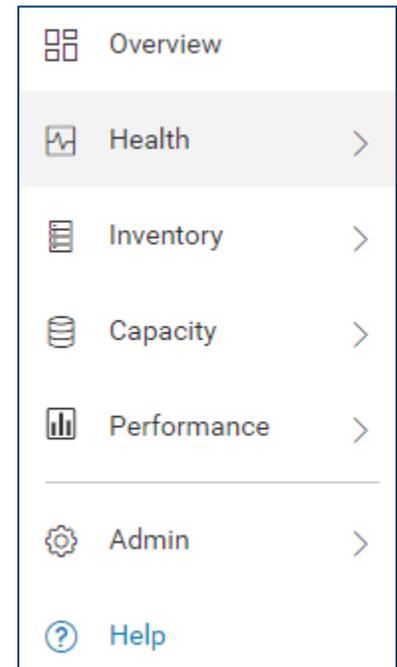
Inventory – View the multi-system Inventory page for Storage, SAN and Converged Systems showing the system code versions as well as location, site and contract status for all systems in the environment. This menu also includes a link to the aggregated listing and detailed views for Hosts.

Capacity – Access the multi-system view for System Capacity for Storage and SAN showing array level capacity information for storage systems, including the overall efficiencies to support the Dell EMC all flash guarantee. For SAN switches, capacity is displayed in terms of ports. Also access the aggregate and detailed Pools listing as well as the Reclaimable Storage listing.

Performance – Access the multi-system Performance page for Storage and SAN showing array level performance KPIs for all storage systems and switch KPIs for SAN switches. Also access the Metrics Browser for more detailed performance analysis.

Admin – Includes links to various administrative tasks. This includes Customization, which allows users to temporarily pause connectivity health checks for hosts connected to Unity and SC Series systems as well as capacity health checks for Unity file systems. The Collectors section is where users can download the CloudIQ Collector for VMware and Connectrix and see the status of all installed Collectors. The Connectivity page shows the connectivity status of all CloudIQ capable systems as well as provides the ability to onboard SC Series, PowerVault and VxBlock Converged systems. The Settings menu is used to configure access for User Community and Customer Support as well as email notification settings. Settings also allows users to set filters on which systems they want to see in both the CloudIQ user interface as well as the mobile app.

Help – Online CloudIQ documentation which is searchable.



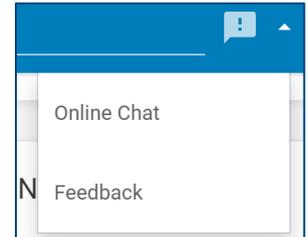
1.5.2 Global Search

The Global Search feature helps users quickly find Systems, Hosts, Pools/ Storage Resource Pools, Storage Groups, LUNs/Volumes, File Systems, and Virtual Machines, and. Users can specify a few keywords and get a summarized list of top matches. From there, users can click an item to access its details or go to an expanded view with all matches.



1.5.3 Online Chat/Feedback

Selecting the exclamation point pull-down allows the user to either open a live chat session with Dell Technologies customer support or submit feedback to the CloudIQ product team. When opening a live chat session, the user will need to provide the serial number of the system in question.



1.5.4 What's New in CloudIQ

CloudIQ is updated frequently to deliver helpful new content to users. As such, please utilize the CloudIQ Simulator (<https://cloudiq.emc.com/simulator>) to view the latest features which may not be documented in this paper.

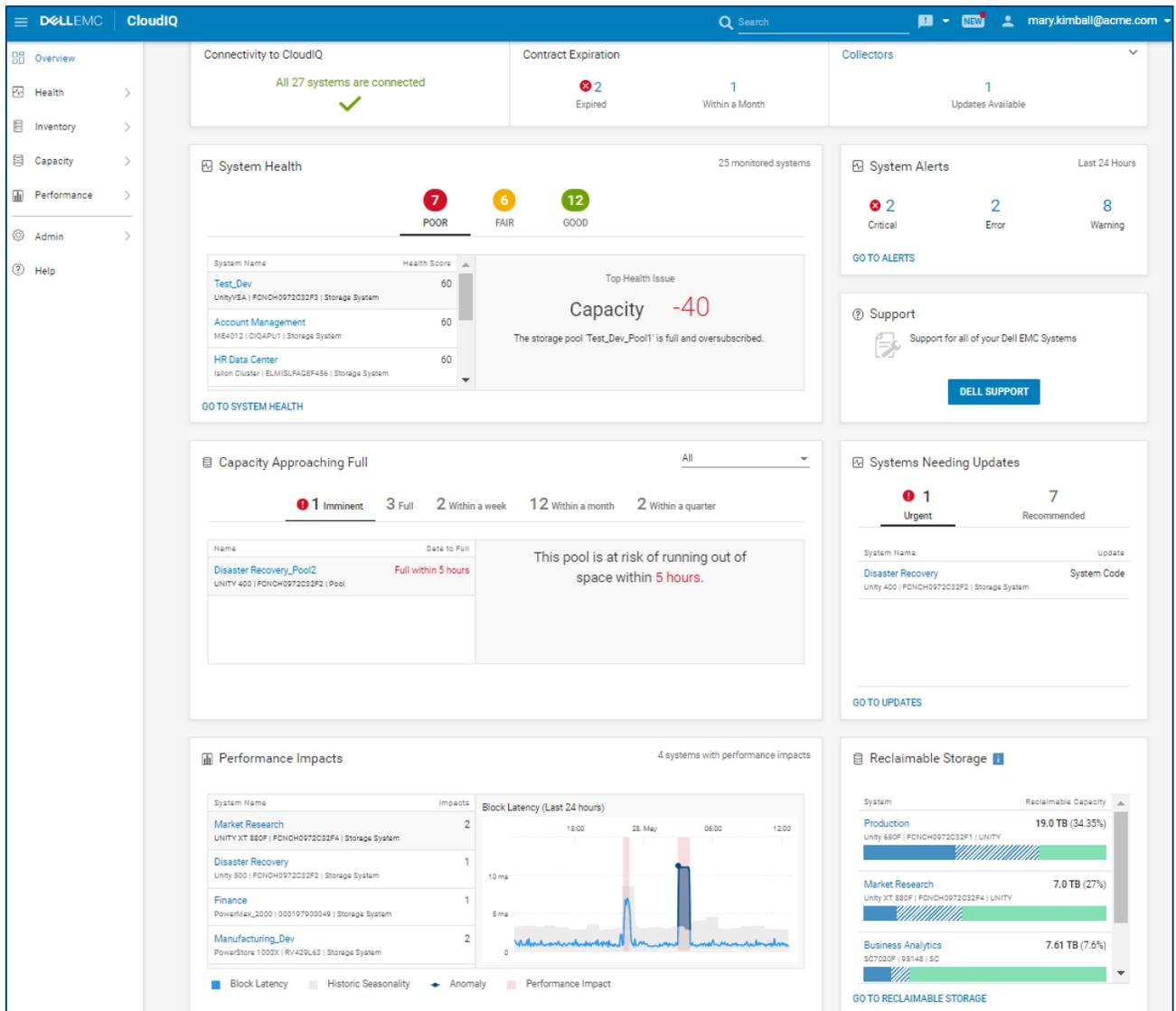
New features can be seen by clicking the  icon on the top menu bar.

The "What's New in CloudIQ" window will pop up showing recent changes and enhancements. Clicking **View All Enhancements** displays a historical list of all the updates. The most recent information is presented first and users can scroll down the list to see the monthly evolution of CloudIQ since its introduction. This display can be turned off by sliding the **Don't show again until the next update** button.

Selecting either the user icon () or the user email address allows the user to sign out of the UI.

2 Overview Page

The **Overview** Page provides a consolidated view of the Dell EMC Storage and SAN environment. This is the highest-level summary of the environment providing users with a roll-up of the key factors to understand the overall health and operation of the storage environment.



There are three tiles along the top of the Overview page.

Connectivity to CloudIQ – Shows the connectivity status for all systems registered in CloudIQ and the CloudIQ Collector. Systems are displayed in the following four categories:

- **Install Base Issues:** CloudIQ cannot display due to Install Base configuration issues.
- **Lost Connection:** Systems that have lost connection and are no longer sending data to CloudIQ.
- **Not Set Up:** Systems that are not set up to send data through Secure Remote Services to CloudIQ.
- **Connected:** Systems that are successfully sending data to CloudIQ.

Selecting each category redirects the user to the Connectivity Page and displays a filtered list of system(s) and collector(s) corresponding to that connectivity status.

Contract Expiration – Shows the number of systems with contracts that are:

- Expired
- Expire within a month
- Expire within a quarter

The user can select the number to drill down and see a filtered list of systems from the Inventory view that meet the expiration criteria. Systems whose contracts have expired will be removed from other standard CloudIQ views.

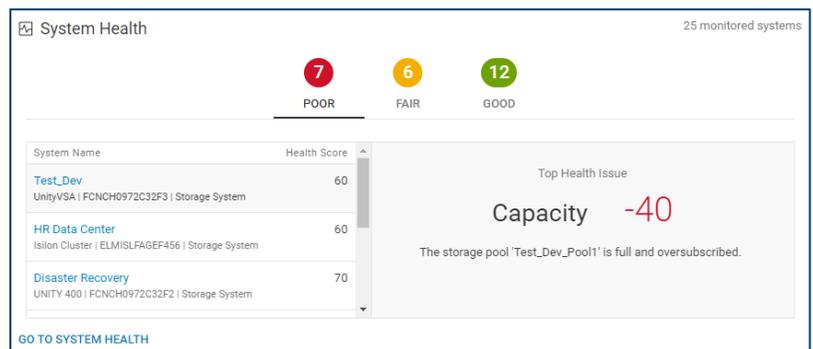
Collectors – Displays number of CloudIQ Collectors that have

- Issues that need to be resolved
- Available Updates

The user can select the number in each category to view a filtered list of collectors from the Collectors view.

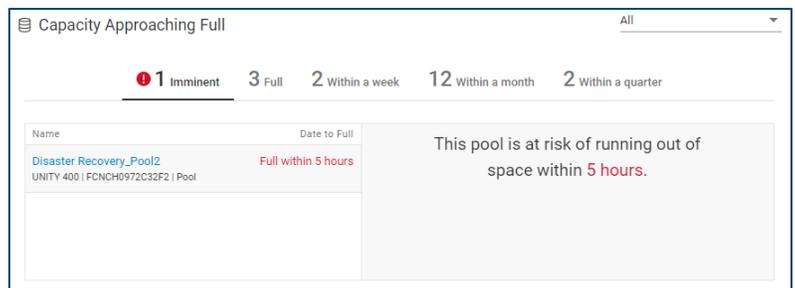
System Health – Categorizes all monitored storage systems and Connectrix switches into three ranges of health scores:

- **Poor:** 0-70
- **Fair:** 71-94
- **Good:** 95-100
- **Unknown:** list of systems whose health score cannot currently be calculated. This is possibly caused by a connection issue.



Selecting a range's number along the top of the tile displays the system names and health scores for that range, sorted from low to high. The chart is interactive allowing the user to select a system in the list to display its Top Health Issue in the right pane. This displays the most impactful issue affecting the health score. Selecting the system name hyperlink directs the user to the Health Score tab of the systems details page which shows the user all identified issues as well as a history of the health score for the system.

Capacity Approaching Full – Leverages predictive analytics to identify the storage pools clusters, and file systems running out of space. The chart is interactive allowing the user to select each storage object to display a trend line of the historical capacities. For Unity and PowerVault storage pools, XtremIO and PowerScale/Isilon clusters and Unity File Systems, a forecast capacity chart is also shown. The estimated time range until each pool/cluster/file system will be full is shown as:



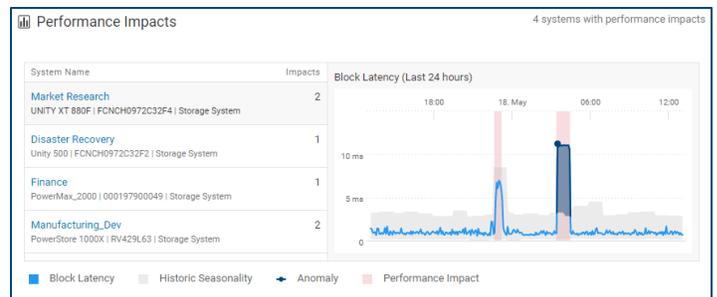
- Imminent (predicted to run out of space within 24 hrs.)
- Full
- Within a week
- Within a month
- Within a quarter

There is a pull-down menu that allows the user to filter the tile based on object type: Pools, Clusters or File Systems.

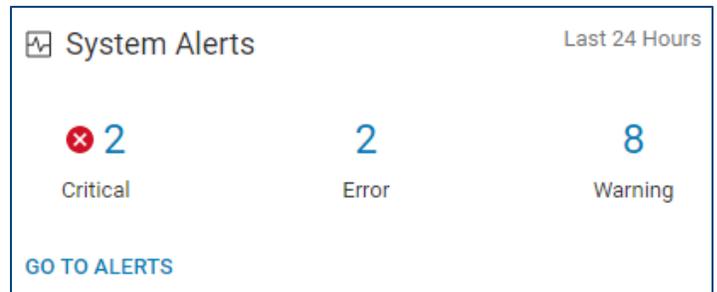
Note that the Imminent risk category is currently supported only for Unity storage pools, but will expand to include other platforms in the future.

Selecting the object name hyperlink directs the user to the Capacity tab on the object details page. This could be the pool details page, file system details page or the cluster details page, depending on the object type.

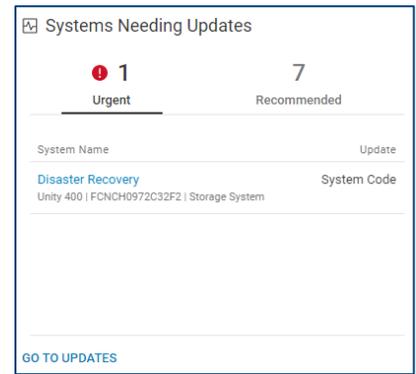
Performance Impacts – Currently supported for Unity, PowerMax, and PowerStore systems. Utilizes CloudIQ analytics to identify when there are performance impacts on a system due to a possible resource contention. It will also identify the existence of performance anomalies where the current system workload is outside of expected boundaries based on historical workloads. The chart is interactive allowing the user to select each system with a performance impact and see the block latency of that system over the last 24 hours in the right pane. Both performance impacts and performance anomalies are highlighted in the chart. Selecting the system name hyperlink directs the user to the Performance tab of the system details page where the user can see more detailed performance information for the system.



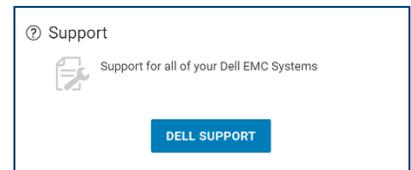
System Alerts – Summarizes the alerts collected by CloudIQ over the last 24 hours across the Critical, Error and Warning severity levels. Clicking a number opens a list of alerts in the Alerts window filtered by the selected severity level. Selecting the “GO TO ALERTS” link navigates the user to a filtered list of alerts, across all severity levels, from the last 24 hours.



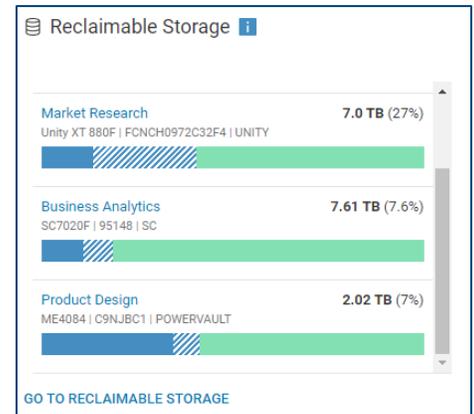
Systems Needing Updates – This tile identifies systems that have either Urgent or Recommended system code, firmware or management software updates available. It shows the system as well as the type of update. Selecting the “GO TO UPDATES” link opens the System Updates page which shows all available code, firmware and software updates across all systems as well as links to download the update(s). Selecting the system name hyperlink directs the user to the Configuration tab on the system details page.



Support – Link to the Dell Support Site for a cloud-based dashboard with service insights for managed systems.



Reclaimable Storage – This tile summarizes Unity, SC Series and PowerVault ME4 systems that have reclaimable storage. Each system with reclaimable storage shows the total amount of used, reclaimable (of used) and free storage. Selecting the system name hyperlink directs the user to the Capacity tab on the system details page.



3 Health

3.1 System Health

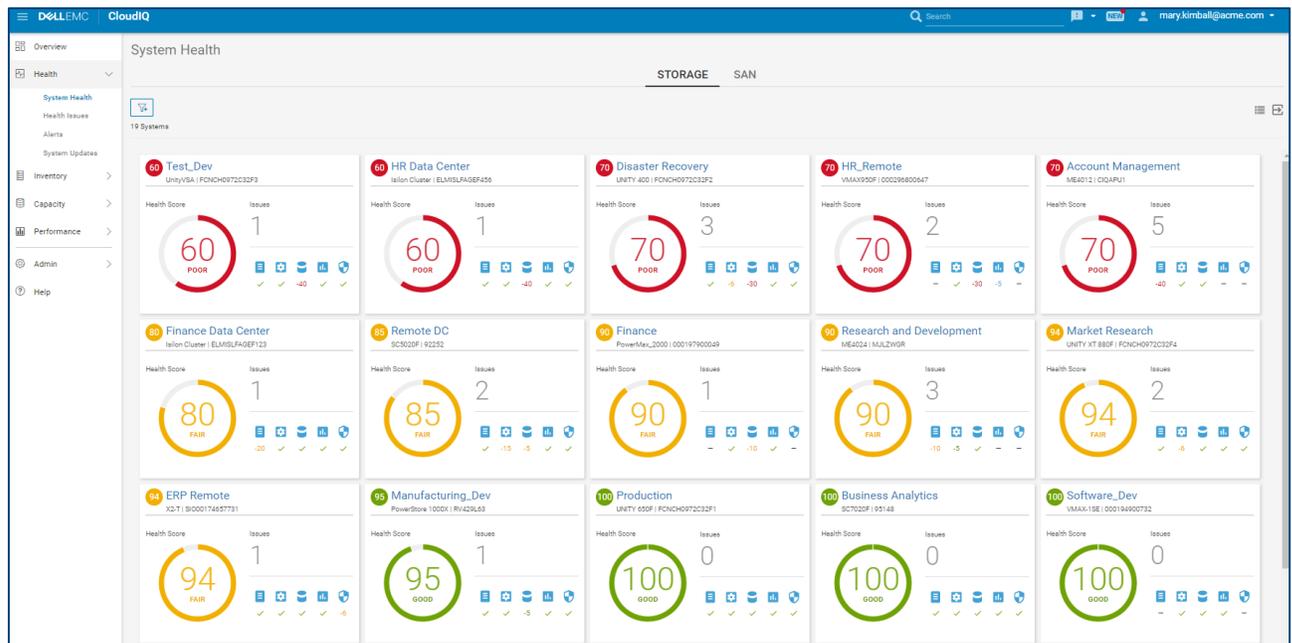
The System Health page displays the Proactive Health Score for all systems across all products in a consolidated view. There are two tabs, “STORAGE” and “SAN”, that organize the storage systems and switches into individual views. Users can quickly identify the systems at highest risk along with the number of issues in each category that makes up the health score.

The System Health page shows the five categories that are monitored by CloudIQ; **Components** (🔧), **Configuration** (⚙️), **Capacity** (💧), **Performance** (📊) and **Data Protection** (🔒).

Note: PowerMax and VMAX systems do not currently include health issues in the Components or Data Protection categories. CloudIQ will display a dash (—) for these categories.

Note: PowerVault ME4 systems do not currently include Performance or Data Protection categories. CloudIQ will display a dash (—) for these categories.

Note: Connectrix switches currently utilize only Components to obtain the health score.

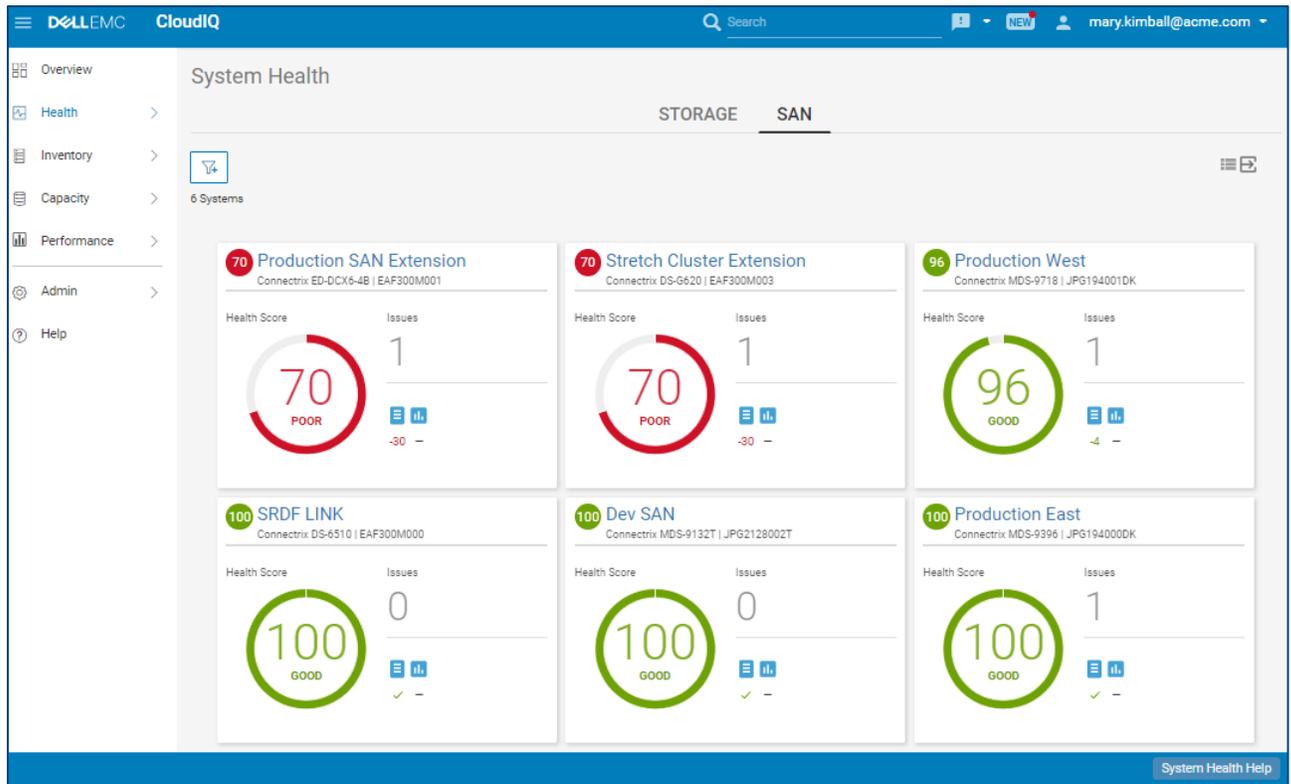


Each system has a health score displayed in the circle (ranging from 100 to 0) which is calculated as 100 minus the issue with the greatest impact. Each of the five categories has either a green check mark, a negative number or a dash. The green check indicates no issues are present for that category. A negative number represents the deduction for the most impactful issue in the category. A dash indicates that the category is not supported for that system type. This approach is intended to help the user first focus on the most significant issue for the system, so that the user can resolve the issue to improve the health score.

The Health Score range is as follows:

- **Good** = 95 – 100 (Green)
- **Fair** = 71 – 94 (Yellow)
- **Poor** = 0 – 70 (Red)

The System Health Score is displayed in the color that corresponds to the range. Blue coloring with a dash instead of a number indicates a system that has just recently been added to CloudIQ and does not yet have a calculated health score. Gray coloring with a number indicates a connectivity issue which leads to an uncertain health score. In this case, the user should check the system connectivity.



The **Card** view, shown above for both Storage and SAN, is the default view for this page. Users can alternatively choose the **List** view, by selecting the List View Icon (☰) in the top right of the window. The list view, shown on the next page for Storage, may be more useful for larger environments because it allows for a more condensed view of the information as well as the ability for the user to sort columns.

Users can also export the data from many of the views in CloudIQ to a CSV file by selecting the Export CSV icon (📄) in the top right of the view. Exporting the data from any one of the multi-system views exports the data from all the multi-system views including the information displayed in the Health, Inventory, Performance and Capacity views. Note that the exported information includes either the Storage or the SAN views depending on where the user initiates the export.

Users can filter the systems in both the Card View and List View by selecting the **Filter** icon (🔍) and entering in various criteria. The available criteria vary based on the view, but examples include System Name, Product Type, Health Score, Site name and Location. The filter settings stay in effect until the user clears the filter or logs out of the UI.

Each view provides the following information:

- **Score** – CloudIQ Proactive Health Score for system
- **Name** – User-defined name of system
- **Model** – Specific model of system
- **Serial number** – Unique serial number or identifier for the system

System Health

STORAGE SAN

19 Systems

Clear All

System: Enter a System Name or ID

Product:

- Isilon
- PowerMax
- PowerStore
- PowerVault
- SC Series
- Unity
- XtremIO

Health Score:

- 10000
- 8000
- 6000
- 4000
- 2000
- 0000

Site: Enter a Site

Location: Enter a Location

Health Score	System	Identifier	Model	Components	Configuration	Capacity	Performance	Data Protection
60	Test_Dev	FCNCH0972C32F3	UnityVSA	✓	✓	-40	✓	✓
60	HR Data Center	ELMISLFAGEF456	Isilon Cluster	✓	✓	-40	✓	✓
70	Disaster Recovery	FCNCH0972C32F2	UNITY 400	✓	-6	-30	✓	✓
70	HR_Remote	00296800647	VMAX950F	-	✓	-30	-5	-
70	Account Management	CIQAPU1	ME4012	-40	✓	✓	-	-
80	Finance Data Center	ELMISLFAGEF123	Isilon Cluster	-20	✓	✓	✓	✓
85	Remote DC	92252	SC5020F	✓	-15	-5	✓	✓
90	Finance	000197900049	PowerMax_2000	-	✓	-10	✓	-
90	Research and Development	MJLZWGR	ME4024	-10	-5	✓	-	-
94	Market Research	FCNCH0972C32F4	UNITY XT 880F	✓	-6	✓	✓	✓
94	ERP Remote	SIO00174657731	X2-T	✓	✓	✓	✓	-6
95	Manufacturing_Dev	RV429L63	PowerStore 1000X	✓	✓	-5	✓	✓
100	Production	FCNCH0972C32F1	UNITY 650F	✓	✓	✓	✓	✓
100	Business Analytics	95148	SC7020F	✓	✓	✓	✓	✓
100	Software_Dev	000194900732	VMAX-1SE	-	✓	✓	✓	-
100	Prod with iCDM	SIO00174657100	X1	✓	✓	✓	✓	✓
100	ERP Production	SIO00174657444	X2-R	✓	✓	✓	✓	✓

Selecting an individual storage system or switch from either the card view or list view navigates the user to the System Details page. These pages are discussed later in this paper. Refer to the following sections:

- Storage/Switch System Details – Health Score
- Storage/Switch System Details – Configuration
- Storage/Switch System Details – Capacity
- Storage/Switch System Details – Performance

3.2 Health Issues

The Health Issues page displays a comprehensive view of all the current health issues across all the storage systems and Connectrix switches in the environment. The user can click the Refine button to filter the view to show a subset of systems based on the system name. When the user starts typing the name of the system, a prepopulated list of system names is displayed that contains the entered text.

The screenshot shows the Dell EMC CloudIQ interface. The left sidebar contains navigation options: Overview, Health (selected), Alerts, System Updates, Inventory, Capacity, Performance, Admin, and Help. The main content area is titled 'Health Issues' and shows 31 total issues. It is filtered to show issues for three systems:

- Test_Dev (UnityVSA)**: Health Score 60, 3 Issues. Last Health Scan Wed, May 20 2020, 11:49:56 AM UTC (1 hour ago).
 - 40 The storage pool 'Test_Dev_Pool1' is full and oversubscribed. Capacity. 9 hours ago.
 - 40 The file system 'TD_Pool1_NAS_Datastore1' is full. Capacity. 9 hours ago.
 - 40 The file system 'TD_Pool1_NAS_Datastore2' is full. Capacity. 9 hours ago.
- HR Data Center (Isilon Cluster)**: Health Score 60, 1 Issue. Last Health Scan Wed, May 20 2020, 12:00:56 PM UTC (1 hour ago).
 - 40 Node pool Main Pool (node pool ID: 1) is at or over capacity. Capacity. 9 hours ago.
- Disaster Recovery (UNITY 400)**: Health Score 70, 5 Issues. Last Health Scan Wed, May 20 2020, 12:36:56 PM UTC (38 minutes ago).
 - 30 The storage pool 'Disaster Recovery_Pool2' is oversubscribed and growing at a substantially increasing rate, ... Capacity. 9 hours ago.
 - 20 The file system 'DR_Pool2_FS1' is predicted to run out of space within a week. Capacity. 9 hours ago.
 - 20 The file system 'DR_Pool2_FS2' is predicted to run out of space within a week. Capacity. 9 hours ago.
 - 6 Host 'Remote_ESX1' is not logged in to both SPs: this host will lose connectivity in the event of failover. Configuration. 9 hours ago.
 - 6 Host 'Remote_ESX2' is not logged in to both SPs: this host will lose connectivity in the event of failover. Configuration. 9 hours ago.
- HR_Remote (VMAX950F)**: Health Score 70, 2 Issues. Last Health Scan Wed, May 20 2020, 12:40:56 PM UTC (34 minutes ago).
 - 5 Storage Groups out of compliance HR_REMOTE_SG_11, HR_REMOTE_SG_12, HR_REMOTE_SG_13. Performance. 11 hours ago.
 - 30 % Effective Used Capacity threshold exceeded for SPR SRP_1. Capacity. 11 hours ago.

3.3 Alerts

The **Alerts** page displays all alerts associated with the monitored systems. The Refine button allows the user to filter alerts based on the following criteria:

- **Date** – Date range
- **System** – System Name or ID
- **Product** – Product type
 - PowerMax
 - PowerStore
 - SC Series
 - Unity
 - XtremIO

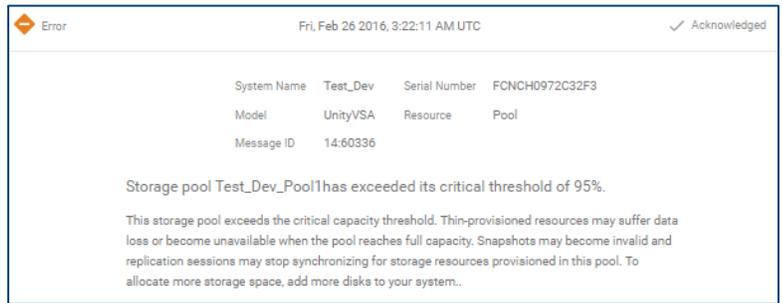
- **Severity**
 - **Critical** – Event that has significant impact on the system and needs to be remedied immediately
 - **Error** – Event that has minor impact on the system and needs to be remedied
 - **Warning** – Event that administrators should be aware of but has no significant impact on the system
 - **Information** – Event that does not impact the system functions
- **Acknowledged**
 - **Acknowledged** – Event that has been reviewed and acknowledged on the array
 - **Unacknowledged** – Event that has not been acknowledged on the array

Severity	Alert Title	Description	Component	Timestamp	Status
Warning	Finance (PowerMax_2000)	Running Enginuity 5978.0.2318 is older than Target Enginuity 5978.142.142	System	Thu, Mar 26 2020, 3:07:09 PM UTC	
Warning	Production (UNITY 650F)	Storage pool Prod_Pool2 has exceeded its user-specified threshold.	Pool	Thu, Mar 26 2020, 3:07:09 PM UTC	
Warning	Remote DC (SC5020F)	The storage pool 'Remote DC_Pool1' is oversubscribed and predicted to run out of space within ...	Storage	Thu, Mar 26 2020, 2:07:09 PM UTC	
Warning	Market Research (UNITY XT 880F)	Host ProdApp1_Host2 is only configured with one path to the storage system. Configure multipl...	-	Thu, Mar 26 2020, 11:07:09 AM UTC	✓
Warning	Software_Dev (VMAX1SE)	Back-End metadata usage has changed to 60 percent...	System	Thu, Mar 26 2020, 11:07:09 AM UTC	✓
Warning	Finance (PowerMax_2000)	Aggregation failed to run for Symmetrix 000297000453 within last 24 hours.	System	Thu, Mar 26 2020, 11:07:09 AM UTC	✓
Critical	HR Data Center (Isilon Cluster)	Chassis Cooling: Drive power down.	Disk	Thu, Mar 26 2020, 11:07:09 AM UTC	✓
Warning	Market Research (UNITY XT 880F)	Host ProdApp1_Host1 is only configured with one path to the storage system. Configure multipl...	-	Thu, Mar 26 2020, 11:07:09 AM UTC	✓
Error	Test_Dev (UnityVSA)	Storage pool Test_Dev_Pool1 has exceeded its critical threshold of 95%.	Pool	Thu, Mar 26 2020, 9:07:09 AM UTC	✓
Error	HR_Remote (VMAX950F)	Port state has changed to Offline. - Object is: 000297000453:RE-3G:27	System	Thu, Mar 26 2020, 9:07:09 AM UTC	✓
Critical	Finance Data Center (Isilon Cluster)	Chassis Cooling: Drive power down.	Disk	Thu, Mar 26 2020, 9:07:09 AM UTC	✓
Tuesday					
Warning	Market Research (UNITY XT 880F)	Host LocalESX3 is only configured with one path to the storage system. Configure multiple path...	-	Tue, Mar 24 2020, 6:07:09 PM UTC	✓
Warning	Market Research (UNITY XT 880F)	Host LocalESX4 is only configured with one path to the storage system. Configure multiple path...	-	Tue, Mar 24 2020, 6:07:09 PM UTC	✓
Warning	HR_Remote (VMAX950F)	Retention failed to run for Symmetrix 000297000453 within last 24 hours.	System	Tue, Mar 24 2020, 6:07:09 PM UTC	✓
Warning	Finance (PowerMax_2000)	No diagnostic data received for Symmetrix 000197900256 within the last 1 hour	System	Tue, Mar 24 2020, 6:07:09 PM UTC	✓

Note: Alerts shown in CloudIQ originate from the storage system and can only be acknowledged and unacknowledged on the array.

Note: Alerts for PowerVault ME4, Connectrix, and VxBlock systems are not yet supported.

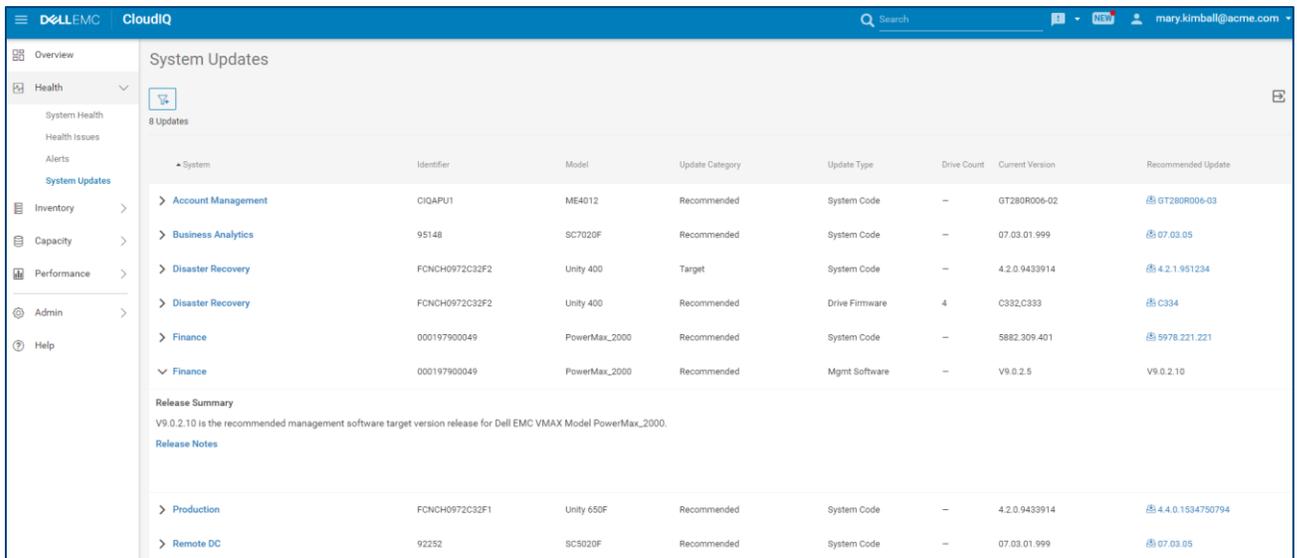
The alerts are grouped in current and weekly sections. A checkmark on the right side of the alert row indicates that the alert has been acknowledged. More details pertaining to an alert can be seen by selecting the alert.



3.4 System Updates

The System Updates page displays a list of all available code, firmware and management software updates across all systems. It includes the system name, update category, update type as well as the current version and update version. The Update Version column is a hyperlink to the code allowing the user to quickly access the update code. Selecting the “>” icon expands the row to display the Release Summary with more details about the update as well as a link to the release notes for the system update.

The user can filter the results by selecting the Filter icon, sort any of the columns and export the list to a CSV file.



Note: System Updates in CloudIQ are not supported for PowerScale or Isilon systems.

4 Inventory

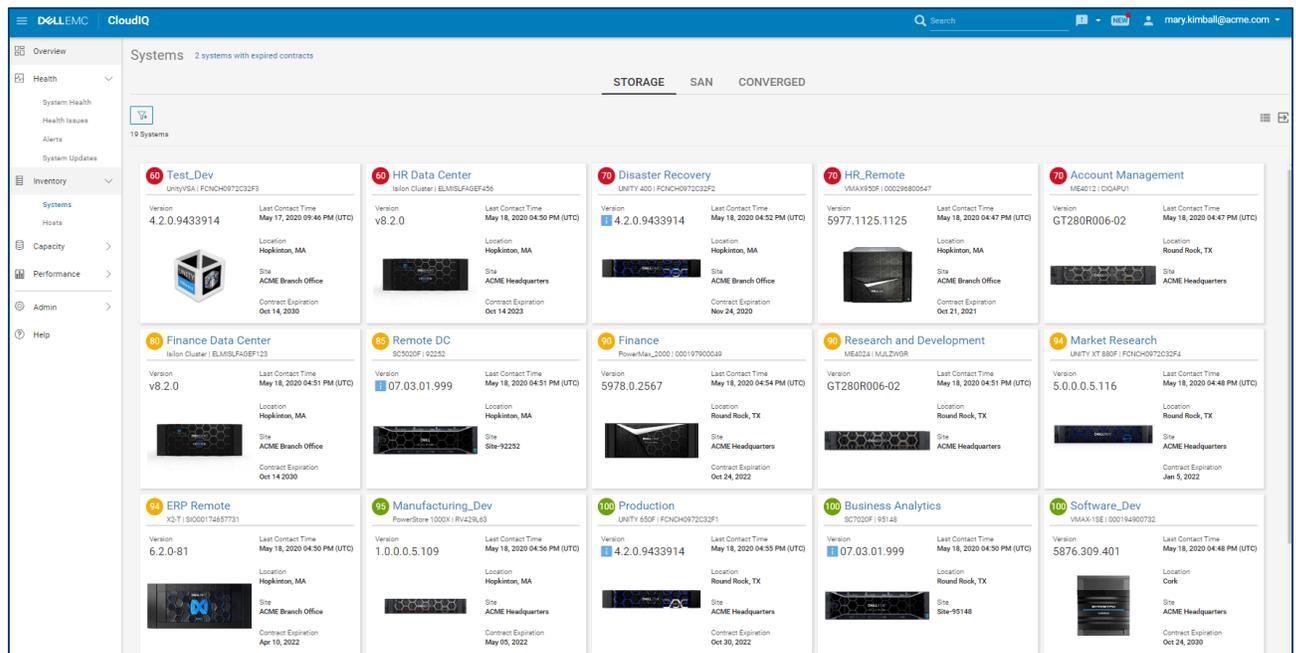
4.1 Systems

The Systems page is the multi-system view showing the configuration information for all systems in the environment. With the addition of VBlock/VxBlock support, there can be three tabs in the multi-systems inventory view: STORAGE, SAN and CONVERGED. The information displayed on the Systems pages includes:

- **Version (vCenter Version for Converged)** – Version of installed software
- **Last Contact Time** – The last time that CloudIQ received data from the system
- **Managed by (Converged only)** – Type of AMP managing the Converged System
- **Location** – Location where the system is installed
- **Site** – Site ID with which the system is associated
- **Contract Expiration** – Expiration date for the service contract. Not supported for PowerVault or SC Series.

There will also be an indication when a storage system has a code update available. Hovering the mouse over the information icon  opens a popup window showing the update version. Clicking the “Learn More” link from within the popup window opens a dialog with summary information and links to the Release Notes and the software download.

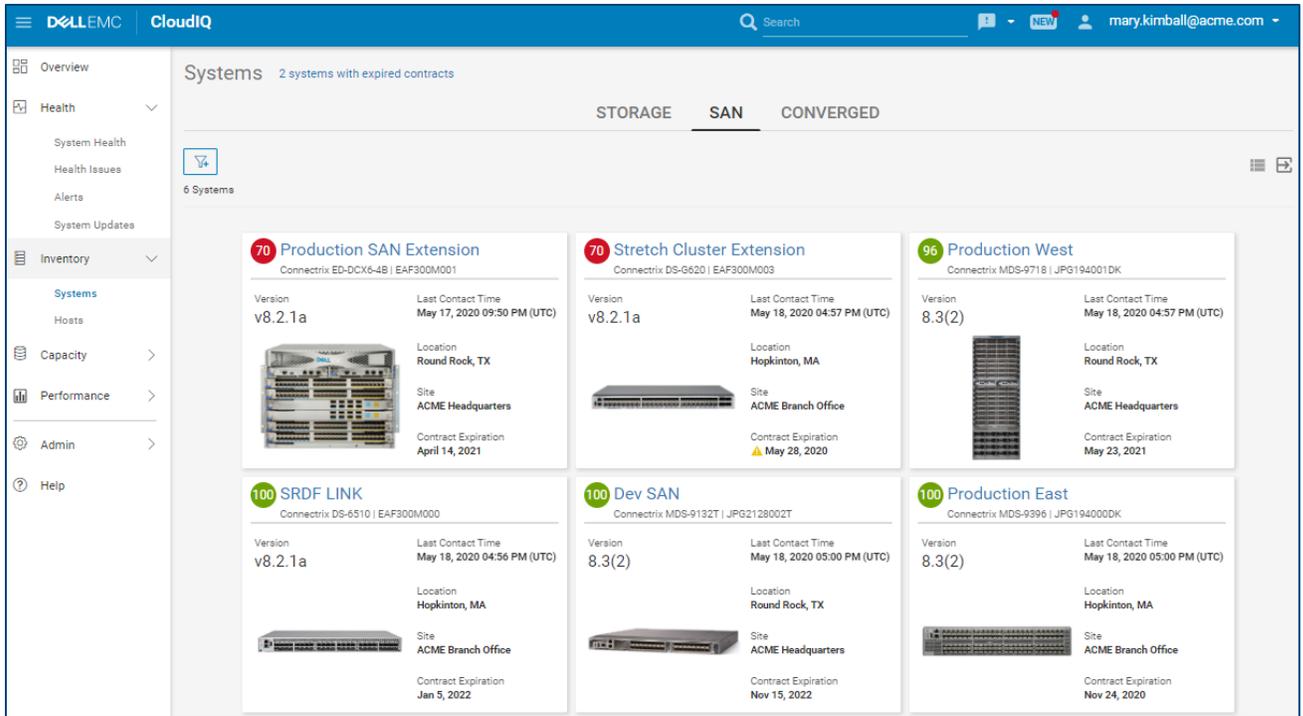
The following shows an example of the STORAGE tab.



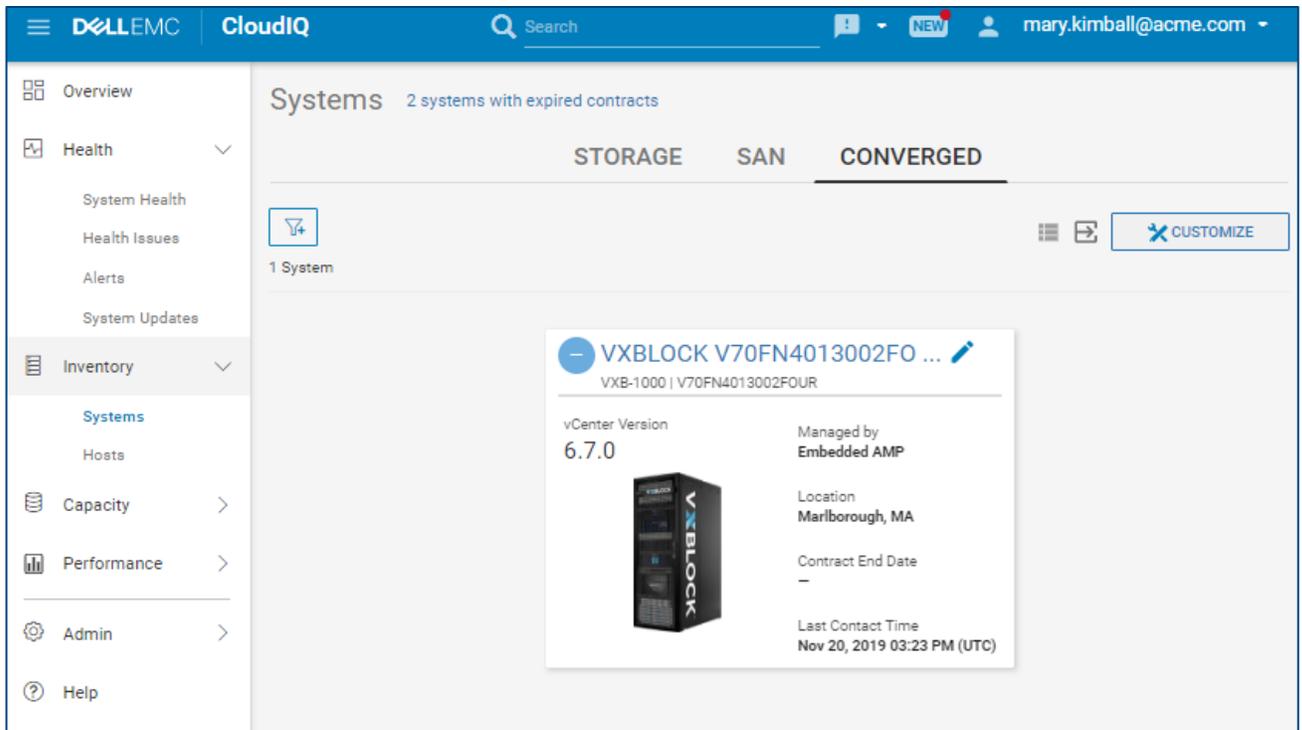
The screenshot displays the Dell EMC CloudIQ interface. The top navigation bar includes the Dell EMC logo, the CloudIQ title, a search bar, and the user profile 'mary.kimball@acme.com'. The left sidebar contains navigation options: Overview, Health (System Health, Health Issues, Alerts, System Updates), Inventory (Systems, Hosts), Capacity, Performance, Admin, and Help. The main content area is titled 'Systems 2 systems with expired contracts' and has three tabs: STORAGE (selected), SAN, and CONVERGED. The STORAGE tab shows a grid of 15 system cards, each representing a storage system. Each card includes a version number, last contact time, location, site, and contract expiration date. The systems are: Test_Dev, HR Data Center, Disaster Recovery, HR_Remote, Account Management, Finance Data Center, Remote DC, Finance, Research and Development, Market Research, ERP Remote, Manufacturing_Dev, Production, Business Analytics, and Software_Dev.

System Name	Version	Last Contact Time	Location	Site	Contract Expiration
Test_Dev	4.2.0.9433914	May 17, 2020 09:46 PM (UTC)	Hopkinton, MA	ACME Branch Office	Oct 14, 2020
HR Data Center	v8.2.0	May 18, 2020 04:30 PM (UTC)	Hopkinton, MA	ACME Headquarters	Oct 14, 2023
Disaster Recovery	4.2.0.9433914	May 18, 2020 04:32 PM (UTC)	Hopkinton, MA	ACME Branch Office	Nov 24, 2020
HR_Remote	5977.1125.1125	May 18, 2020 04:47 PM (UTC)	Hopkinton, MA	ACME Branch Office	Oct 21, 2021
Account Management	GT280R006-02	May 18, 2020 04:47 PM (UTC)	Round Rock, TX	ACME Headquarters	
Finance Data Center	v8.2.0	May 18, 2020 04:51 PM (UTC)	Hopkinton, MA	ACME Branch Office	Oct 14, 2020
Remote DC	07.03.01.999	May 18, 2020 04:51 PM (UTC)	Hopkinton, MA	Site-92252	
Finance	5978.0.2567	May 18, 2020 04:54 PM (UTC)	Round Rock, TX	ACME Headquarters	Oct 24, 2022
Research and Development	GT280R006-02	May 18, 2020 04:51 PM (UTC)	Round Rock, TX	ACME Headquarters	
Market Research	5.0.0.0.5.116	May 18, 2020 04:48 PM (UTC)	Round Rock, TX	ACME Headquarters	Jan 5, 2022
ERP Remote	6.2.0-81	May 18, 2020 04:50 PM (UTC)	Hopkinton, MA	ACME Branch Office	Apr 10, 2022
Manufacturing_Dev	1.0.0.0.5.109	May 18, 2020 04:56 PM (UTC)	Hopkinton, MA	ACME Headquarters	May 09, 2022
Production	4.2.0.9433914	May 18, 2020 04:35 PM (UTC)	Round Rock, TX	ACME Headquarters	Oct 30, 2022
Business Analytics	07.03.01.999	May 18, 2020 04:50 PM (UTC)	Round Rock, TX	Site-92148	
Software_Dev	5876.309.401	May 18, 2020 04:48 PM (UTC)	Cork	ACME Headquarters	Oct 24, 2020

An example of the SAN tab is displayed below showing similar attributes to those displayed in the STORAGE tab.



An example of the CONVERGED tab is shown below. Note that the user can edit the system name to provide a more user-friendly name and differentiate it when multiple systems are being monitored. Users can also utilize the Customize button to display different attributes in the card view.



4.2 Hosts

The Hosts page shows a list of all hosts or servers attached to storage systems being monitored by CloudIQ. Users can click the filter icon to specify one or more storage system names to restrict the view to display only those hosts on the selected system(s). Currently supported for Unity, SC Series, XtremIO and PowerVault ME4.

The Hosts listing shows:

- **Issues** – Health of the host represented by:
 - The number of issues on the host
 - A green checkmark if no issues are detected
 - A dash if the health has not been calculated

Note: Health issues are supported for hosts attached to Unity, PowerVault ME4 and SC Series storage systems.

- **Name** – Host name
- **Network Address** – IPv4 or IPv6 IP address (Not reported for hosts attached to XtremIO and PowerVault ME4 systems).
- **Operating System** – Host operating system (Not reported for hosts attached to PowerVault ME4 systems).
- **Initiator Protocol** – Type of initiator used by the Host (FC, iSCSI).
- **Initiators (#)** – Number of initiators connected between the host and the monitored system.
- **Total Size** – Total size of all LUNs or Volumes provisioned to the host from the system.
- **System** – Storage system connected to the host. If a host is connected to multiple storage systems, a line displays for each system.
- **Model** – Model of the system connected to the host.

The screenshot shows the Dell EMC CloudIQ interface with the 'Hosts' page selected. The left sidebar contains navigation options: Overview, Health, Inventory (selected), Systems, Capacity, Performance, Admin, and Help. The main content area displays a table of 53 hosts. The table has the following columns: Issues (with a green checkmark icon), Name (hyperlinks), Network Address, Operating System, Initiator Protocol, Initiators (#), Total Size (TB), System, and Model. The hosts listed include various server configurations, such as VMware ESXi, Windows Server, and Linux, connected to different storage systems like Research and Development, Business Analytics, ERP Production, and Market Research.

Issues	Name	Network Address	Operating System	Initiator Protocol	Initiators (#)	Total Size (TB)	System	Model
✓	2001000e1e09efa4	–	–	FC	1	23.4	Research and Development	ME4024
✓	2001000e1e09efa5	–	–	FC	1	22.1	Research and Development	ME4024
✓	Analytics-Host-1	–	Linux	FC	2	0	Prod with iCDM	X1
✓	Analytics-Host-2	–	Linux	FC	2	0	Prod with iCDM	X1
✓	BA_App1_Server1	10.0.0.60	VMware ESXi 5.5.0	FC	2	54.6	Business Analytics	SC7020F
✓	BA_App1_Server2	10.0.0.61	Windows Server 2012	FC	2	54.6	Business Analytics	SC7020F
✓	BA_App2_Server3	10.0.0.62	Windows Server 2012	FC	2	54.6	Business Analytics	SC7020F
✓	BA_App2_Server4	10.0.0.63	Windows Server 2012	FC	2	46.8	Business Analytics	SC7020F
✓	Backup-IG001	–	ESX	FC	2	0	ERP Remote	X2-T
✓	ERP-Host-1	–	ESX	FC	2	7.8	ERP Production	X2-R
✓	ERP-Host-2	–	ESX	FC	2	7.8	ERP Production	X2-R
✓	ERP-Host-3	–	ESX	FC	2	7.8	ERP Production	X2-R
✓	ERP-Host-4	–	ESX	FC	2	7.8	ERP Production	X2-R
✓	iCM-Host-ESX1	–	ESX	FC	6	4.6	Prod with iCDM	X1
✓	Initiator7e00	–	–	SAS	1	5.5	Account Management	ME4012
✓	Initiator7e01	–	–	SAS	1	4.6	Account Management	ME4012
✓	LocalESX1	10.0.0.14	VMware ESXi 5.5.0	FC	1	10.2	Market Research	UNITY XT 880F
✓	LocalESX1	10.0.0.14	VMware ESXi 5.5.0	FC	1	19.5	Production	UNITY 650F

As with other listings, the user can sort the list by clicking any of the column headings and export data to a CSV file by selecting the Export icon.

It should be noted that hosts are reported on a per storage system basis meaning that if a host is attached to multiple storage systems, there will be one row per storage system. An example of this is host LocalESX1 shown at the bottom of the Hosts listing above. It shows one row for storage array Market Research and a second row for storage array Production.

Each host name is a hyperlink which opens the Host Details page for that specific host with respect to the associated storage system. The following sections discuss the Host Details page in more depth.

4.2.1 Host Details – Properties

The Properties tab displays configuration data for a host including the operating system, IP Address, and initiator protocol. It also displays any health issues associated to the host with suggested remediation. Details about the storage objects attached to the host, virtual machines residing on the host and initiators are provided in the tabs at the bottom of the page. The information in each of the tabs can be exported to a CSV file.

Disaster Recovery > Remote_ESX1 LAUNCH UNISPHERE

Properties | Capacity | Performance

Description: - PAUSE CONNECTIVITY HEALTH CHECKS

Operating System: VMware ESXi 5.5.0
 Network Address: 10.0.0.30
 Initiator Protocol: FC

Total Issues: 1 | **Configuration: 1 Issue**

Configuration Issue:
 2 days ago Host 'Remote_ESX1' is not logged in to both SPs; this host will lose connectivity in the event of failover.
Resolution:
 This host does not have logged-in paths to both SPA and SPB. Review your connectivity to ensure that all hosts have a connection to both SPs to ensure High Availability.

STORAGE | VIRTUAL MACHINES | INITIATORS 4 Storage Objects

Issues	Name	Type	Thin	Size (GB)	Allocated (GB)	Pool	Consistency Group	Host I/O Limit
✓	DR_Pool3_SAN_Dat...	VMware VMFS	Yes	1000	550	Disaster Recovery_Pool3	MRApp2CG	5K IOPS
✓	DR_Pool3_SAN_Dat...	VMware VMFS	Yes	1500	825	Disaster Recovery_Pool3	MRApp2CG	5K IOPS
✓	DR_Pool3_SAN_Dat...	VMware VMFS	Yes	1500	825	Disaster Recovery_Pool3	TD_CG1	5K IOPS
✓	DR_Pool3_SAN_Dat...	VMware VMFS	Yes	1500	825	Disaster Recovery_Pool3	TD_CG1	5K IOPS

4.2.2 Host Details – Capacity

The Capacity tab for a host provides details for the current capacity from the associated storage system including provisioned and allocated size, and historical capacity trends, of all the block objects provisioned to that host.

Disaster Recovery > Remote_ESX1 LAUNCH UNISPHERE

Properties | **Capacity** | Performance

Total Size: 5.3 TB | Allocated Size: 2.7 TB

Historical Trend Viewing data from the last 6 months

Value	Last Received
Total	129.6 TB
Allocated (90.49%)	117.3 TB

Chart showing capacity trends from Jul '19 to Feb '20. Y-axis: GB 100k.

4.2.3 Host Details – Performance

The Performance tab for a host provides the 24-hour average values of key performance indicators (Latency, IOPS and Bandwidth) of each block object provisioned the host. It also displays the names of other hosts to which the block objects are also provisioned.

Disaster Recovery > Remote_ESX1 LAUNCH UNISPHERE

Properties Capacity Performance

4 Storage Objects Viewing data from the Last 24 hours

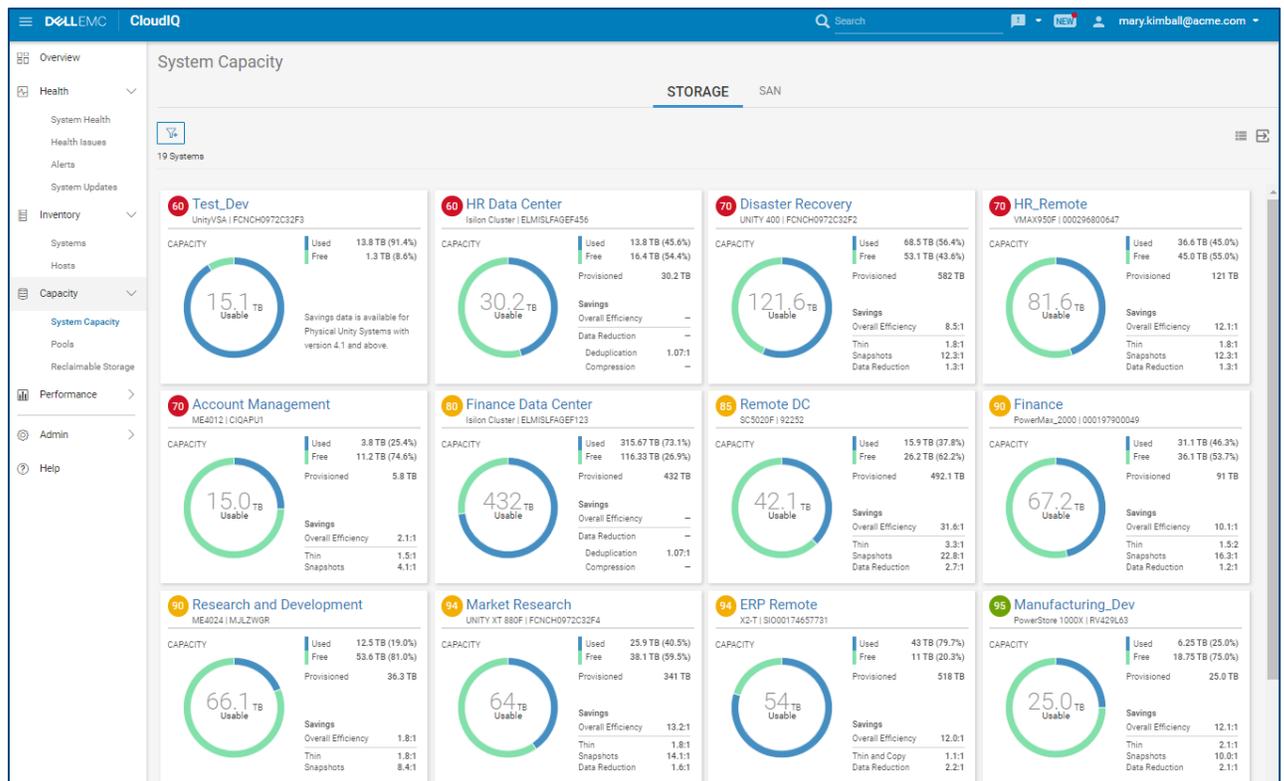
Name	Pool	Other Hosts	Latency (ms)	IOPS (K)	Bandwidth (MBps)
DR_Pool3_SAN_Datastore1	Disaster Recovery_Pool3	Remote_ESX2	1.1	0.9	9.7
DR_Pool3_SAN_Datastore2	Disaster Recovery_Pool3	Remote_ESX2	1.1	0.9	9.7
DR_Pool3_SAN_Datastore5	Disaster Recovery_Pool3	Remote_ESX2	1.1	0.8	9.6
DR_Pool3_SAN_Datastore6	Disaster Recovery_Pool3	Remote_ESX2	1.1	0.5	9.5

5 Capacity

5.1 System Capacity

The System Capacity page displays the system level storage capacity for storage systems and port capacity for switches across all monitored systems. The information for storage systems includes:

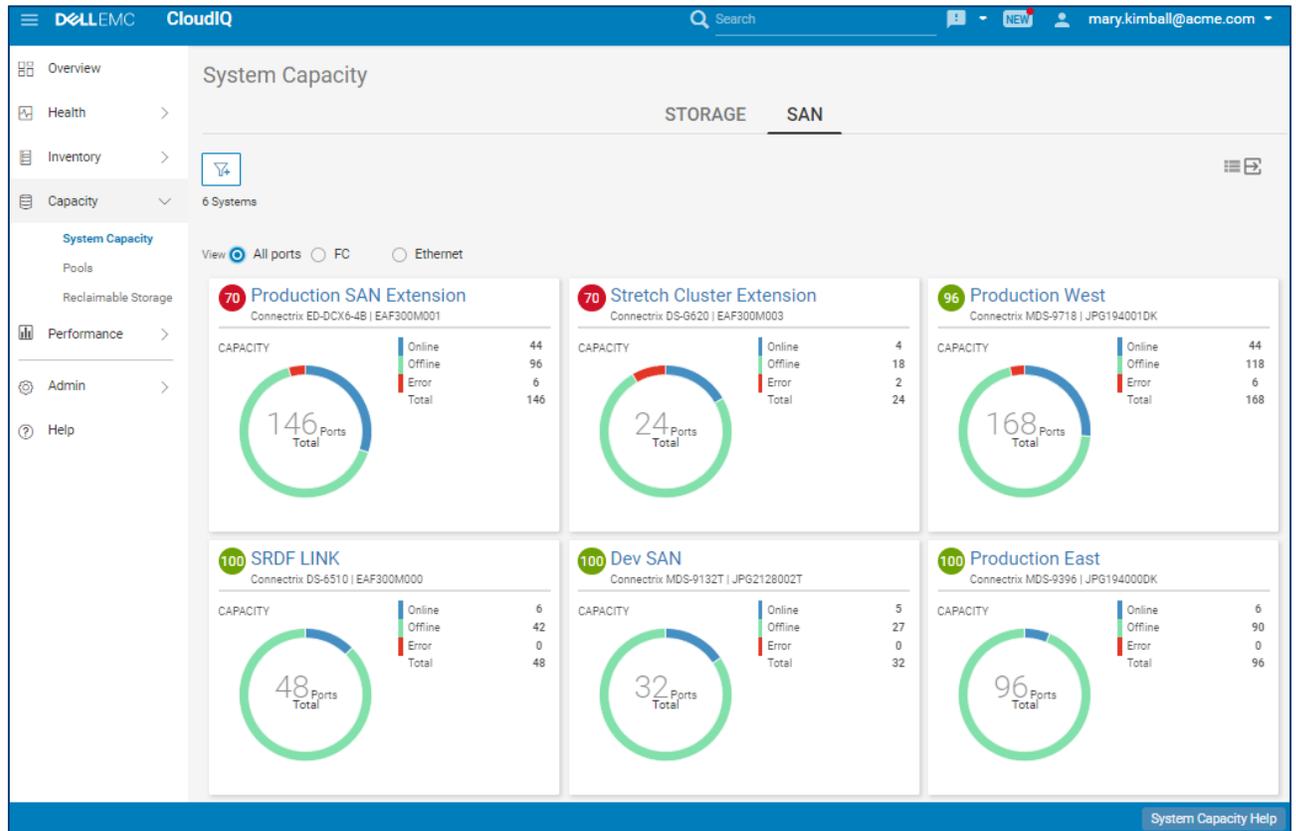
- **Usable** – Total disk capacity, which is the sum of Used and Free space
- **Used** – Disk capacity that is allocated to an object, such as a LUN, Volume, or file system
- **Free** – Disk capacity provisioned to a storage pool but not yet allocated to an object, such as a LUN, Volume or file system
- **Provisioned** – Total capacity visible to hosts attached to this system
- **Overall Efficiency** – System-level storage efficiency ratio, based on the following combined savings ratios:
 - **Thin** – Ratio of thin provisioned objects on the system (Dell EMC Unity, PowerStore, SC Series, VMAX/PowerMax, PowerVault ME4)
 - **Snapshots** – Ratio of snapshots on the system (Dell EMC Unity, PowerStore, SC Series, VMAX/PowerMax, PowerVault ME4),
 - **Thin and Copy** – Ratio of thin provisioned objects (XtremIO volumes, including snapshots).
 - **Data Reduction** – Ratio of data that has data reduction applied, using compression and/or deduplication. (Not supported for PowerVault ME4)
 - **Deduplication** – Ratio gained by savings from deduplication (PowerScale/Isilon only)



Note: For Dell EMC Unity systems running version 4.3 and later and SC Series running version 7.3, Data Reduction includes Compression and/or Deduplication.

For SAN switches, the user can filter the view to show All ports, FC ports or Ethernet ports. For each selection, the displayed information includes:

- **Total Ports** – Total number of ports (All ports, FC ports or Ethernet ports depending on previous selection)
- **Online** – Number of ports in an online state
- **Offline** – Number of ports in an offline state
- **Error** – Number of ports in an error state



5.2 Pools

The Pools page provides an aggregated listing of storage pools including PowerMax storage resource pools. The **Issues** column will display the number of health issues associated with any pool or storage object in that pool or a green check mark for items with no associated issues. Issues can be calculated for Unity, SC Series, PowerScale/Isilon and PowerVault. The pool name and system name are hyperlinks to the details for the item.

The Pools listing represents the raw storage on the system that is available to be provisioned as either Block storage or File storage. This listing provides the Total Size (TB), Used and Subscription percentages, and Free (TB) storage within the pool that has not been provisioned for storage objects. The Time to Full range is also shown. Time to Full is based upon the storage consumption measurements. The longer the pool is configured, the more accurate the prediction of Time to Full. This Time to Full measurement identifies pools that are at greatest risk of running out of storage space, and that require attention.

Issues	Name	System	Model	Total Size (TB)	Used (%)	Subscription (%)	Time To Full	Free (TB)
✓	A	Product Design	ME4084	15.64	45.12	66.77	Greater than quarter	8.42
✓	A	Research and Developm...	ME4024	60.36	14.14	48.70	Unpredictable	51.82
✓	A	Account Management	ME4012	8.38	0.10	15.19	Learning	8.37
✓	B	Product Design	ME4084	13.41	37.87	92.63	Greater than quarter	8.21
1	B	Research and Developm...	ME4024	5.86	71.84	132.25	Within a month	1.65
✓	B	Account Management	ME4012	6.70	40.21	67.16	Within a quarter	3.95
✓	Business Analytics_Pool1	Business Analytics	SC7020F	85.2	18.7	65.5	Greater than quarter	69.3
✓	Cache Pool	Finance Data Center	Isilon Cluster	192 TB	82.4	100.0%	Learning	33.8 TB
✓	Disaster Recovery_Pool1	Disaster Recovery	UNITY 400	25.6	64.1	117.2	Unpredictable	9.2
1	Disaster Recovery_Pool2	Disaster Recovery	UNITY 400	12.8	85.7	156.3	Imminent	1.8
✓	Disaster Recovery_Pool3	Disaster Recovery	UNITY 400	83.2	49.4	49.9	Within a month	42.1
—	Finance_SRP1	Finance	PowerMax_2...	26.4	39.0	115.5	Greater than quarter	16.1
—	Finance_SRP2	Finance	PowerMax_2...	40.8	51.0	99.3	Greater than quarter	20.0
—	HR_Remote_SRP1	HR_Remote	VMAX950F	40.8	45.0	148.3	Greater than quarter	22.5
—	HR_Remote_SRP2	HR_Remote	VMAX950F	40.8	45.0	148.3	Greater than quarter	22.5
✓	Main Pool	Finance Data Center	Isilon Cluster	391 TB	71.0	100.0%	Learning	113.4 TB
✓	Main Pool	HR Data Center	Isilon Cluster	30.2 TB	45.6	100.0%	Learning	16.4 TB

5.2.1 Pool Details – Properties

The information in the **Properties** tab for a pool varies depending on array type. It provides various pool attributes and any health issues associated with the pool. Expanding the issue will provide a suggested resolution. Where supported, there is a hyperlink in the top right of the window to launch the associated

element manager. The bottom of the Pool Details page has different tabs of information depending on array type. The following series of screenshots show the information for each array type.

Unity and SC Series:

- Storage
- Virtual Machines
- Drives

Disaster Recovery > Disaster Recovery_Pool2

Properties | Capacity | Performance

FAST Cache: -
FAST VP Scheduler: On
Type: Traditional

Total Issues: 1
Capacity: 1 Issue
9 hours ago: The storage pool 'DisasterRecovery_Pool2' is oversubscribed and predicted to run out of space within 5 hours.
Resolution: Consider adding drives to the pool or migrating data to another pool.

STORAGE	VIRTUAL MACHINES	DRIVES	4 Storage Objects								
Issues	Name	Type	Size (GB)	Used (GB)	Allocated (GB)	Thin Enabled	Data Reduction	Consistency Group	Host I/O Limit	NAS Server	Time
✓	DR_Pool2_F...	File System	6000	1320	1650	Yes	1.1:1 (5% or 256.0 MB)	-	-	NAS_Server_3	With
✓	DR_Pool2_F...	File System	6000	1320	1650	Yes	1.1:1 (5% or 256.0 MB)	-	-	NAS_Server_3	With
✓	DR_Pool2_L...	LUN	4000	-	1100	Yes	1.1:1 (5% or 256.0 MB)	ProdApp2CG	10K IOPS	-	-
✓	DR_Pool2_L...	LUN	4000	-	1100	Yes	1.1:1 (5% or 256.0 MB)	ProdApp2CG	10K IOPS	-	-

PowerVault:

- Storage
- Drives

Research and Development > B

Properties | Capacity | Performance

Type: Virtual

Total Issues: 1
Configuration: 1 Issue
2 days ago: Pool 'B': A virtual disk group is missing one or more disks.
Resolution: Ensure that spare disks are available. Reconstruction should start automatically. - When the reconstruction is complete, replace the failed disk(s). (Look for event 8 in the event log to determine which disk(s) failed.) - Disk groups that cannot find compatible spares will automatically move data to fault-tolerant components.

STORAGE	DRIVES	4 Storage Objects			
Name	Type	Size (GB)	Used (GB)	Allocated (GB)	
Research_Volume3	BASE	1500.0		760.0	
Research_Volume4	BASE	2750.0		1230.8	
Research_Volume7	BASE	2500.0		2098.0	
Research_Volume8	BASE	1000.0		123.3	

Capacity

PowerScale/Isilon

- Nodes

Finance Data Center > Main Pool

Properties Capacity

Tier -

Node Count 8

Protection Scheme

L3 Cache Disabled

Total Issues 0 Total

Components ✓

Configuration ✓

Capacity ✓

Performance ✓

Data Protection ✓

All health checks were successful.

8 Storage Objects

Issues	Name	Type	Size (GB)	Used (GB)	Pool
✓	Node 1	Node	18.6	0.7	Main Pool
✓	Node 2	Node	18.6	0.7	Main Pool
✓	Node 3	Node	18.6	0.7	Main Pool
✓	Node 4	Node	18.6	0.7	Main Pool

PowerMax

- no tabs

Finance > Finance_SRP1 LAUNCH UNISPHERE

Configuration Capacity Performance

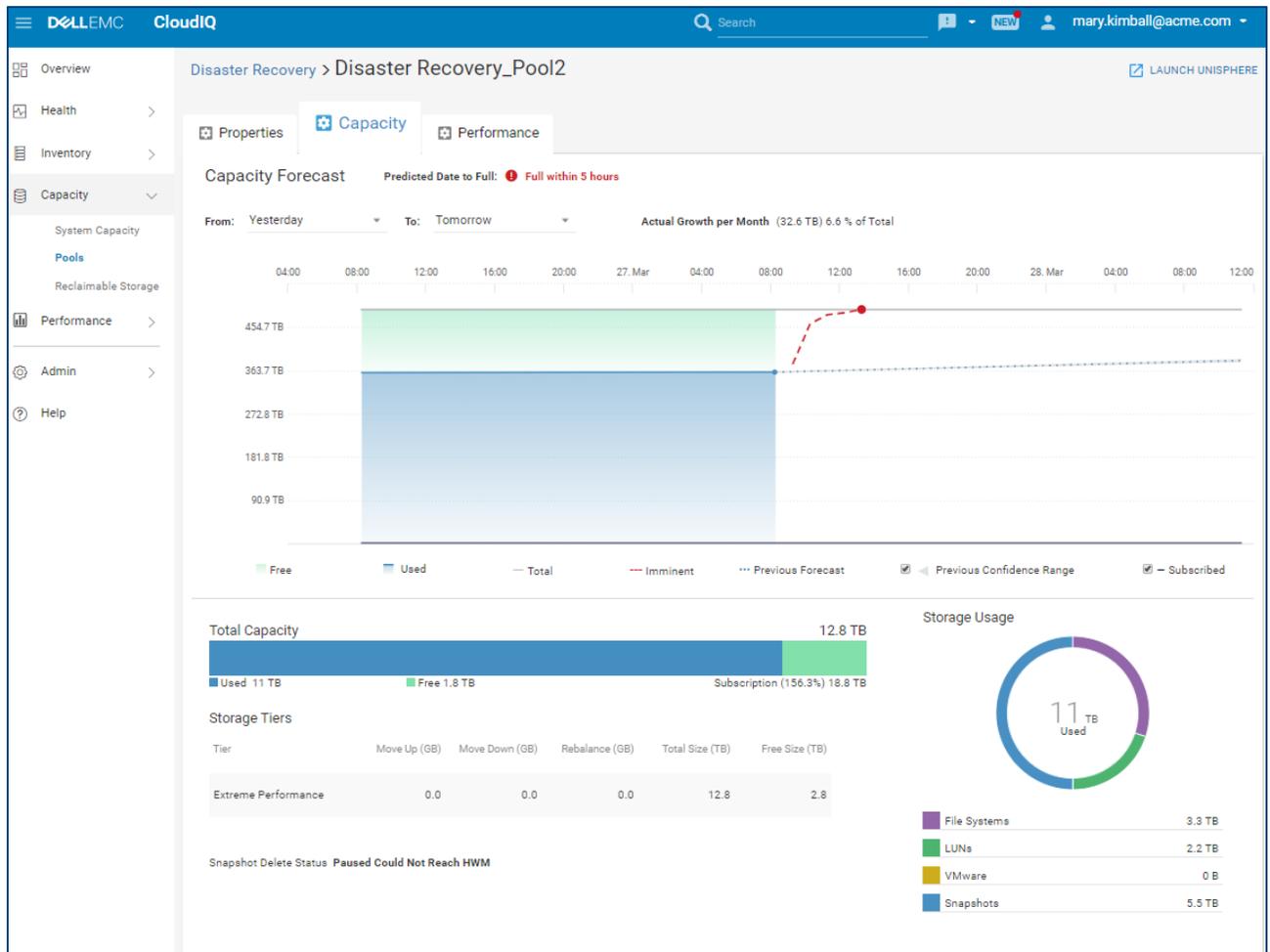
Compression Enabled Reserved Capacity 12 Description Storage Resource Pool for Finance Production

5.2.2 Pool Details – Capacity

The **Capacity** tab for a pool varies based on array type.

5.2.2.1 Unity/PowerScale/Isilon/PowerVault

The graph along the top displays the historical pool capacity data and the Predicted Date to Full date (Unity, PowerVault and PowerScale/Isilon). The graph specifies pool space as Actual Free, Actual Used, Forecast Free, and Forecast Used. The Confidence Range represents the confidence level in predicting the date to full; the wider the range, the lower the confidence level. If the pool is in a Learning, Full, or Unpredictable state, only the historical trend graph is displayed. Otherwise, the historical trend with the forecast graph is displayed.



The beginning of the chart is based on the selection in the “From:” field. By default, the setting is set to “3 months ago”. The following times are available from the pull down:

- 1 month ago
- 3 months ago (default)
- months ago
- 1 year ago
- 2 years ago
- Custom

The end of the chart is based on the selection in the “To:” field. By default, the setting is set to “Predicted Full”. The following times are available in the pull down:

- Today (Only historical data is shown)
- 1 month from today
- 3 months from today
- 6 months from today
- Predicted Full (default)
- Custom

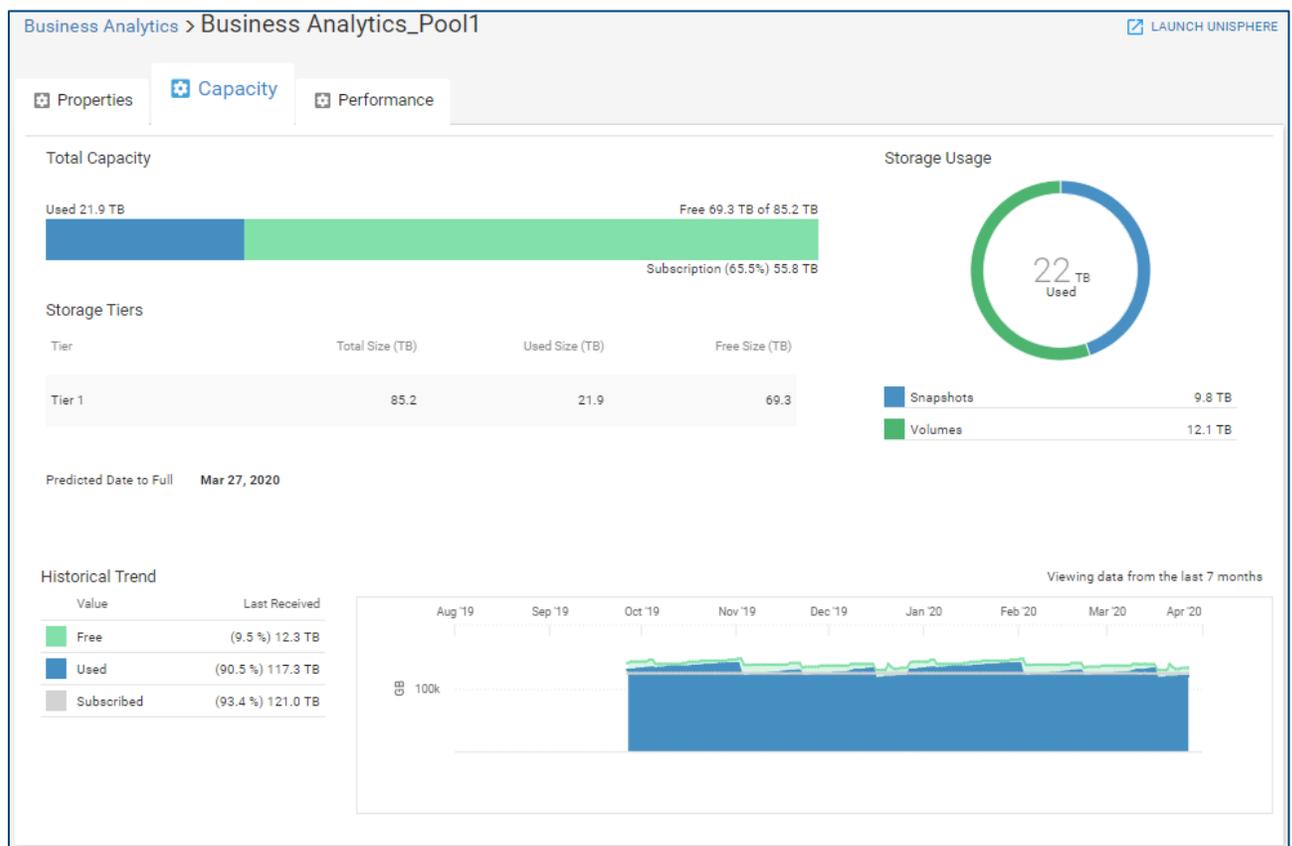
The **Subscribed** checkbox enables the user to view or hide the pool subscription data on the graph.

The **Confidence Range** checkbox enables the user to view or hide the upper and lower confidence range forecasts.

The bottom of the Pools Capacity tab provides details for the pool capacity, showing total Used and Free storage as well as Subscription. There is a Storage Usage ring showing how the used storage is configured.

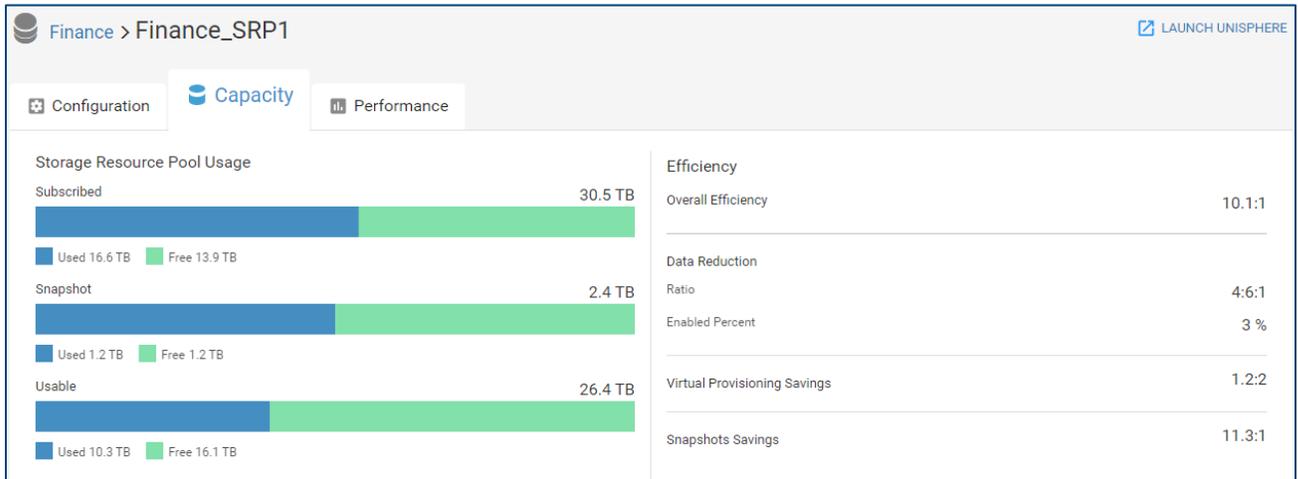
5.2.2.2 SC Series

For SC Series, the historical trend of Used, Free and Subscribed storage is provided along with a Predicted Date to Full. However, the chart does not display forecasting data.



5.2.2.3 PowerMax/VMAX3

For PowerMax and VMAX3 arrays, the Capacity tab displays Used and Free storage in bar charts for Subscribed, Snapshot and Usable space in a Storage Resource Pool. It also displays the Overall Efficiency ratio calculated as the sum of all TDEVs plus snapshot sizes (based on 128K track size) divided by the physical used storage (based on the compressed track size). Data Reduction ratio and enabled percentage, Virtual Provisioning savings and Snapshot savings are also displayed.

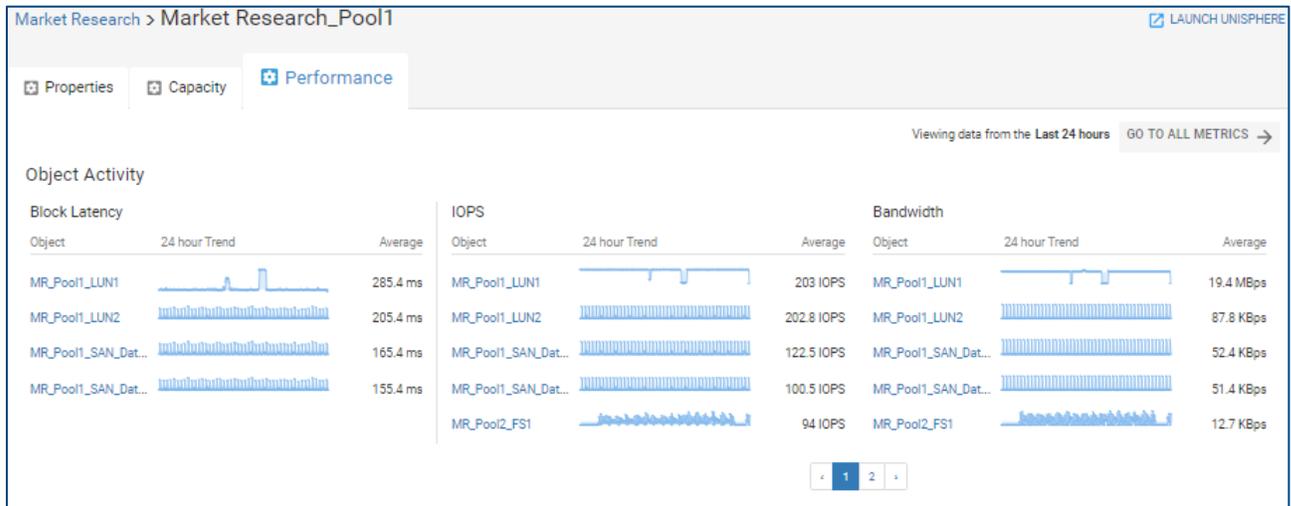


5.2.3 Pool Details – Performance

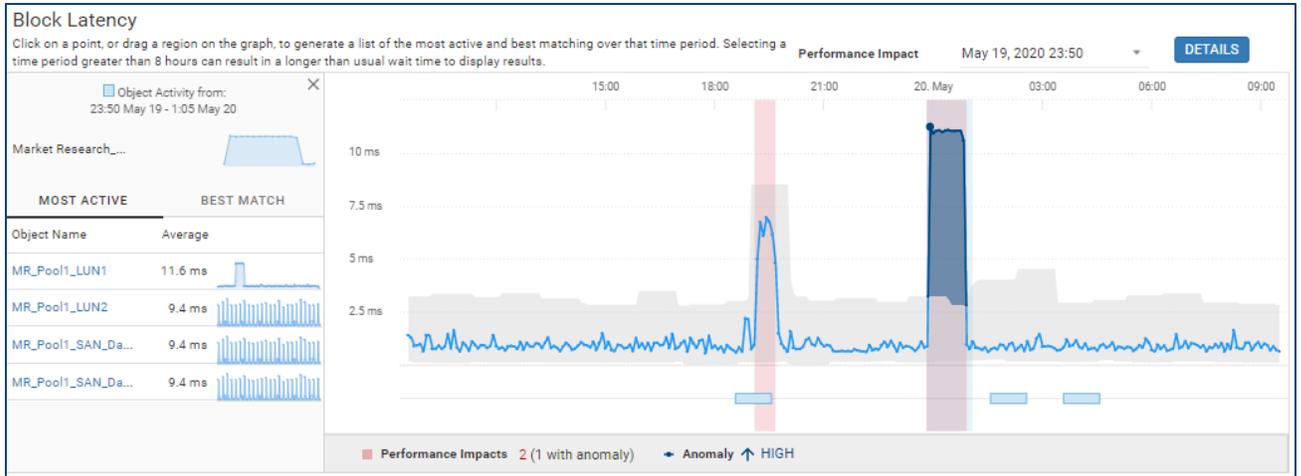
The Performance tab for pools is available for Unity, SC Series, PowerMax/VMAX and PowerVault systems. The information under the Performance tab differs slightly for each supported array type.

5.2.3.1 Unity

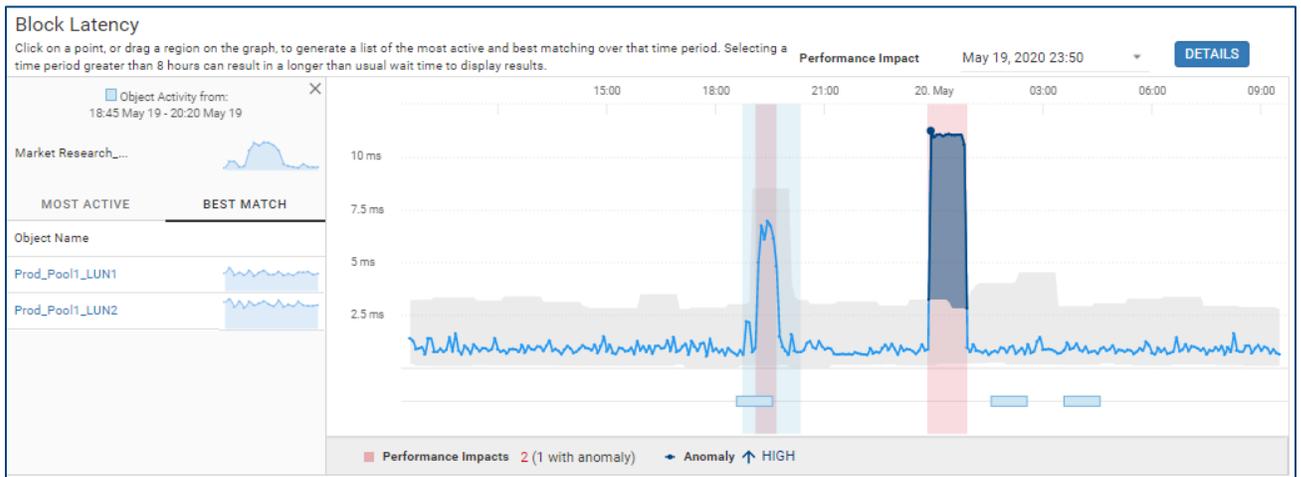
For Unity pools, the top of the page displays 24-hour trend lines and a 24-hour average for Latency (Block only), IOPS and Bandwidth (LUNs and File Systems) for the top 5 storage objects associated to the pool.



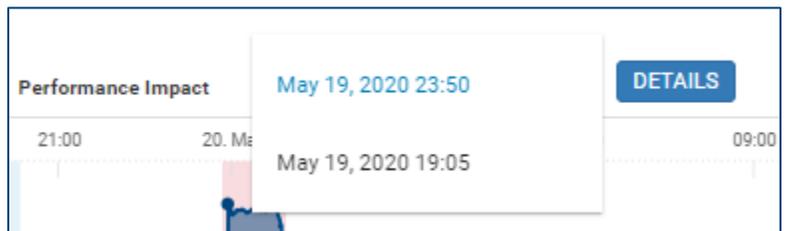
Scrolling down this view provides the user with detailed performance graphs for Block Latency, IOPS, Bandwidth and Backend IOPS (one chart per tier). CloudIQ identifies and highlights not only performance anomalies on the Block Latency chart, but also performance impacts. Performance anomalies are highlighted in dark blue while performance impacts are highlighted in pink. Highlighting an area on the Block Latency, IOPS or Bandwidth performance graphs identifies up to the top 5 most active objects contributing to that metric over the highlighted period.



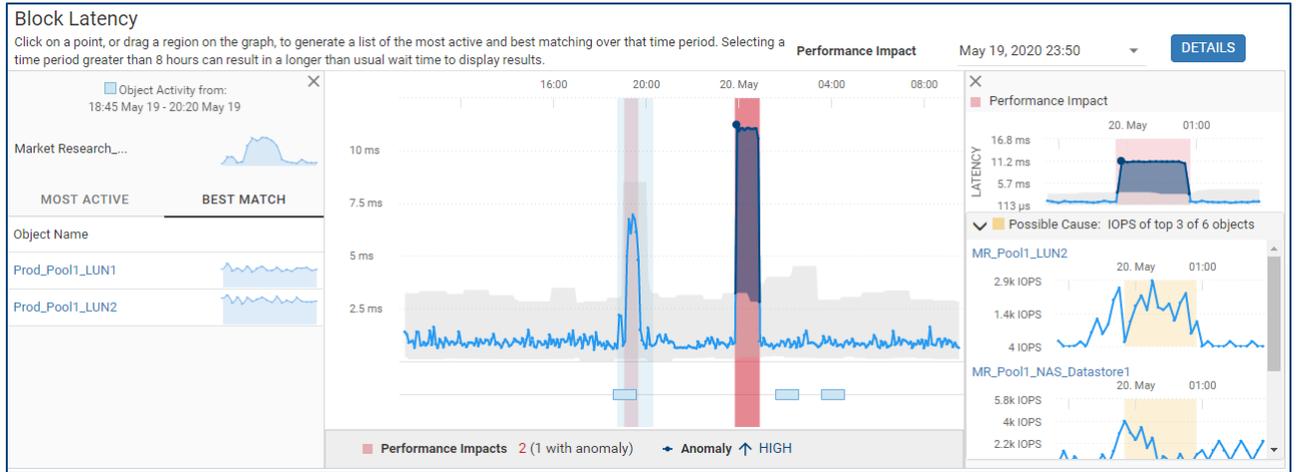
When the user selects Best Match on the left-hand side of the chart, CloudIQ identifies up to 5 objects that have the highest correlation to the selected period. Best Match is available on the Block Latency, IOPS and Bandwidth performance charts.



When there are performance impacts detected by CloudIQ, the user can view details of them by selecting the Details button in the top right of the chart. If there are multiple performance impacts during the 24-hour time period displayed on the chart, the user can select which impact to investigate by selecting the pull-down menu next to the date.

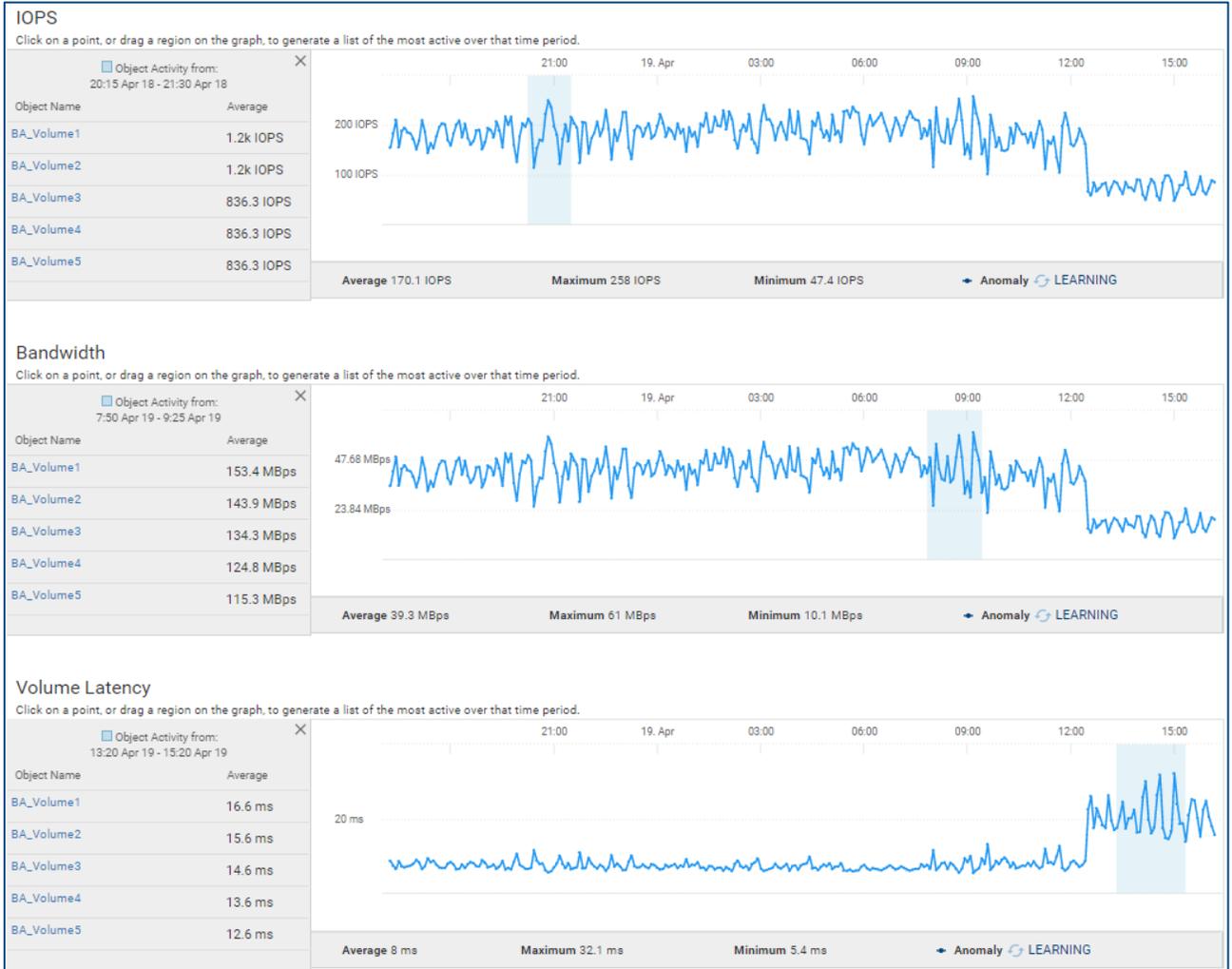


The following shows the results of the details of a performance impact. In the right side of the chart, CloudIQ shows the time of the selected performance impact and then identifies the most likely competing workloads causing the impact.



5.2.3.2 SC Series

Similar to Unity, the top half of the Performance tab for SC Series pools displays 24-hour trend lines and a 24-hour average for Latency, IOPS and Bandwidth. Scrolling down provides displays 24-hour performance graphs for IOPS, Bandwidth and Volume Latency. CloudIQ identifies and highlights performance anomalies on each performance chart for SC Series pools. Highlighting an area in any of these performance graphs identifies the top volumes contributing to that metric during the highlighted period.

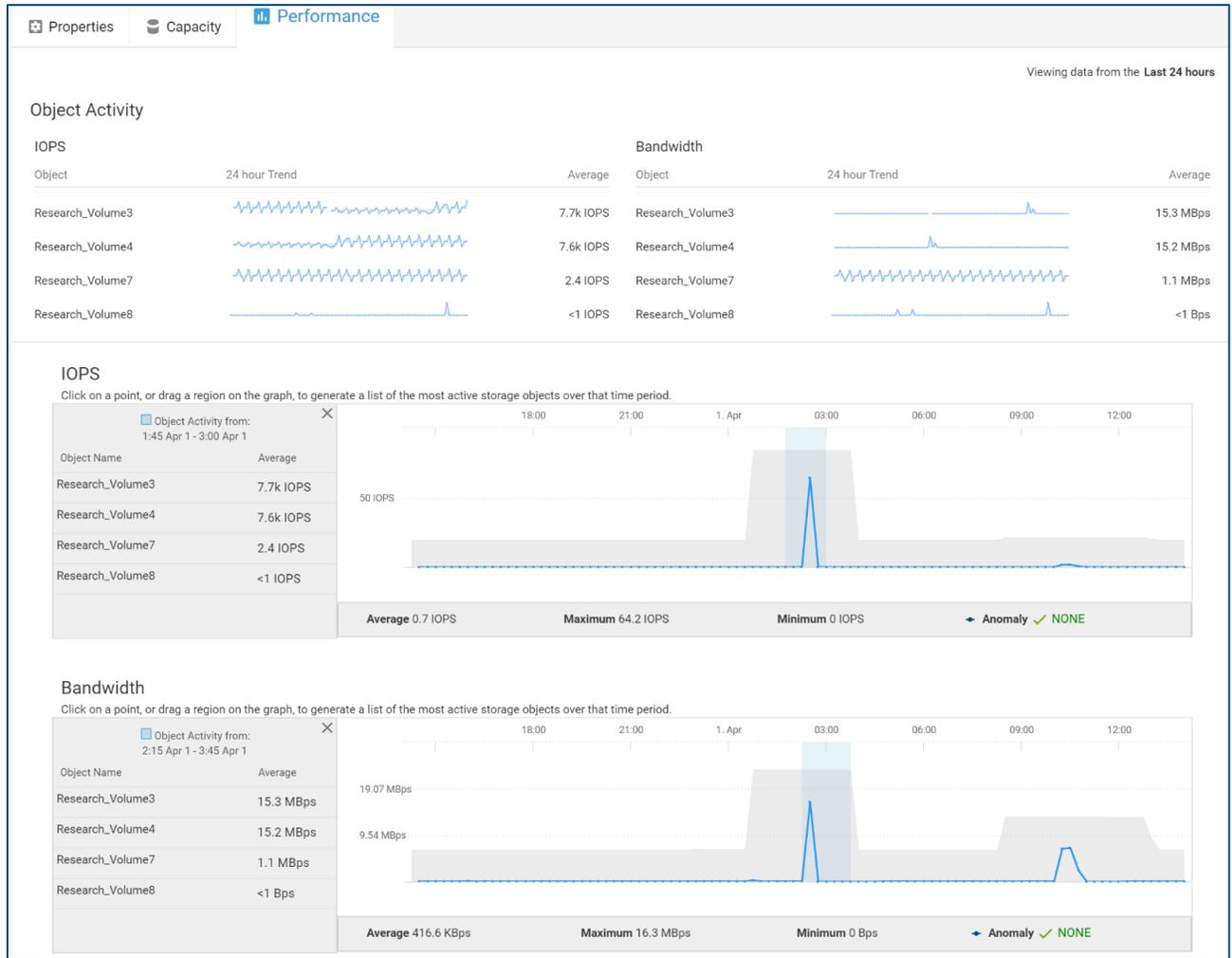


5.2.3.3 PowerMax

The Performance tab for PowerMax Storage Resource Pools provides 24-hour charts for Latency, IOPS, Bandwidth, %Read, IO Size and Queue Length. CloudIQ identifies and highlights performance anomalies for each chart in the SRP Performance tab. The performance charts for PowerMax are not selectable.

5.2.3.4 PowerVault

The Performance tab for PowerVault pools also displays top object activity on the top half of the page and 24-hour charts at the bottom of the page. Metrics displayed include IOPS and Bandwidth. Selecting an area in the IOPS and Bandwidth charts displays the top volumes contributing to that metric at that time frame.



Note: The Performance tab is not yet supported for PowerScale/Isilon pools.

5.3 Reclaimable Storage

The **Reclaimable Storage** page shows block and file objects that may no longer be in use. This is currently supported for Unity, SC Series and PowerVault systems. It shows the total number of storage objects as well as the total amount of potentially reclaimable space across all systems. The following criteria is used to identify potentially reclaimable storage:

- Block Objects with no front end I/O activity
- File Objects with no front end I/O activity
- Block Objects with no Hosts attached

Note: The Reclaimable Storage report intelligently filters out objects that are array-based replicas, since those replicas are neither attached to hosts nor do they have front-end I/O.

The **Group By** pull down menu in the top-right of the page allows the user to group the storage objects either by storage system (default) or by the rule types mentioned above.

Group by System (Default) shows the total number of storage objects and reclaimable space per system. A more detailed view of the objects identified under each rule can be seen by selecting the line item to expand to display the associated details.

The Filter button allows the user to filter the results based on System or Rule Type.

The screenshot displays the 'Reclaimable Storage' dashboard. At the top, it shows '23 Total Storage Objects' and '34.0 TB Total Reclaimable Space'. The 'Group by' menu is set to 'System'. The dashboard is organized into sections for different systems:

- Production (Unity 650F)**: Storage Objects 8, Reclaimable Space 19.0 TB.
 - 5 Block Objects with no front end I/O activity in at least the past week. Reclaimable Space 10.0 TB.

Object	Reclaimable Space	Pool	Last IO Time	Host
Prod_Pool1_LUN1	2.0 TB	Production_Pool1	Tue, Jul 18 2017, 12:00:00 AM UTC	ProdApp1_Host1
Prod_Pool1_LUN2	1.0 TB	Production_Pool1	Tue, Jul 18 2017, 12:00:00 AM UTC	ProdApp1_Host2
Prod_Pool2_LUN1	3.0 TB	Production_Pool2	Tue, Jul 18 2017, 12:00:00 AM UTC	-
Prod_Pool2_LUN2	2.0 GB	Production_Pool2	Tue, Jul 18 2017, 12:00:00 AM UTC	ProdApp2_Host2
Prod_Pool2_SAN_Datstore1	2.0 GB	Production_Pool1	Tue, Jul 18 2017, 12:00:00 AM UTC	LocalESX2
 - 2 Block Objects with no Hosts Attached. Reclaimable Space 2.0 TB.
 - 1 File Objects with no front end I/O activity in at least the past week. Reclaimable Space 7.0 TB.
- Market Research (Unity XT 880F)**: Storage Objects 4, Reclaimable Space 7.0 TB.
 - 1 Block Objects with no front end I/O activity in at least the past week. Reclaimable Space 1.0 TB.
 - 3 Block Objects with no Hosts Attached. Reclaimable Space 6.0 TB.
- Business Analytics (SC7020F)**: Storage Objects 6, Reclaimable Space 7.61 TB.
 - 2 Block Objects with no front end I/O activity in at least the past week. Reclaimable Space 1.63 TB.
 - 4 Block Objects with no Hosts Attached. Reclaimable Space 5.98 TB.
- Product Design (ME4084)**: Storage Objects 5, Reclaimable Space 2.02 TB.
 - 3 Block Objects with no front end I/O activity in at least the past week. Reclaimable Space 1.7 TB.
 - 2 Block Objects with no Hosts Attached. Reclaimable Space 321.4 GB.

The **Group by Rule Type** shows reclaimable storage for each rule. In this view, the total number of storage objects and reclaimable capacity is summarized for each rule.

Reclaimable Storage		
23 Total Storage Objects 34.0 TB Total Reclaimable Space		Group by Rule Type
System <small>Enter a System Name or ID</small>	Block Objects with no front end I/O activity in at least the past week Storage Objects 11 Reclaimable Space 14.0 TB	
	Production	Storage Objects 5 Reclaimable Space 10.0 TB
	Market Research	Storage Objects 1 Reclaimable Space 1.0 TB
	Business Analytics	Storage Objects 2 Reclaimable Space 1.63 TB
	Product Design	Storage Objects 3 Reclaimable Space 1.7 TB
	Block Objects with no Hosts Attached Storage Objects 11 Reclaimable Space 14.0 TB	
	Production	Storage Objects 2 Reclaimable Space 2.0 TB
	Market Research	Storage Objects 3 Reclaimable Space 6.0 TB
	Business Analytics	Storage Objects 4 Reclaimable Space 5.98 TB
	Product Design	Storage Objects 2 Reclaimable Space 321.4 GB
	File Objects with no front end I/O activity in at least the past week Storage Objects 1 Reclaimable Space 7.0 TB	
	Production	Storage Objects 1 Reclaimable Space 7.0 TB

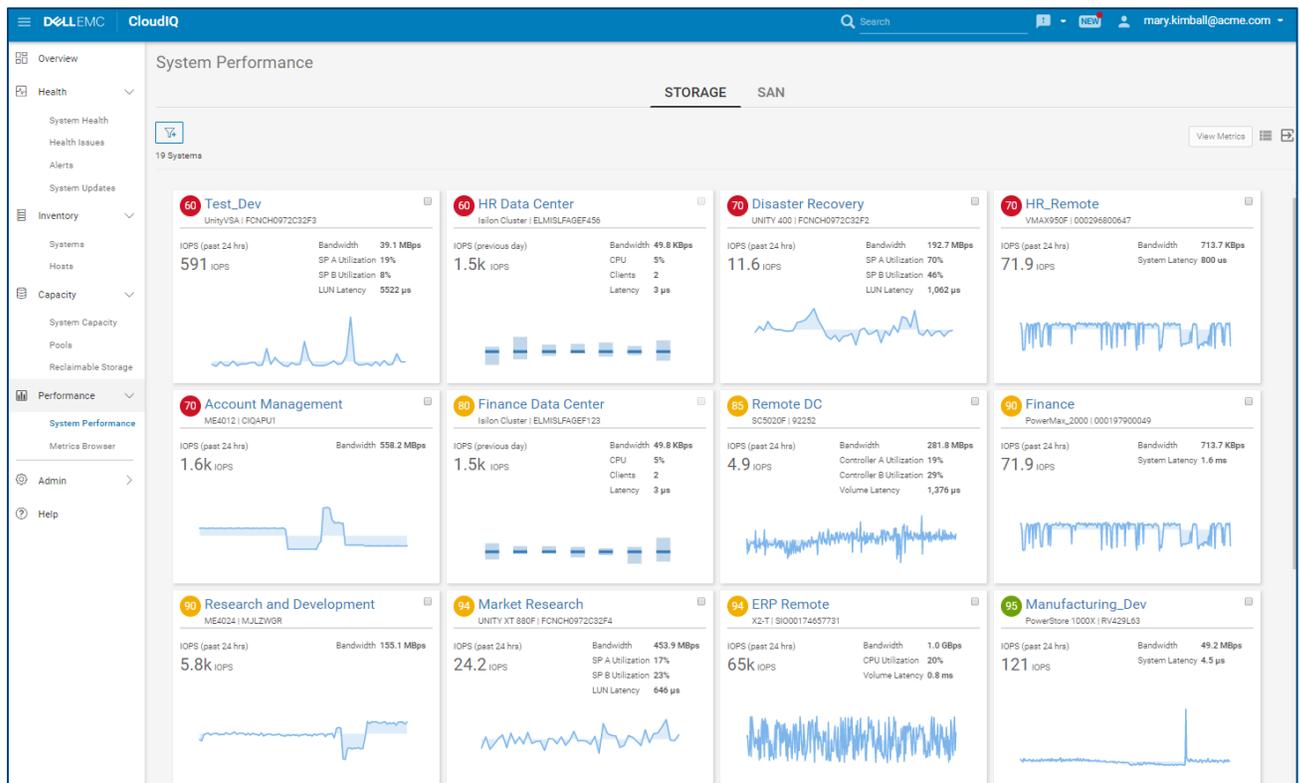
6 Performance

6.1 System Performance

The System Performance page displays system-level performance metrics across all systems.

The information displayed for storage systems includes:

- **IOPS** – Average I/O requests per second over the last 24-hour period.
- **Bandwidth** – System bandwidth showing average host bytes per second over the last 24-hour period.
- **Utilization (Card View Only)** – Average percent of time the Storage Processors (Unity) or Controllers (SC and XtremIO) are busy over the last 24-hour period.
- **Latency** – The average time required for a packet to travel from the host to the object over the last 24-hour period. (LUNs for Unity, Volumes for SC Series and XtremIO). For PowerMax and VMAX, displays the response time for read and write I/O requests for the system.
- **Performance Trend graph** – Chart showing IOPS over the past 24 hours with a data point on every update (varies slightly per product type).

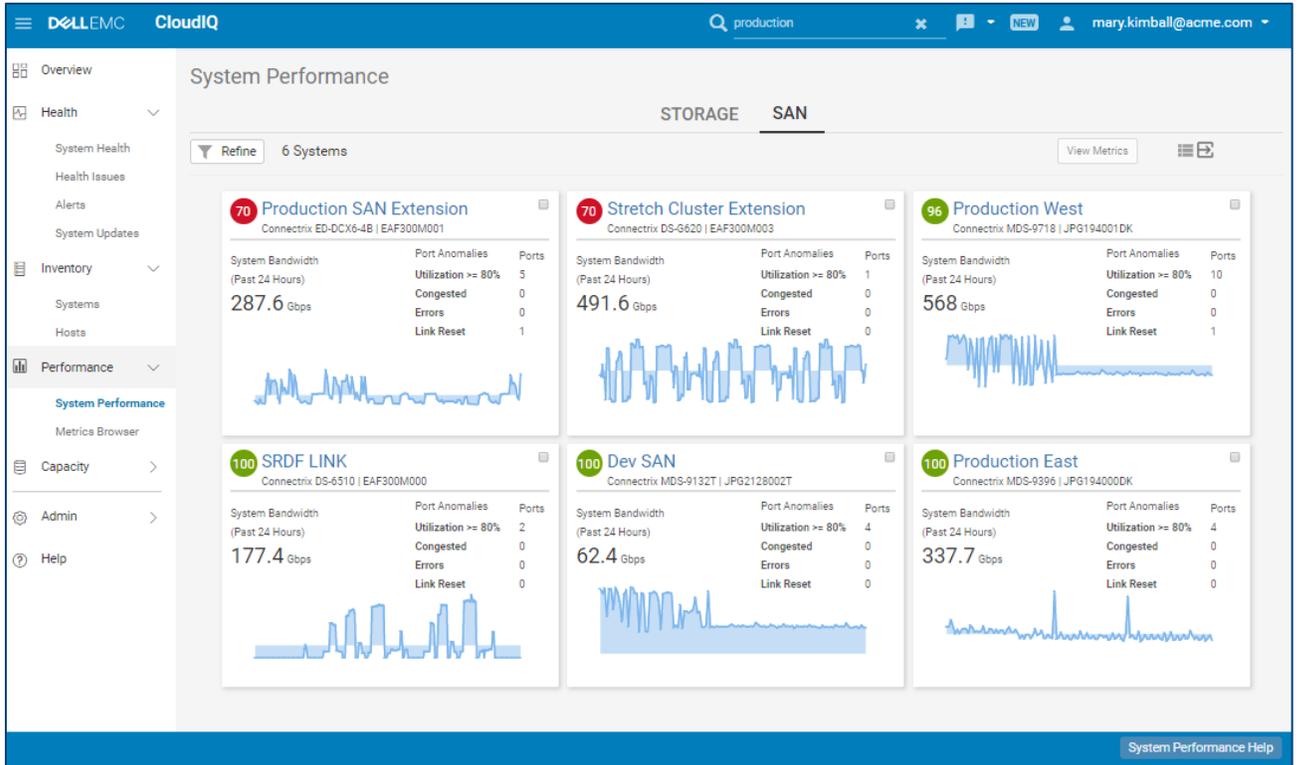


For storage systems, CloudIQ offers the additional feature of enabling the user to select multiple systems (up to 10) to compare performance metrics. The user can simply click the checkbox to select the systems to compare, and then click the **Compare Metrics** button. In the Card view, the checkbox is in the upper right corner of each card, and in the List view, the checkbox is in the rightmost column. The “Compare Metrics” button only appears on the GUI after you have chosen more than 1 system.

Note: Only systems of the same product type can be selected for comparison.

The information displayed for SAN switches includes:

- **System Bandwidth** – Average bandwidth for the switch over the last 24-hour period.
- **Utilization >= 80%** - Number of ports with utilization greater than or equal to 80%
- **Congested** – Number of ports with congestion
- **Errors** – Number of ports with errors
- **Link Reset** – Number of ports with link resets



6.2 Metrics Browser

The Metrics Browser section allows the user to create custom performance dashboards. Different performance metrics are available based upon the selected System type and Category, as shown in the tables below.

Dell EMC Unity Metrics

Metric	Block	Drive	Ethernet	Fibre Channel	File	iSCSI	Pool	Pool Backend	System	System Backend	System-Cache
Bandwidth	X	X	X	X	X	X	X	X	X	X	
Block Latency	X						X		X		
CPU Utilization									X		
IO Size	X				X		X	X	X	X	
IOPS	X	X			X		X	X	X	X	
% Read	X	X			X		X	X	X	X	
Queue Length	X						X		X		
VVol Latency							X		X		
Errors			X								
Packets			X								
Requests				X		X					
Total Link Errors				X							
% Clean											X
% Dirty											X
% Free											X
% Read Hits											X
% Write Hits											X
Flushed											X

SC Series Metrics

Metric	Drive	FC, SAS, iSCSI	Pool	Pool Backend	System	System Backend	Volume
Bandwidth	X	X	X	X	X	X	X
Latency	X	X	X	X	X	X	X
CPU Utilization					X		
IO Size		X	X	X	X	X	X
IOPS	X	X	X	X	X	X	X
% Read	X	X	X	X	X	X	X
Queue Length	X	X	X	X	X	X	X

XtremIO Metrics

Metric	Initiator	System	Target	Volume
Bandwidth	X	X	X	X
Block Latency	X	X	X	X
IOPS	X	X	X	X
CPU Utilization		X		

PowerMax/VMAX Metrics

Metric	Storage Group	Storage Resource Pool	System
Bandwidth	X	X	X
Latency	X	X	X
IOPS	X	X	X
IO Size	X	X	
% Read	X	X	
Queue Length	X	X	

PowerStore Metrics

Metric	Appliance	File System	System	Volume	Volume Group
Bandwidth	X	X	X	X	X
CPU Utilization	X				
IOPS	X	X	X	X	X
Latency	X	X	X	X	X
% Read		X			
IO Size		X		X	X
Queue Depth				X	

PowerVault Metrics

Metric	Controller	Drive	Host	Pool	Pool Backend	System	System Backend	Volume
% Read	X	X	X	X	X	X	X	X
Bandwidth	X	X	X	X	X	X	X	X
IO Size	X	X	X	X	X	X	X	X
IOPS	X	X	X	X	X	X	X	X
% Read Hits								X
% Write Hits								X

VMware Metrics

Metric	ESXi	Virtual Machine	Datastore
Active Memory	X	X	
Bandwidth per Datastore		X	
CPU Readiness		X	
CPU Usage	X		
IOPS per Datastore		X	
Latency per Datastore		X	
Storage Latency		X	
Capacity			X
Free Space			X
Uncommitted			X

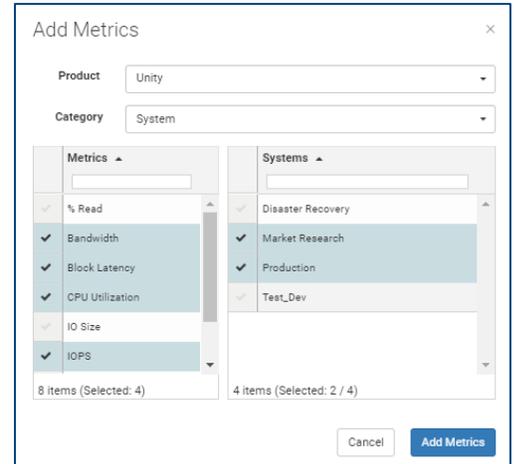
Connectrix Metrics (Fibre Channel Only)

Metric	Switchport	System
Buffer Errors	X	
Class-3 Discards	X	
Congestion Ratio	X	
CRC Errors	X	
Link Resets	X	X
Physical Layer Errors	X	
Protocol Errors	X	
Throughput	X	X
Time at Zero Tx Credit	X	
Utilization	X	X
B2B Credit Zero/sec		X
Errors		X

6.3 Creating a Dashboard

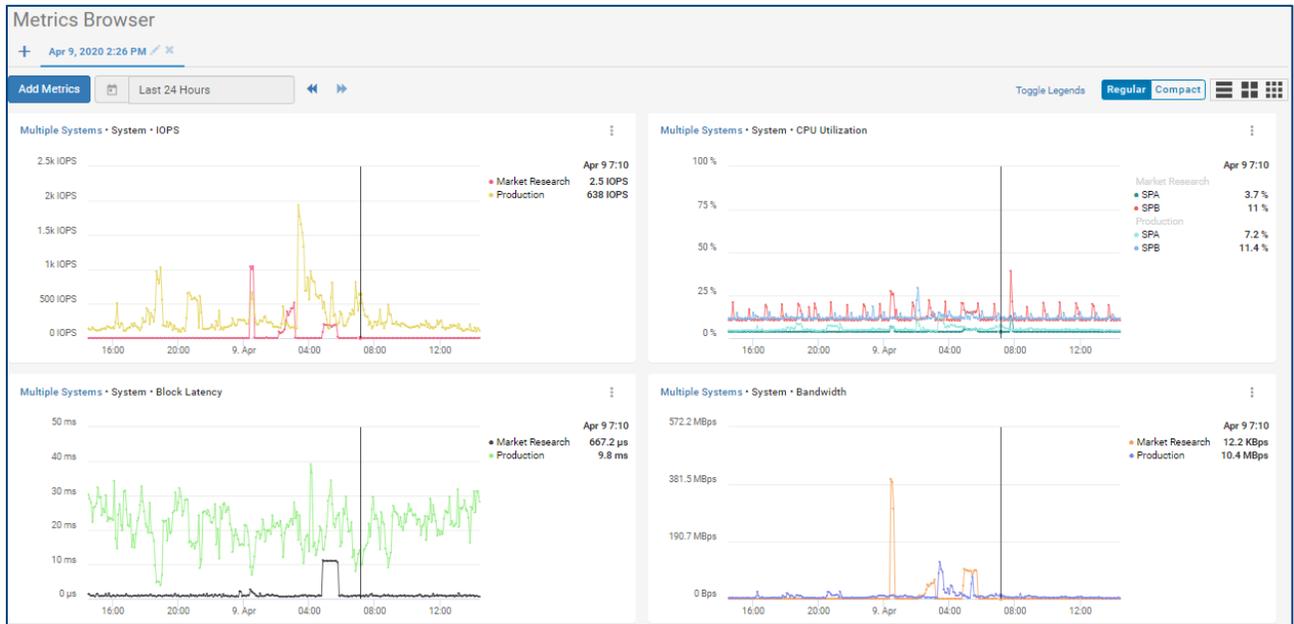
Selecting **Add Metrics** from the Metrics Browser page opens a window that allows the user to select which metrics and objects to add to the performance dashboard.

1. Select the Product.
2. Select the Category.
3. Select System (for non-system metrics)
4. Select the performance metrics from the Metrics list.
5. Select the System(s)/Object(s).
6. Select Add Metrics.



The resulting dashboard shows the performance graphs for each selected metric and object. Scrolling across the timeline graph with the mouse displays a vertical line on each graph with the associated metric values in the legends for quick correlation of performance at any given time. These charts can be viewed with one, two or three charts per row. By default, the time range is set to Last 24 Hours, but can be changed using a pre-defined value ranging from Last Hour to Last 7 Days. The user can also enter a custom time range allowing for longer and specific time ranges.

The user also has the option to remove the legends by selecting Toggle Legends. This expands the horizontal space to view the chart. Changing from Regular charts to Compact charts reduces the chart height allowing the user to see more information in a smaller area.



Note: VVol data is not included in object-level (LUN, file system, and drive) metrics because VVol object data is not collected.

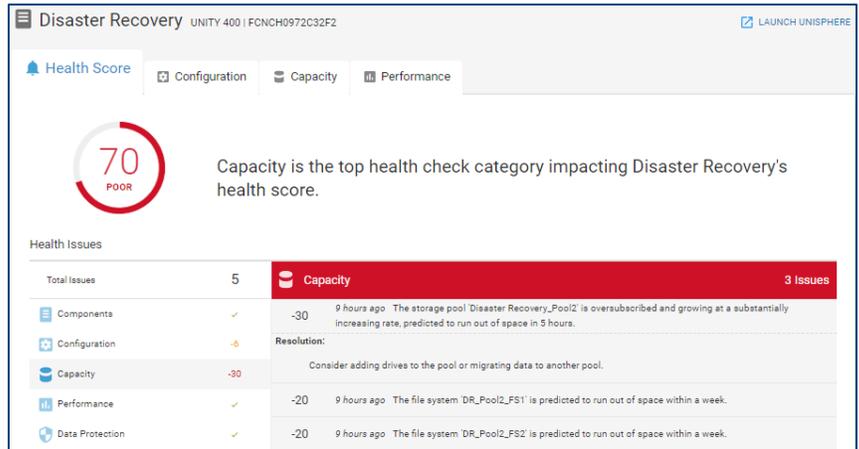
7 Storage System Details

Selecting the storage system hyperlink in the overview page or any of the multi-system views opens the System Details page for that system. The following sections discuss each tab of the Storage System Details page in greater depth.

7.1 Storage System Details – Health Score

The Health Score tab shows the details for a selected system driving the health score number. The view provides a listing of issues found in each of the following categories:

- Components
- Configuration
- Capacity
- Performance
- Data Protection

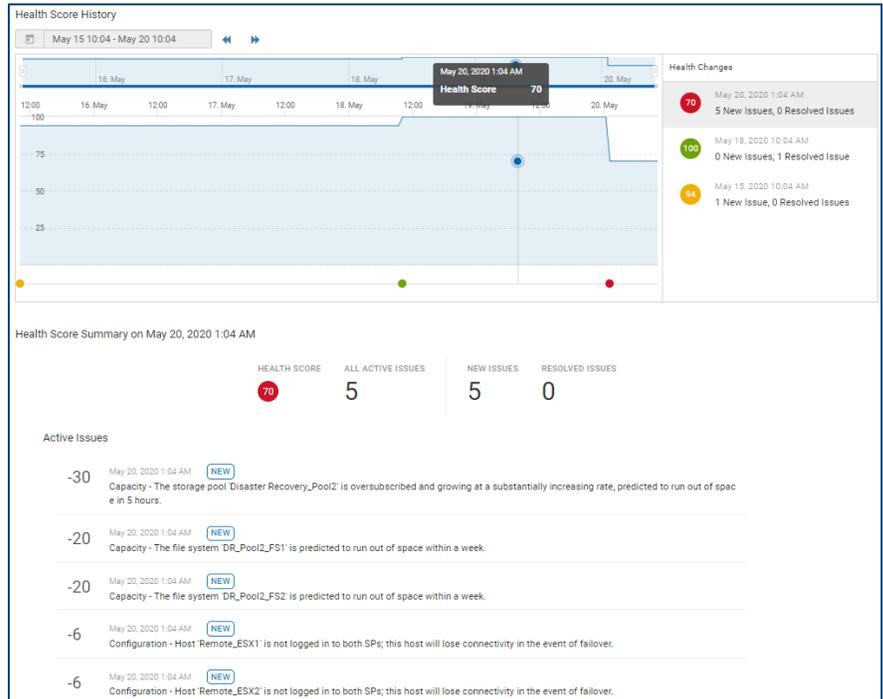


In this example there are five issues: two in the Configuration category and three in the Capacity category. Selecting the category and then selecting one of the issues will display the recommended resolution.

Notes: The Components and Data Protection categories do not apply for PowerMax/VMAX systems. The Performance and Data Protection categories do not apply for PowerVault ME4 systems. Only the Components category is currently used for Connectrix switches.

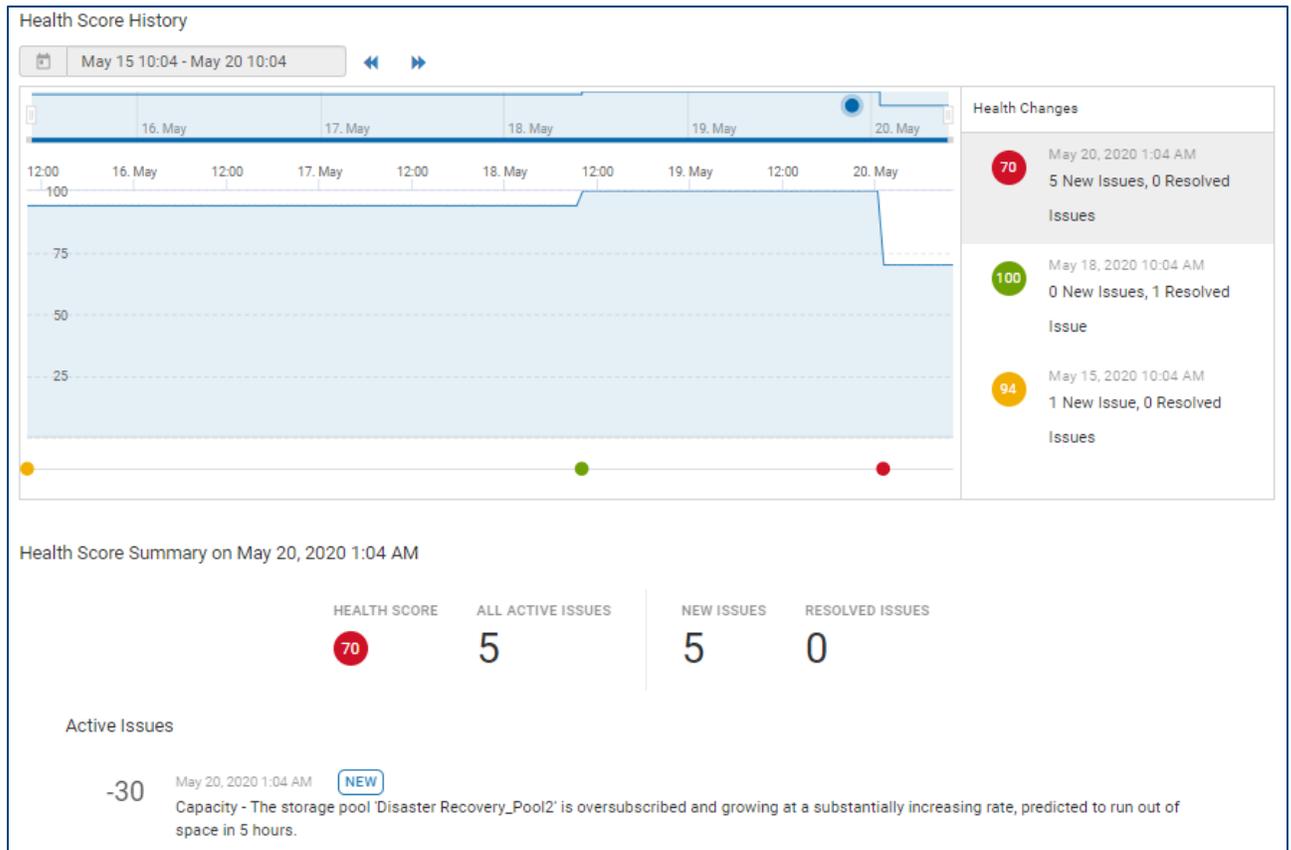
Scrolling down in this view shows the history of the health score for the system as shown below. This graph displays the historical trend of the health score and details of any issue(s) over the displayed range of time.

Selecting any of the issues listed to the right of graph will mark the change on the timeline and a summary of the active issues will be displayed below the graph. Selecting an individual active issue will open a recommended resolution.



Selecting the calendar will open a drop-down allowing users to select one of the predefined ranges or enter a custom time range. A custom view is the default. Selecting any of the dates on the right will present the list of issues for that date.

Viewing a history of health issues across a longer-term time range can be helpful in identifying recurring issues in the environment.



7.2 Storage System Details – Configuration

The Configuration tab shows the configuration data and contract information of the selected system as well as the physical and logical components of the system. The upper portion of this view provides the system attributes such as Serial Number/ServiceTag, Model, Location, Code Version, IP Address and Contract Expiration. Some attributes vary by system type (such as Uptime and Hotfixes which are specific to Unity).

Disaster Recovery UNITY 400 | FCNCH0972C32F2

Health Score Configuration Capacity Performance

Serial Number	FCNCH0972C32F2	SPA Up Time	1 month	IPv4	10.0.0.3
Model	UNITY 400	SPB Up Time	1 month	IPv6	2620:0:170:7430:260:1600:3c2c:32f1
Location	Hopkinton, MA	Version	4.2.0.9433914	Contract Expiration	Nov 24, 2020
Site	ACME Branch Office	Last Contact Time	1 hour ago	Service Plan	ProSupport 4HR/Mission Critical
		Hotfixes	4.2.0.9433914.0.1.008, 4.2.0.9433914.0.1.009	Contract Number	31578817BR

POOLS STORAGE VIRTUAL MACHINES DRIVES HOSTS 3 Pools

Issues	Name	Type	Total Size (TB)	Used (%)	Subscription (%)	Time To Full	Free (TB)
✓	Disaster Recovery_Pool1	Traditional	25.6	64.1	117.2	Unpredictable	9.2
1	Disaster Recovery_Pool2	Traditional	12.8	85.7	156.3	Imminent	1.8
✓	Disaster Recovery_Pool3	Traditional	83.2	49.4	49.9	Within a month	42.1

As noted earlier, CloudIQ indicates when a storage system has a code update available. In this single system view, there is also an indication if the management software has an available update (for PowerMax/VMAX and XtremIO systems). Clicking the 'Learn More' link will open a dialog with summary information and relevant links to support resources.

The bottom half of the page provides details about the physical and logical components of the system. The tabs differ based on product type but could include:

- Pools (Unity, SC Series, PowerVault and PowerScale/Isilon) / Storage Resource Pools (PowerMax/VMAX)
- Storage (Unity, PowerStore, SC Series and PowerVault) / Volumes (XtremIO) / Storage Groups (PowerMax/VMAX)
- Virtual Machines (Unity, PowerStore, SC Series, XtremIO and PowerMax/VMAX)
- Drives (Unity, PowerStore, SC Series and PowerVault)
- Hosts (Unity, PowerStore and XtremIO) / Servers (SC Series) / Initiators (PowerVault)
- Consistency Groups (XtremIO)
- Service Levels (PowerMax/VMAX)
- Nodes (PowerScale/Isilon)
- Appliances (PowerStore)
- Storage Containers (PowerStore)

The **Pools/Storage Resource Pools** tab shows various information about the configured storage pools including Total Size, Used %, Subscription %, Time to Full, and Free. This information helps in understanding the pools at risk where subscription rate is greater than the total free storage and the Time to Full is predicted within a month.

The **Storage/Volumes** tab shows all the storage objects in the system. Depending on product type, this tab displays various used and free capacity information for the storage objects.

- Unity: LUNs, File Systems, VMware VMFS, and VMware NFS
- SC Series: Volumes
- XtremIO: Volumes

This view can help to determine which specific object is consuming the greatest amount of storage.

The **Storage Groups** tab shows a listing of storage groups on the storage system along with the total capacity, associated storage resource pool, the associated service level and whether or not it is in compliance with the service level objective.

The **Virtual Machines** tab lists the VMs on the storage system along with various details including the operating system and associated vCenter, ESX Server and ESX Cluster.

The **Drives** tab gives the details on the drives for the given storage system and their location in the system. It includes remaining endurance, storage tier and firmware version. There will also be an indication if there is a firmware update available.

The **Hosts/Servers/Initiators** tab gives the details about the hosts attached to this storage system. It includes host name, IP Address, operating system, initiator protocol and total accessible storage for each host from the specific storage system. For PowerVault initiators, it lists the initiator name, protocol and total provisioned storage to each initiator from the storage system.

The **Consistency Groups** tab lists the XtremIO consistency groups on the system including their mapped status, number of volumes and total and used capacities.

The **Service Levels** tab lists the configured service levels on PowerMax systems along with the expected response times.

The **Nodes** tab provides information on each PowerScale/Isilon node such as node type, total and used capacity and associated pool.

The **Appliances** tab lists each appliance in the PowerStore cluster along with attributes such as State, Serial Number, CPU, Used and Provisioned storage.

The **Storage Containers** tab provides capacity information for the storage containers in the PowerStore cluster.

7.3 Storage System Details – Capacity

The Capacity tab shows slightly different information depending on the product type. The storage capacity details for Unity, PowerStore, SC Series, PowerVault and PowerScale/Isilon include:

- Total Capacity
- Storage Usage
- Drive Type Usage (Not applicable for Isilon)
- Pools

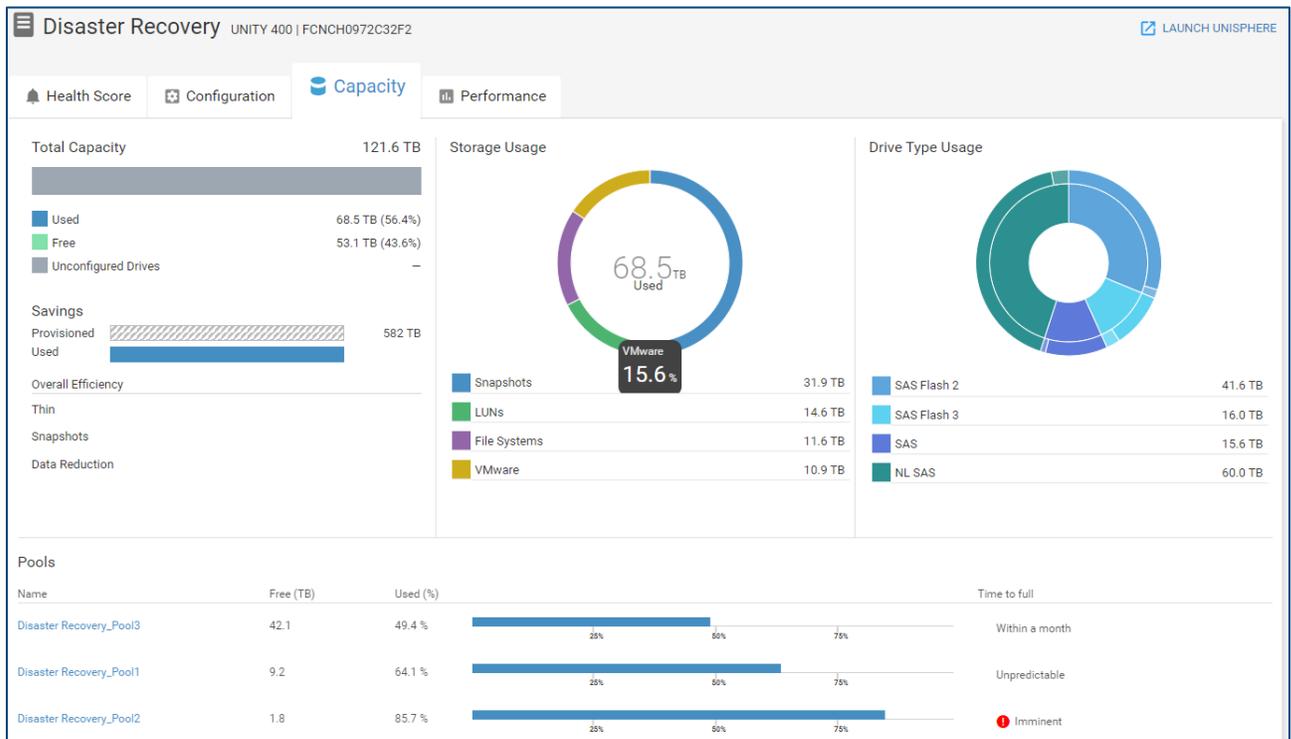
The **Total Capacity** is a breakdown of the raw storage: Used, Free, and Unconfigured Drives (Unprovisioned Capacity for Isilon).

Savings includes a breakdown of the Logical and Used capacity of the total storage visible to the hosts, as well as the Efficiency Savings explained previously.

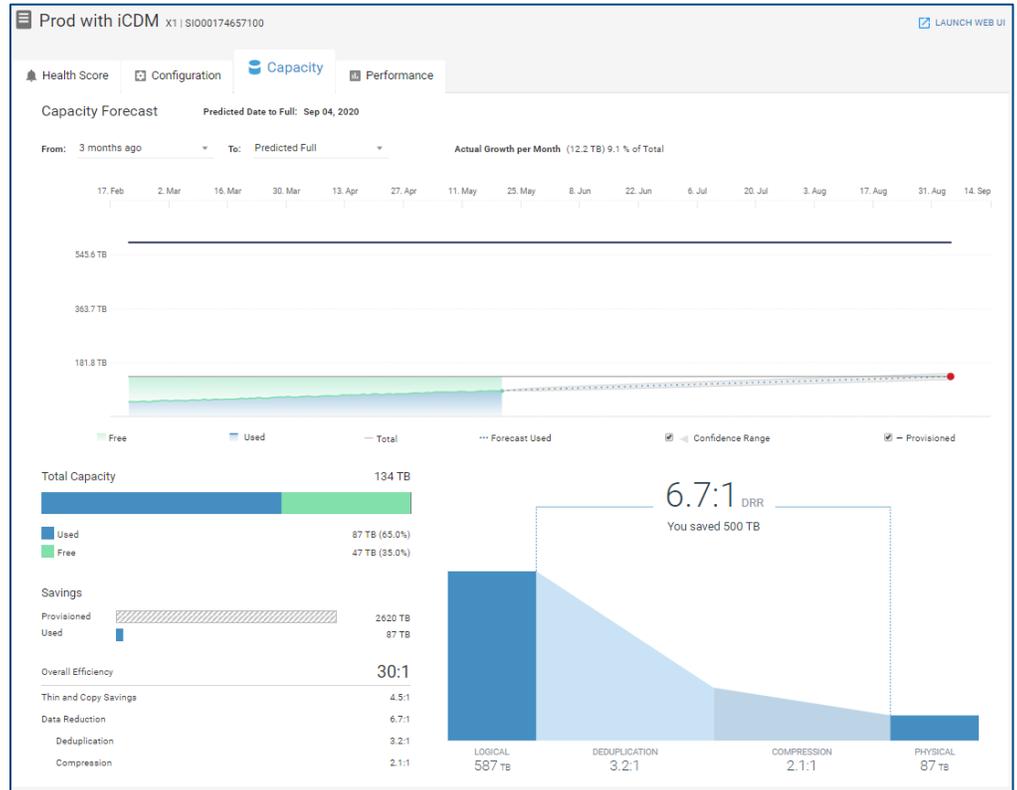
Storage Usage shows the consumed capacity of these categories of storage objects: Block (LUNs for Unity, Volumes for PowerStore, SC Series and PowerVault), File Systems (Unity and PowerStore), Virtual Hot Spares (PowerScale/Isilon), User data (PowerScale/Isilon), VMware (VMware datastores for Unity and PowerStore), and Snapshots.

Drive Type Usage (not available for PowerScale/Isilon) shows the drive types installed in the system, with configured and unconfigured capacity. Hovering over the rings will show the details related to that configuration.

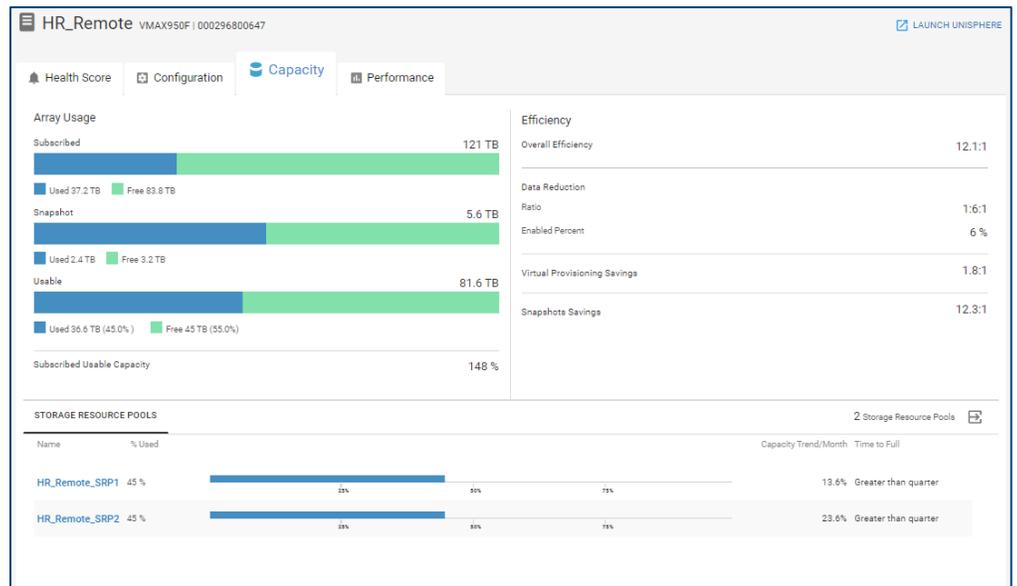
Pools lists the configured storage pools on the system. It includes the Free, Used, and Time to Full details for each pool. Selecting a pool name navigates the user to the Pool Details page.



XtremIO systems include the total capacity broken down by used and free along with a detailed data reduction chart.



PowerMax/VMAX systems display Used and Free capacities for Subscribed, Snapshot and Usable storage as well as the storage efficiency ratios and the percent used per storage resource pool.



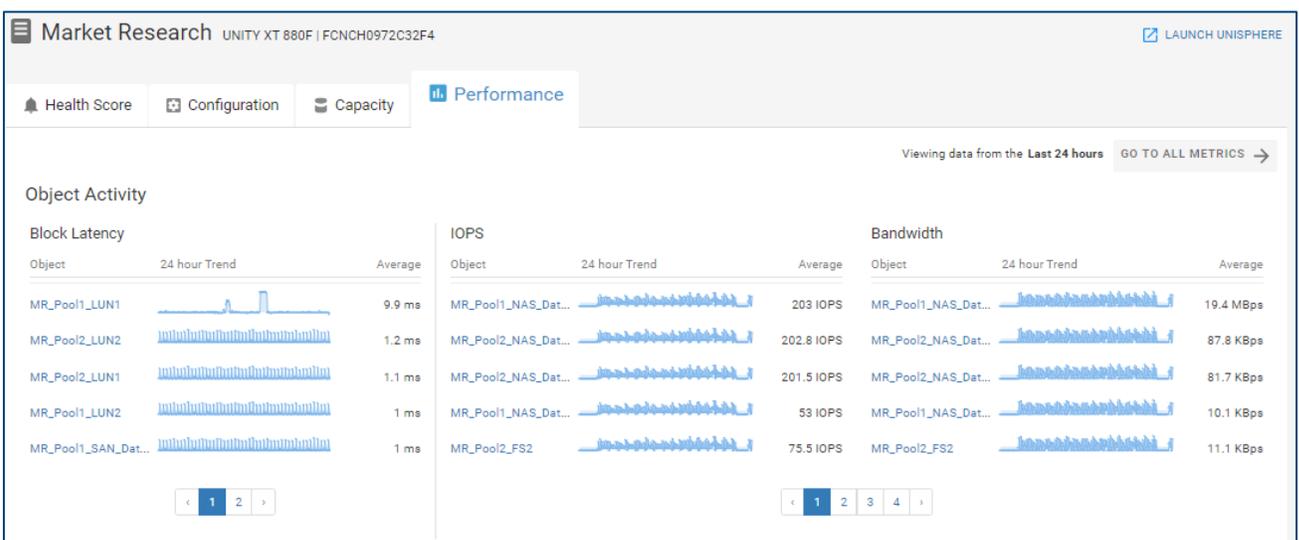
7.4 Storage System Details – Performance

The Performance tab is supported for all storage systems. It is similar to the Performance tab for Pools discussed earlier in this paper. The top portion of this tab is the Object Activity and it shows key performance metrics for storage objects sorted by their 24-hour averages. The result is the user immediately sees the top contenders for resources on the system.

The following metrics are displayed with a 24-hour trend line as well as the 24-hour average. It is sorted to show objects with the highest averages over the last 24 hours allowing the user to immediately see the top contenders for resources on the system.

- Block Latency (Unity), Volume Latency (SC Series), Latency (PowerStore, PowerMax/VMAX and XtremIO)
- IOPS (all platforms)
- Bandwidth (all platforms)

Note: For PowerMax/VMAX systems, CloudIQ displays these performance metrics at the Storage Group level.



The remaining charts show 24-hour history of key system level performance metrics with an overlay of historic seasonality. The metrics vary slightly by product type:

- Block Latency (Unity) / Volume Latency (SC Series) / Latency (PowerStore, PowerMax/VMAX, XtremIO and PowerScale/Isilon)
- IOPS (all platforms)
- Backend IOPS (for Unity - if multiple storage tiers exist, each tier has a separate chart)
- Bandwidth (all platforms)
- Storage Processor Utilization (Unity) / Controller Utilization (SC Series) / CPU Utilization (XtremIO and PowerScale/Isilon)
- Client (PowerScale/Isilon)
- Protocol: IOPS (PowerScale/Isilon)
- Protocol: Bandwidth (PowerScale/Isilon)
- Protocol: Throughput (PowerScale/Isilon)

For additional performance metrics, the user can select the **GO TO ALL METRICS** button in the upper right corner of the Object Activity window to access the Metrics Browser. Section 6.2 (The Metrics Browser) provides more information about performance charts and how to create customized performance dashboards.

CloudIQ identifies performance anomalies on all system level performance charts for all system types. Performance anomalies are identified by a shaded blue area. For Unity, PowerStore and PowerMax systems, CloudIQ identifies areas of performance impacts on the Block Latency chart. Performance impacts are identified by a pink shaded area. Similar to the latency chart for Unity storage pools, the user can select the DETAILS button to see the most likely competing workloads causing the impact.

For Unity systems, configuration changes are identified as rectangles along the X-axis of the charts. Selecting the configuration change rectangle opens the Storage Configuration Changes popup window which contains details of the change(s). This helps the user potentially correlate configuration changes in the environment to performance impacts.

Selecting any area in the Latency, IOPS and Bandwidth charts for any system type displays the top five most active storage objects during that time period in the left-hand side of the chart (LUNs for Unity, Volumes for PowerStore, SC Series, PowerVault and XtremIO, Storage Groups for PowerMax/VMAX). In the example below, the area around the second impact with the performance anomaly is highlighted and it shows the most active objects in the left-hand side of the screen. For Unity systems, CloudIQ also provides the Best Match tab identifying objects whose performance characteristics most closely correlate to the selected range in the performance chart. This is shown in the IOPS chart below.



8 Block Object Details

Block objects include LUNs for Unity systems and volumes for SC Series, XtremIO and PowerVault. They can be accessed via the Storage listing for individual Systems and Pools and can also be found using global search.

8.1 Block Object Details – Properties

The **Properties** tab for a Block object displays attributes for the object as well as any Health issues associated with this object. The bottom of the page varies slightly depending on storage type. It displays the Hosts (for Unity and XtremIO systems), Servers (for SC Series) or Initiators (for PowerVault) associated to the object. The Virtual Machines tab lists information for VMs residing on the object and is available for Unity, SC Series and XtremIO objects. The Consistency Groups tab is available for XtremIO volumes listing consistency group information to which the volume belongs.

Market Research > MR_Pool1_LUN1 LAUNCH UNISPHERE

Properties | Capacity | Performance | Data Protection

Pool: Market Research_Pool1
 Type: LUN
 FAST Cache: –
 FAST VP Policy: Start High Then Auto-Tier
 Consistency Group: MRApp1CG
 Thin: Yes
 SP Owner: SP A
 CLI ID: sv_10
 WWN: 60:06:01:60:0A:30:3E:00:AB:2D:48:58:26:AE:B2:23
 Data Reduction: On

Total Issues: 0 **Total**

Components ✓
 Configuration ✓
 Capacity ✓
 Performance ✓
 Data Protection ✓

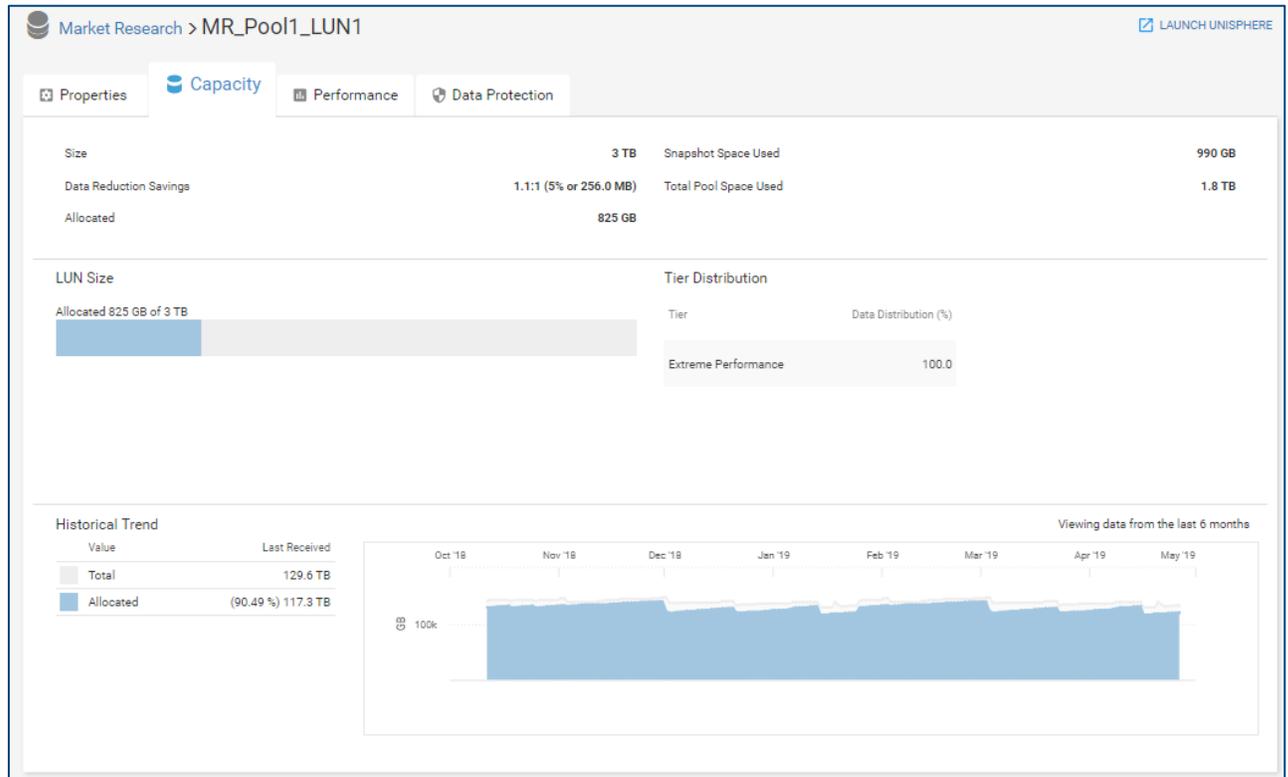
All health checks were successful.

HOSTS | VIRTUAL MACHINES 2 Hosts

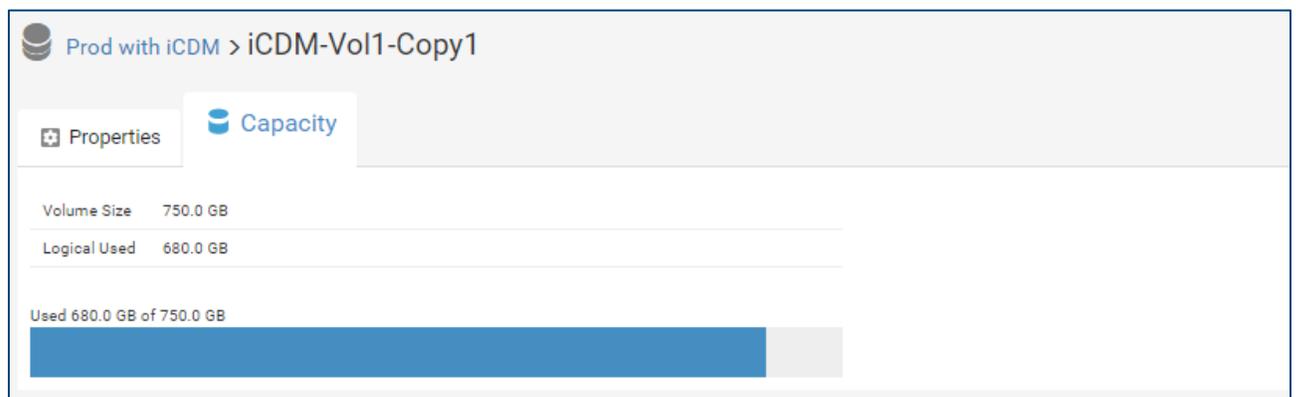
Issues	Name	Network Address	Operating System	Initiator Protocol	Initiators (#)	Total Size (TB)
1	MRApp1_Host1	10.0.0.20	Windows Server 2012	FC	2	5.8
1	MRApp1_Host2	10.0.0.21	Windows Server 2012	FC	2	5.8

8.2 Block Object Details – Capacity

The **Capacity** tab for Unity, SC Series and PowerVault block objects provides details for the capacity being used including Data Reduction savings and capacity utilization by Snapshots. The Historical Trend shows the capacity changes over time helping users identify increasing trends to anticipate future capacity usage.



The Capacity tab for an XtremIO volume does not support the historical trend. Volume Size and Logical Used metrics are reported as shown below.

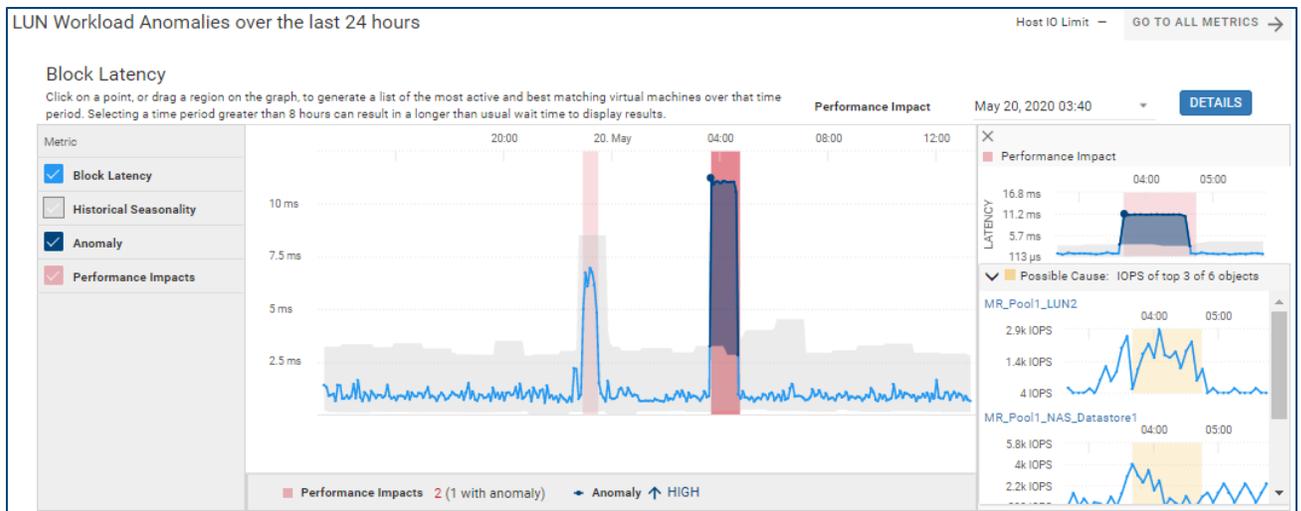


8.3 Block Object Details – Performance

The **Performance** tab for block objects (Unity, SC Series and PowerVault) provides performance details for the block object activity. Similar to the system and pool level performance charts, CloudIQ identifies performance anomalies for each performance metric. For Unity systems, CloudIQ also identifies performance impacts at the object level.

Highlighting an area in the Latency, IOPS and Bandwidth charts for a block object identifies up to the 5 most active virtual machines contributing to the metric during that time period. Unity systems have the additional feature of providing the virtual machine(s) that most closely correlates to the behavior in the selected time range. This is shown under the Best Match tab.

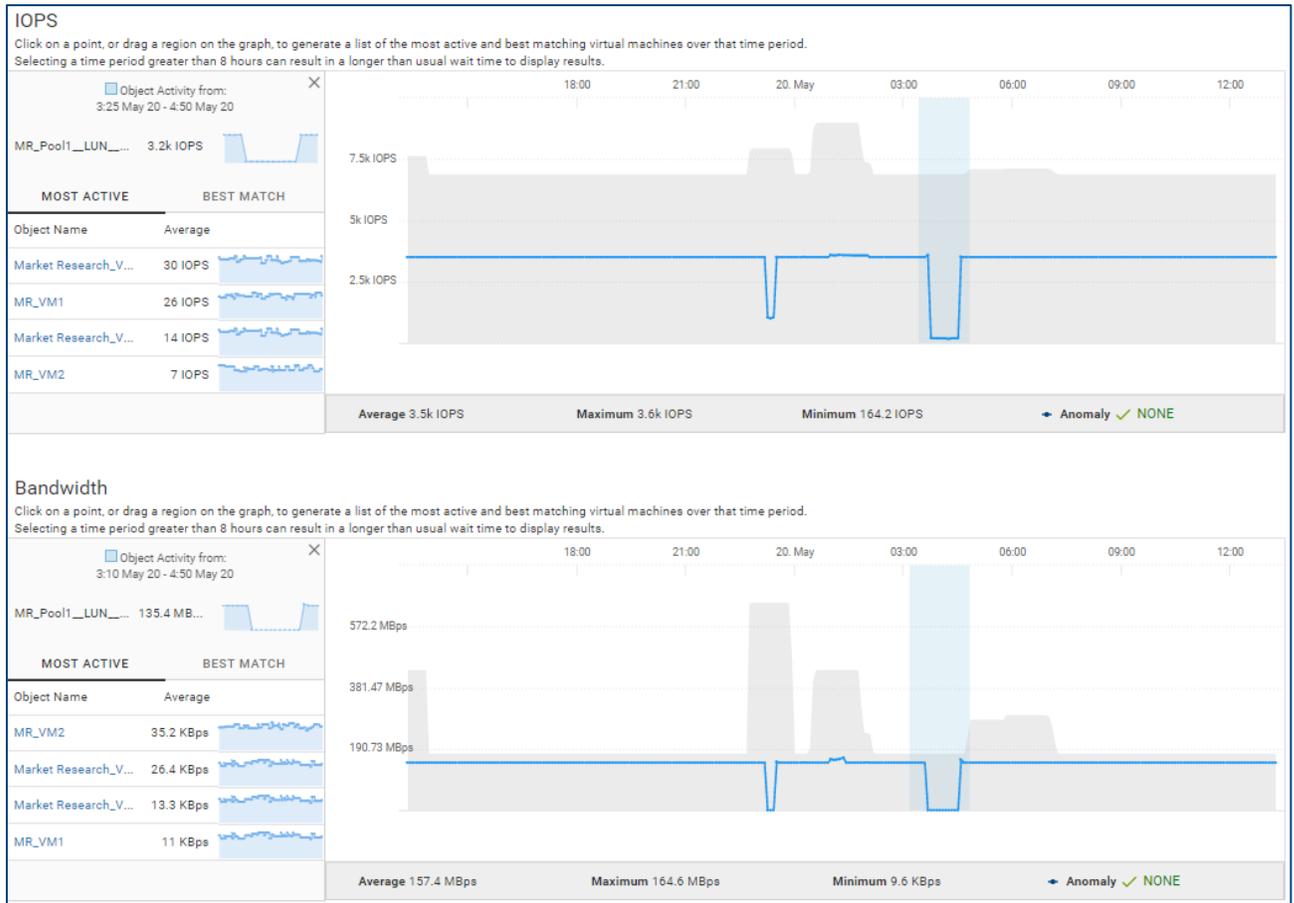
The following shows two performance impacts on a Unity block latency chart. The first is an impact only, the second is an impact with a performance anomaly. Selecting the Details button opens a window in the right-hand side of the chart identifying storage objects whose IOPS are strongly correlated with the rise in latency for the impacted LUN. These objects are the most likely candidates causing resource contention and the performance impact.



The bottom of the page displays LUN/Volume performance charts for the following metrics:

- Latency (Unity and SC Series)
- IOPS (all)
- Bandwidth (all)
- % Read (Unity and PowerVault)
- IO Size (Unity and PowerVault)
- Queue Length (Unity)

In the following screenshot, a region of the IOPS chart is highlighted. The left-hand side of the chart displays the Most Active tab which displays the most active virtual machines contributing to the metric during that time period. In the Bandwidth chart, the Best Match tab is selected which identifies the VM whose bandwidth most closely correlates to the metric during the selected time frame.



8.4 Block Object Details – Data Protection

The **Data Protection** tab for Unity and SC Series block objects displays how data protection has been configured for the selected object. There are two levels of data protection available: Replication – remote protection from system to system and Snapshots – local protection within the system. The **Replication** section on the top of the page shows replication details and status of the replication session. The **Snapshots** section at the bottom half of the page shows how data is backed up within the system using snapshot technology. Snapshot schedules and deletion policies are displayed. The snapshot list can be exported to a CSV file.

Market Research > MR_Pool1_LUN1
LAUNCH UNISPHERE

Properties
Capacity
Performance
Data Protection

Replication

Session Name	rep_async
Mode	Asynchronous (60 minutes)
Local Role	Source
Sync Progress	80% complete, about 30 minutes remaining
Sync Transfer Rate	395.2 MB/Sec
Time of Last Sync	Mon, Oct 17 2016, 5:50:21 PM UTC

I/O

Auto Sync Configured

Market Research MR_Pool1_LUN1

Disaster Recovery DR_Pool3_LUN1

Snapshots

<p>Schedule: Snap Schedule all rules</p> <p>Rule 1: Every Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday at 11:00 PM, retain for 14 days</p> <p>Note: Schedule times are in UTC displayed in 12-hour format.</p>	<p>Pool Automatic deletion policy</p> <p>Start deleting snapshots when the total pool consumption reaches 95%, and continue deleting until the total pool consumption reaches 85%</p> <p>Start deleting snapshots when the pool consumption by the snapshots reaches 25%, and continue deleting until the pool consumption by the snapshots reaches 20%</p>
--	--

7 Snapshots E

Name	Source	State	Taken	Taken By	Attached	Last Writable Time	Modified	Auto Delete	Expiration Time
mySnap-1556112110020	MR_Pool1_LUN1	Ready	Sun, Mar 31 2019, 2:39:23 ...	Snap Schedule all r...	No	Fri, Mar 29 2019, 2:39:23 P...	No	No	Tue, Apr 16 2019, 2:39...
mySnap-1556112110021	MR_Pool1_LUN1	Ready	Thu, Mar 21 2019, 2:39:23 ...	Snap Schedule all r...	No	Tue, Mar 19 2019, 2:39:23 ...	Yes	No	Tue, Apr 2 2019, 2:39...
mySnap-1556112110021	MR_Pool1_LUN1	Ready	Tue, Mar 19 2019, 2:39:23 ...	Snap Schedule all r...	No	Fri, Mar 15 2019, 2:39:23 P...	Yes	No	Sun, Mar 31 2019, 2:3...
mySnap-1556112110021	MR_Pool1_LUN1	Ready	Tue, Mar 5 2019, 2:39:23 P...	Snap Schedule all r...	No	Sun, Mar 3 2019, 2:39:23 P...	Yes	No	Thu, Mar 21 2019, 2:3...
mySnap-1556112110024	MR_Pool1_LUN1	Ready	Mon, Mar 11 2019, 2:39:23 ...	Snap Schedule all r...	No	Thu, Mar 7 2019, 2:39:23 P...	Yes	No	Tue, Mar 19 2019, 2:3...
mySnap-1556112110024	MR_Pool1_LUN1	Ready	Mon, Feb 25 2019, 2:39:23 ...	Snap Schedule all r...	No	Sat, Feb 23 2019, 2:39:23 P...	Yes	No	Mon, Mar 11 2019, 2:3...
mySnap-1556112110024	MR_Pool1_LUN1	Ready	Mon, Feb 11 2019, 2:39:23 ...	Snap Schedule all r...	No	Sat, Feb 9 2019, 2:39:23 P...	Yes	No	Mon, Feb 25 2019, 2:3...

9 File Object Details

File Objects (Unity systems only) are accessible in the Storage listing for individual Systems and Pools. File objects can also be accessed using global search.

9.1 File Object Details – Properties

The **Properties** tab displays various attributes for the file object and any health issues found for the object. Attributes include the Pool, FAST VP Policy, NAS Server, Protocol and Data Reduction status. It also provides the ability to pause the capacity health check for the file system. Note that this can also be accomplished from the Customization menu under Admin. See Chapter 15 for more details.

The bottom half of the view shows any virtual machines that reside on the file object.

📁
Market Research > MR_Pool1_FS1

⚙️ **Properties**

📊 Capacity

📈 Performance

🛡️ Data Protection

Pool Market Research_Pool1

Type File System

Thin Yes

FAST Cache –

FAST VP Policy Start High Then Auto-Tier

NAS Server NAS_Server_5

CLI ID sv_910

Protocol Linux/Unix Shares (NFS)

Data Reduction On

PAUSE CAPACITY HEALTH CHECKS

Total Issues	0	Total
Components	✓	<div style="font-size: 2em; color: #0070c0; margin-bottom: 10px;">✓</div> <p style="color: #0070c0; font-weight: bold;">All health checks were successful.</p>
Configuration	✓	
Capacity	✓	
Performance	✓	
Data Protection	✓	

VIRTUAL MACHINES
1 Virtual Machine 📄

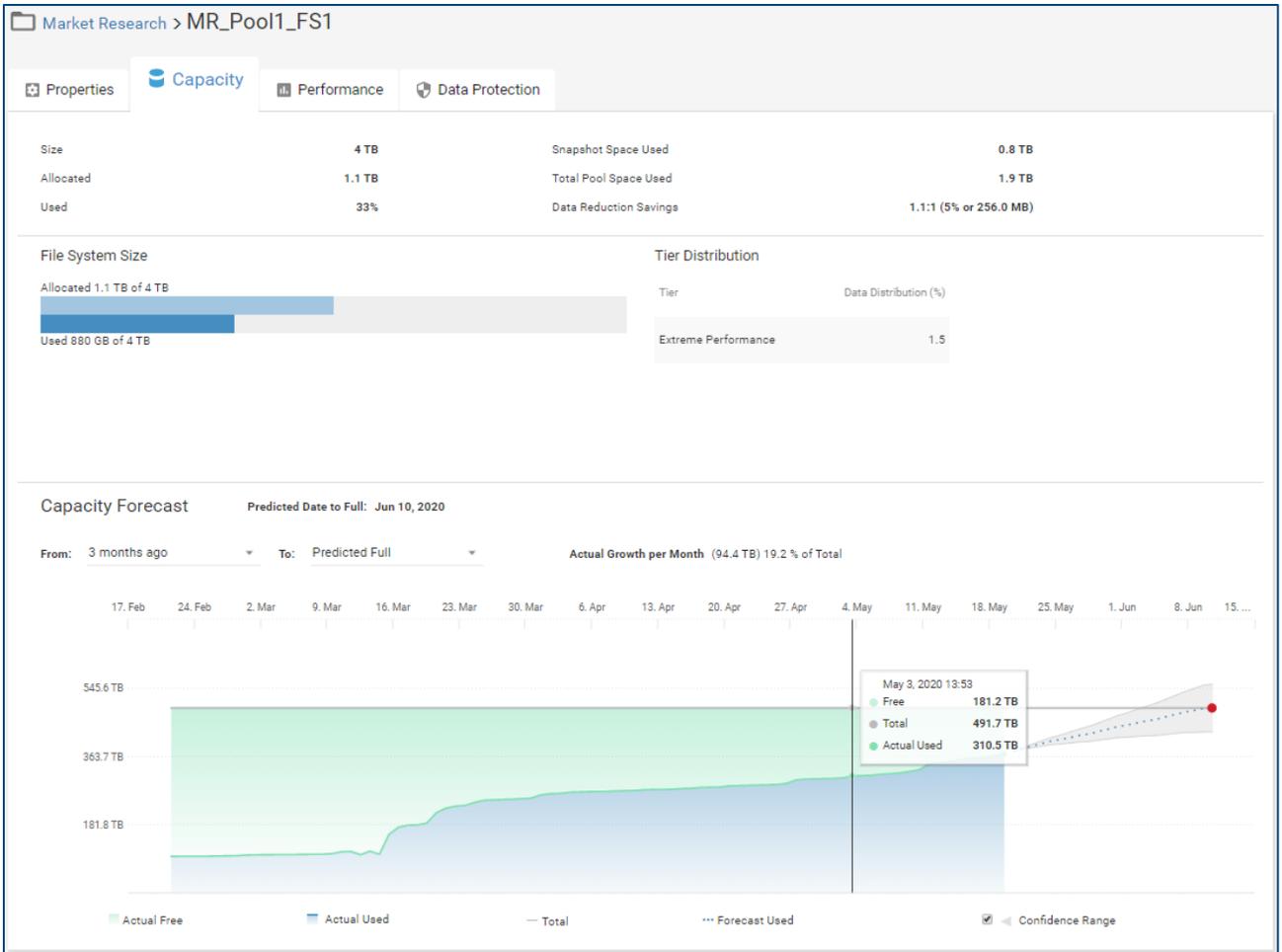
Name	Export Path	Network Address	Operating System	vCenter	ESXi	Cluster
MR_VM2	10.1.2.3:/nfs_share	10.0.1.2	Red Hat Enterprise Linux 6.8 (64-bit)	10.0.0.100	LocalESX1	Research Cluster

9.2 File Object Details – Capacity

The **Capacity** tab for a File object provides details for how the file capacity is being used, including capacity utilization for snapshots and Data Reduction Savings. The file used percentage is based upon the actual data written to the file system.

The Capacity Forecast shows a historical trend and capacity changes since the object was created. CloudIQ's predictive analytics algorithms are applied to provide ongoing predictions as to when the file system will become full.

Hovering across the trend line displays the specific total, used and free values for that selected point in time.



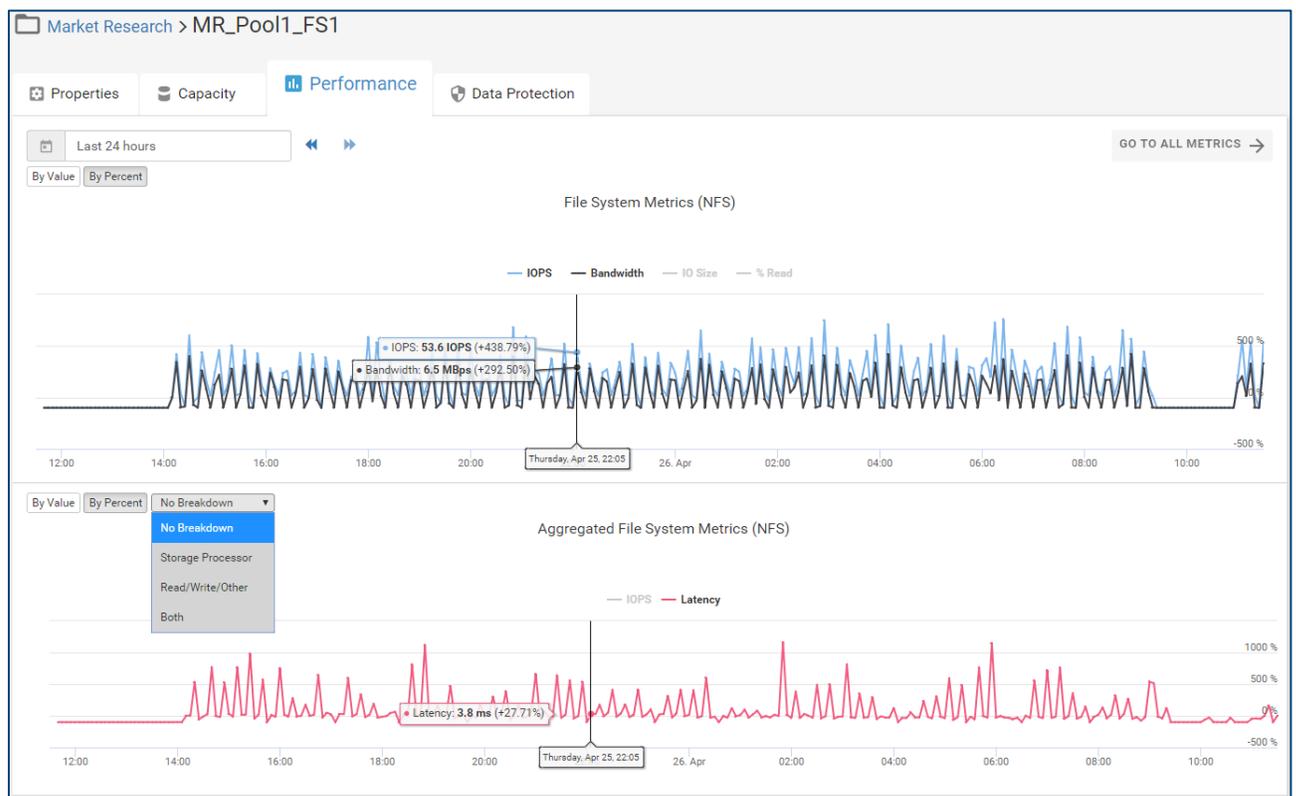
9.3 File Object Details – Performance

The **Performance** tab for a file object provides two performance graphs with aggregated metrics for a 24-hour period (default). This can be changed to one of several pre-defined time ranges or a custom time range. As the user hovers the mouse over the graph, the metrics details will be shown in pop-up boxes. The following metrics are available:

- File System Metrics (NFS)
 - IOPS
 - Bandwidth
 - IO Size
 - % Read
- Aggregated File System Metrics (NFS)
 - IOPS
 - Latency

The Aggregated File System Metrics (NFS) graph has the ability to breakdown the data by:

- Storage Processor
- Read/Write/Other
- Both



9.4 File Object Details – Data Protection

The **Data Protection** tab for a file object displays how data protection has been configured for that object. There are two levels of data protection available: Replication – remote protection from system to system and Snapshots – local protection within the system. The **Replication** section on the top of the page shows remote replication details and status of the replication session. The **Snapshots** section at the bottom half of the page shows how data is backed up within the system using snapshot technology. Snapshot schedules are also displayed. The snapshot list can be exported to a CSV file.

📁 Disaster Recovery > DR_Pool1_FS1

Properties
Capacity
Performance
Data Protection



I/O



Auto Sync Configured



Disaster Recovery
DR_Pool1_FS1

Replication

Session Name	rep_async
Mode	Asynchronous (60 minutes)
Local Role	Destination
Sync Progress	80% complete, about 30 minutes remaining
Sync Transfer Rate	395.2 MB/Sec
Time of Last Sync	Mon, Oct 17 2016, 5:50:21 PM UTC

Snapshots

Schedule	Snap Schedule
Rule 1	Every Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday at 11:00 PM, retain for 14 days
<i>Note: Schedule times are in UTC displayed in 12-hour format.</i>	

7 Snapshots 📄

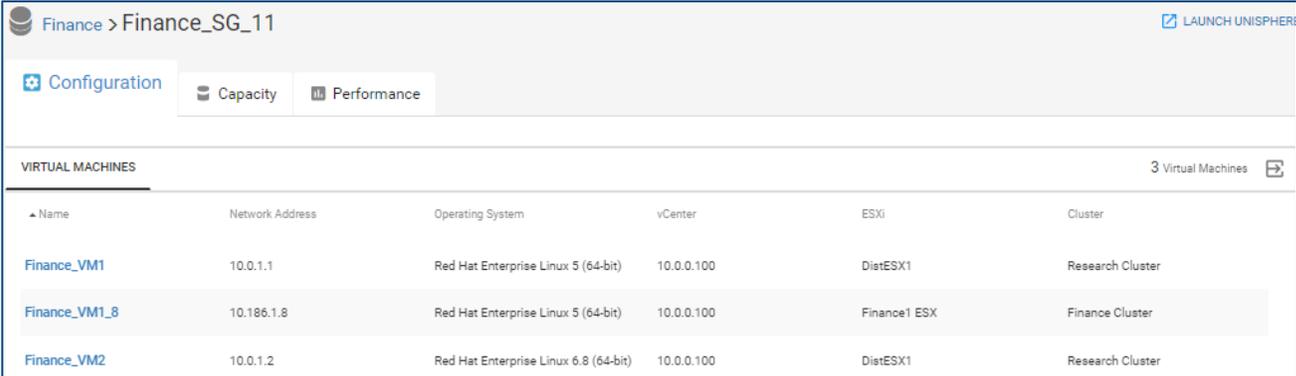
Name	Source	State	Taken	Taken By	Shared	Last Writable Time	Modified	Auto Delete	Expiration Time	Access Type
mySnap-1555084...	DR_Pool1_FS1	Ready	Sun, Apr 14 2019, 5:2...	Snap Schedule	No	Wed, Apr 10 2019, 5:...	No	No	Wed, Apr 24 2019, 5:...	Share
mySnap-1555084...	DR_Pool1_FS1	Ready	Thu, Apr 4 2019, 5:24...	Snap Schedule	No	Sun, Mar 31 2019, 5:2...	Yes	No	Sun, Apr 14 2019, 5:2...	Share
mySnap-1555084...	DR_Pool1_FS1	Ready	Mon, Mar 25 2019, 5:...	Snap Schedule	No	Thu, Mar 21 2019, 5:2...	Yes	No	Thu, Apr 4 2019, 5:24...	Share
mySnap-1555084...	DR_Pool1_FS1	Ready	Mon, Mar 11 2019, 5:...	Snap Schedule	No	Sat, Mar 9 2019, 5:24:...	Yes	No	Tue, Mar 19 2019, 5:2...	Share
mySnap-1555084...	DR_Pool1_FS1	Ready	Fri, Mar 1 2019, 5:24:...	Snap Schedule	No	Mon, Feb 25 2019, 5:...	Yes	No	Fri, Mar 15 2019, 5:24...	Share
mySnap-1555084...	DR_Pool1_FS1	Ready	Fri, Mar 1 2019, 5:24:...	Snap Schedule	No	Wed, Feb 27 2019, 5:...	Yes	No	Mon, Mar 11 2019, 5:...	Share
mySnap-1555084...	DR_Pool1_FS1	Ready	Thu, Feb 21 2019, 5:2...	Snap Schedule	No	Sun, Feb 17 2019, 5:2...	Yes	No	Wed, Feb 27 2019, 5:...	Share

10 Storage Group Details (PowerMax/VMAX systems)

Each PowerMax/VMAX system has a listing of the storage groups with key information including the associated Storage Resource Pool, the assigned Service Level and whether or not the Storage Group is in compliance. The storage group name is hyperlinked to enable easy navigation to the details pages for a given storage group. The Storage Group Details Page is also accessible via global search of the storage group name.

10.1 Storage Group Details – Configuration

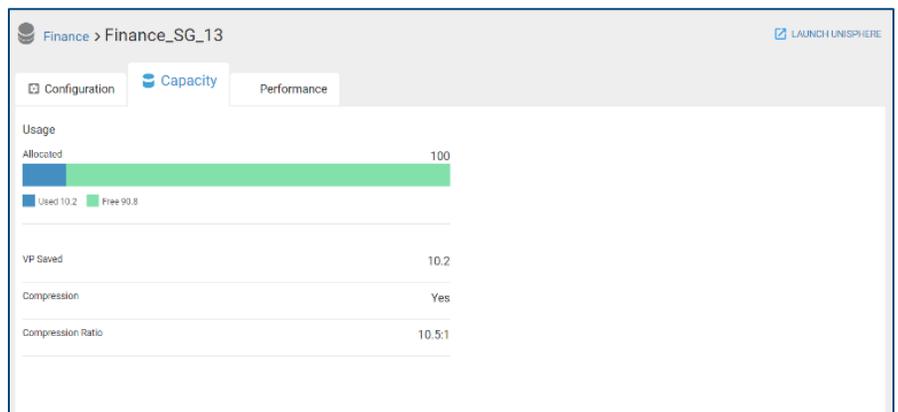
The **Configuration** tab for a storage group displays the attributes of the storage group. In the upper right is a link to “Launch Unisphere”. Selecting this will open the Unisphere element manager for the system hosting this storage group.



Finance > Finance_SG_11					
Configuration					
VIRTUAL MACHINES 3 Virtual Machines					
Name	Network Address	Operating System	vCenter	ESXi	Cluster
Finance_VM1	10.0.1.1	Red Hat Enterprise Linux 5 (64-bit)	10.0.0.100	DistESX1	Research Cluster
Finance_VM1_8	10.186.1.8	Red Hat Enterprise Linux 5 (64-bit)	10.0.0.100	Finance1 ESX	Finance Cluster
Finance_VM2	10.0.1.2	Red Hat Enterprise Linux 6.8 (64-bit)	10.0.0.100	DistESX1	Research Cluster

10.2 Storage Group Details – Capacity

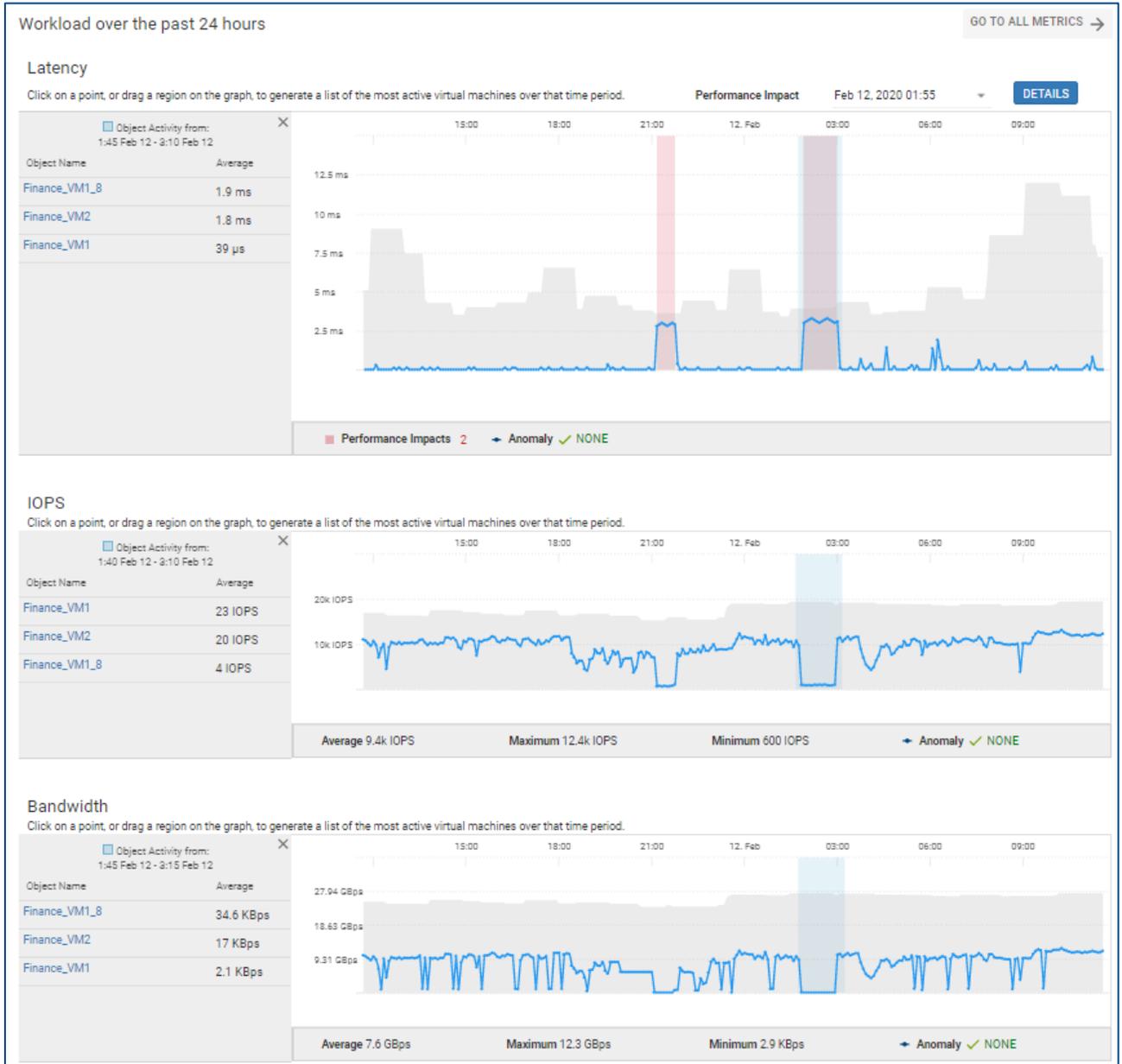
The **Capacity** tab for a Storage Group provides details for the Storage Group capacity, showing Used and Free Allocation. Additionally, Storage Efficiency information is provided, including VP Savings and the Compression ratio.



10.3 Storage Group Details – Performance

The **Performance** tab for a Storage Group provides performance details over a 24-hour period. Performance charts include Latency, IOPS, Bandwidth, %Read, IO Size, and Queue Length. CloudIQ identifies performance impacts on the Latency chart as pink shaded areas. CloudIQ identifies performance anomalies on all storage group performance charts as blue shaded areas.

Highlighting an area in the Latency, IOPS or Bandwidth charts displays the top contributing VMs in the left-hand side of the chart.



11 Connectrix Switch Details

CloudIQ has the ability to monitor Connectrix switches. It leverages a local collector that communicates to the switches using a read-only privilege and the collector then sends the data back to CloudIQ through the Secure Remote Services Gateway.

Selecting the switch hyperlink in the overview page or any of the multi-system views opens the System Details page for that switch. The following sections discuss each tab of the Switch System Details page in greater depth.

11.1 Switch System Details – Health Score

The Health Score tab shows the details for a selected switch driving the health score number. Currently, only the Components category is used in calculating the switch health score. Selecting any issue provides a corresponding recommendation for obtaining additional information and resolution. As with storage, the Health Score History is displayed at the bottom of the page.

The screenshot shows the 'Health Score' tab for 'Production SAN Extension'. A large circular gauge displays a score of 70, labeled 'POOR'. A message states: 'Components is the top health check category impacting Production SAN Extension's health score.' Below this, a 'Health Issues' table is shown:

Category	Total Issues	Score	Time	Description
Components	1	-30	1 day ago	The health status of the SAN system Production SAN Extension is marginal.
Performance	0	-		

A 'Resolution' section provides instructions: 'Ensure the condition degrading switch health is resolved. For additional detail, use the command 'mapsdb -show' on the switch with degraded health.'

11.2 Switch System Details – Configuration

The Configuration tab contains various switch attributes at the top half of the screen, including the serial number, model, location, site, firmware, management IP address and contract information. The bottom half of the window contains the following tabs: Fabrics, Partitions, Zones, Attached Devices, Virtual Machines and Components.

The screenshot shows the 'Configuration' tab for 'Production SAN Extension'. It lists various attributes:

Serial Number	EAF300M001	Firmware Version	v8.2.1a	Chassis WWN	10:00:C4:F5:7C:2D:AA:02
Model	Connectrix ED-DCX6-4B	Last Contact Time	20 hours ago	Contract Expiration	April 14, 2021
Location	Round Rock, TX	Collector	ciq.conn.emc.com	Service Plan	PREMIUM
Site	ACME Headquarters	Management IP Address	10.0.12.1	Contract Number	32678017TM
Switch Up Time	14 days	Switch WWN	10:00:C4:F5:7C:2D:AA:01		

Below the attributes, there are tabs for FABRICS, PARTITIONS, ZONES, ATTACHED DEVICES, VIRTUAL MACHINES, and COMPONENTS. The FABRICS tab is active, showing a table:

Principal Switch WWN	Principal Switch IP Address	Partition ID	Total Switches	Monitored Switches	Total End Devices	Used %
10:00:C4:F5:7C:2D:11:A1	10.0.12.1	8	1	1	0	0.0
10:00:C4:F5:7C:2D:AA:01	10.0.12.1	128	2	1	32	-

11.2.1 Fabrics

The Fabrics tab provides the following information about the fabrics in which the switch participates:

- Principal Switch WWN – Worldwide name of the principal switch in the fabric.
- Principal Switch IP – The IP address of the principal switch in the fabric.
- Partition ID
 - Brocade: If Virtual Fabrics (VF) are enabled, this field displays the VF ID for each VF defined on the switch. If not enabled, this field is set to 128.
 - Cisco: This field shows the VSAN ID.
- Total Switches – Total number of switches participating in the fabric that this VF or VSAN or switch is a member of. This is a hyperlink which, when selected, displays a pop-up window listing all switches in the fabric.
- Total End Devices – Total number of N_Ports participating in the fabric that this VF or VSAN or switch is a member of.
- Monitored Switches – Total number of switches participating in the fabric that are also being managed by CloudIQ.
- Used % - Percentage of ports in this fabric that are currently in use.

FABRICS	PARTITIONS	ZONES	ATTACHED DEVICES	VIRTUAL MACHINES	COMPONENTS	2 Fabrics	
▲ Principal Switch WWN	Principal Switch IP Address		Partition ID	Total Switches	Monitored Switches	Total End Devices	Used %
10:00:C4:F5:7C:2D:11:A1	10.0.12.1		8	1	1	0	0.0
10:00:C4:F5:7C:2D:AA:01	10.0.12.1		128	2	1	32	–

11.2.2 Partitions

The Partitions tab provides information about Virtual Fabrics (Brocade) and VSANs (Cisco).

- Partition ID
 - Brocade: If Virtual Fabrics (VF) are enabled, this field displays the VF ID for each VF defined on the switch. If not enabled, this field is set to 128.
 - Cisco: This field shows the VSAN ID.
- Switch Name – Switch name as defined by the end user. If no switch name is set, this field displays the switch serial number.
- Management IP – IP address of the switch.
- Number of switches – Total number of switches participating in the fabric that this VF or VSAN or switch is a member of.
- Total end devices – Total number of N_Ports participating in the fabric that this VF or VSAN or switch is a member of.
- End devices, this switch only – Total number of N_Ports that are members of this VF or VSAN and are also directly attached to this switch.

FABRICS	PARTITIONS	ZONES	ATTACHED DEVICES	VIRTUAL MACHINES	COMPONENTS	2 Partitions	
▲ Partition ID	Switch Name	Management IP		Number of switches	Total end devices	End devices, this switch only	
8	Production SAN Extension	10.0.12.1		1	0	0	
128	Production SAN Extension	10.0.12.1		2	32	32	

11.2.3 Zones

The Zones tab lists out zoning information for the zones in the active configuration.

- Active Configuration – Name of the enabled zoning configuration.
- Zone Name – Name of the zone.
- Symbolic Name – Symbolic name of a zone member (only shown if zone member is logged into the switch).
- Member Name – Name of the zone member. This is typically the WWPN of the attached device but could also be the WWPN of the switch port or the WWNN of the attached device. It could also be in the “Domain,Port” format or “switch wwn,port” format.
- Alias – User-defined alias associated with the zone member.
- Is Logged In – Identifies if the end device is a member of a zone and logged into the fabric.
- Interface – Identifies the interface on the switch where the end device is currently logged in.
- Partition ID
 - Brocade: If Virtual Fabrics (VF) are enabled, this field displays the VF ID for each VF defined on the switch. If not enabled, this field is set to 128.
 - Cisco: This field shows the VSAN ID.

FABRICS	PARTITIONS	ZONES	ATTACHED DEVICES	VIRTUAL MACHINES	COMPONENTS	16 Zones			
▲ Active Configuration		Zone Name	Symbolic Name	Member Name	Alias	Is Logged In	Interface	Partition ID	
PRDConfig		PrdSQL_IOP063182_VMAX_240_FA_1D_1	[61] *Emulex LPe12002-E FV1.11A5 DV12.0.0.2. H...	10:00:00:00:C9:9D:E0:31	PrdSQL_182_hba0	Yes	3/0	128	
PRDConfig		PrdSQL_IOP063182_VMAX_240_FA_1D_1	[98] *SYMMETRIX:000197600240:FAN-2f00:FN:...	50:00:09:73:98:03:C5:A6	VMAX_240_FA_1D_1	Yes	3/16	128	
PRDConfig		PrdSQL_IOP063182_VMAX_240_FA_1D_2	[61] *Emulex LPe12002-E FV1.11A5 DV12.0.0.2. H...	10:00:00:00:C9:9D:E0:32	PrdSQL_182_hba1	Yes	3/1	128	
PRDConfig		PrdSQL_IOP063182_VMAX_240_FA_1D_2	[98] *SYMMETRIX:000197600240:FAN-2f01 2:FN...	50:00:09:73:98:03:C5:B6	VMAX_240_FA_1D_2	Yes	3/17	128	

11.2.4 Attached Devices

The Attached Devices tab lists out various information for devices that are physically attached to the switch.

- WWPN – Worldwide Port Name of the attached device
- Symbolic Name – Symbolic name of the attached device (only shown if the zone member is logged into the switch).
- Zoned – Identifies if the attached device is a member of the zone that is present in the active configuration.
- Interface – Identifies the interface on the switch where the end device is currently logged in.
- Speed (Gbps) – Speed that the attached device negotiated with the switch during the login process.
- Partition ID
 - Brocade: If Virtual Fabrics (VF) are enabled, this field displays the VF ID for each VF defined on the switch. If not enabled, this field is set to 128.
 - Cisco: This field shows the VSAN ID.

FABRICS	PARTITIONS	ZONES	ATTACHED DEVICES	VIRTUAL MACHINES	COMPONENTS	40 Attached Devices			
▲ WWPN		Symbolic Name	Zoned	Interface	Speed (Gbps)	Partition ID			
		10:00:00:00:C9:9D:E0:31 [61] *Emulex LPe12002-E FV1.11A5 DV12.0.0.2. HN:iop063182. OS:Linux.	Yes	3/0	32	128			
		10:00:00:00:C9:9D:E0:32 [61] *Emulex LPe12002-E FV1.11A5 DV12.0.0.2. HN:iop063182. OS:Linux.	Yes	3/1	32	128			
		10:00:00:00:C9:9D:E0:33 [61] *Emulex LPe12002-E FV1.11A5 DV12.0.0.2. HN:iop063182. OS:Linux.	Yes	3/2	32	128			

11.2.5 Virtual Machines

The Virtual Machines tab shows virtual machines residing on ESX servers that are connected to the switch.

- Name – Name of the virtual machine.
- Network Address – IP address of the virtual machine.
- Operating System – Operating system installed on the virtual machine.
- vCenter – Hostname of vCenter managing the virtual machine.
- ESXi – Hostname of ESXi server hosting the virtual machine.
- Cluster – Name of ESX Cluster hosting the virtual machine.

FABRICS	PARTITIONS	ZONES	ATTACHED DEVICES	VIRTUAL MACHINES	COMPONENTS	11 Virtual Machines																														
				<table border="1"> <thead> <tr> <th>Name</th> <th>Network Address</th> <th>Operating System</th> <th>vCenter</th> <th>ESXi</th> <th>Cluster</th> </tr> </thead> <tbody> <tr> <td>Market Research_VM16_1</td> <td>10.1.16.1</td> <td>Red Hat Enterprise Linux 5 (64-bit)</td> <td>10.0.0.100</td> <td>LocalESX4</td> <td>Market Research Cluster</td> </tr> <tr> <td>Market Research_VM20_1</td> <td>10.1.20.1</td> <td>Red Hat Enterprise Linux 5 (64-bit)</td> <td>10.0.0.100</td> <td>LocalESX4</td> <td>Market Research Cluster</td> </tr> <tr> <td>Test_VM0_1</td> <td>10.178.0.1</td> <td>Red Hat Enterprise Linux 5 (64-bit)</td> <td>VC-Test-27T42L.infra.lab</td> <td>TD_ESX_2</td> <td>Test Cluster</td> </tr> <tr> <td>Test_VM1</td> <td>10.0.7.243</td> <td>Red Hat Enterprise Linux 5 (64-bit)</td> <td>VC-Test-27T42L.infra.lab</td> <td>TD_ESX_1</td> <td>Test Cluster</td> </tr> </tbody> </table>	Name	Network Address	Operating System	vCenter	ESXi	Cluster	Market Research_VM16_1	10.1.16.1	Red Hat Enterprise Linux 5 (64-bit)	10.0.0.100	LocalESX4	Market Research Cluster	Market Research_VM20_1	10.1.20.1	Red Hat Enterprise Linux 5 (64-bit)	10.0.0.100	LocalESX4	Market Research Cluster	Test_VM0_1	10.178.0.1	Red Hat Enterprise Linux 5 (64-bit)	VC-Test-27T42L.infra.lab	TD_ESX_2	Test Cluster	Test_VM1	10.0.7.243	Red Hat Enterprise Linux 5 (64-bit)	VC-Test-27T42L.infra.lab	TD_ESX_1	Test Cluster		
Name	Network Address	Operating System	vCenter	ESXi	Cluster																															
Market Research_VM16_1	10.1.16.1	Red Hat Enterprise Linux 5 (64-bit)	10.0.0.100	LocalESX4	Market Research Cluster																															
Market Research_VM20_1	10.1.20.1	Red Hat Enterprise Linux 5 (64-bit)	10.0.0.100	LocalESX4	Market Research Cluster																															
Test_VM0_1	10.178.0.1	Red Hat Enterprise Linux 5 (64-bit)	VC-Test-27T42L.infra.lab	TD_ESX_2	Test Cluster																															
Test_VM1	10.0.7.243	Red Hat Enterprise Linux 5 (64-bit)	VC-Test-27T42L.infra.lab	TD_ESX_1	Test Cluster																															

11.2.6 Components

The Components tab lists out the system hardware for the switch.

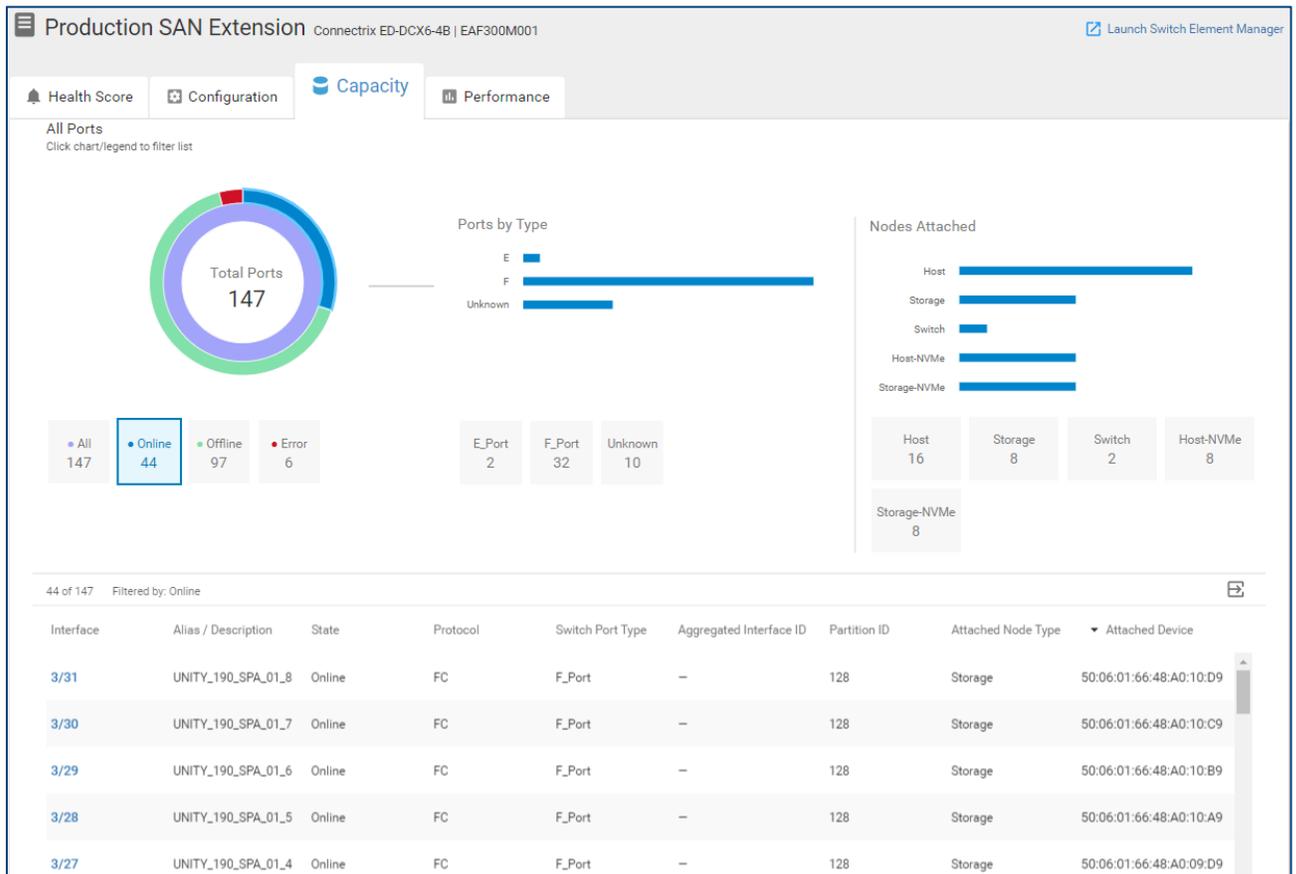
- Type – The type of component installed in the chassis.
- Slot/Unit – Location of the component in the chassis.
- State – For optics, this field provides the strength of the optical signal being received. For other hardware components, this field provides the operational state of the component.
- Part Number – Part number of the component.
- Serial Number – Serial number of the component.

FABRICS	PARTITIONS	ZONES	ATTACHED DEVICES	VIRTUAL MACHINES	COMPONENTS	74 Components																																			
					<table border="1"> <thead> <tr> <th>Type</th> <th>Slot/Unit</th> <th>State</th> <th>Part Number</th> <th>Serial Number</th> </tr> </thead> <tbody> <tr> <td>Blade (cp blade)</td> <td>1</td> <td>enabled</td> <td>60-1003201-10</td> <td>DYK3203N01P</td> </tr> <tr> <td>Fan</td> <td>1</td> <td>ok</td> <td>60-1003203-04</td> <td>DYL3009M045</td> </tr> <tr> <td>Power Supply</td> <td>1</td> <td>ok</td> <td>23-0000161-01</td> <td>DUC2M51L0WA</td> </tr> <tr> <td>Blade (cp blade)</td> <td>2</td> <td>enabled</td> <td>60-1003201-10</td> <td>DYK3203N06P</td> </tr> <tr> <td>Fan</td> <td>2</td> <td>ok</td> <td>60-1003203-04</td> <td>DYL3009M01J</td> </tr> <tr> <td>Power Supply</td> <td>2</td> <td>ok</td> <td>23-0000161-01</td> <td>DUC2M51L0MC</td> </tr> </tbody> </table>	Type	Slot/Unit	State	Part Number	Serial Number	Blade (cp blade)	1	enabled	60-1003201-10	DYK3203N01P	Fan	1	ok	60-1003203-04	DYL3009M045	Power Supply	1	ok	23-0000161-01	DUC2M51L0WA	Blade (cp blade)	2	enabled	60-1003201-10	DYK3203N06P	Fan	2	ok	60-1003203-04	DYL3009M01J	Power Supply	2	ok	23-0000161-01	DUC2M51L0MC	
Type	Slot/Unit	State	Part Number	Serial Number																																					
Blade (cp blade)	1	enabled	60-1003201-10	DYK3203N01P																																					
Fan	1	ok	60-1003203-04	DYL3009M045																																					
Power Supply	1	ok	23-0000161-01	DUC2M51L0WA																																					
Blade (cp blade)	2	enabled	60-1003201-10	DYK3203N06P																																					
Fan	2	ok	60-1003203-04	DYL3009M01J																																					
Power Supply	2	ok	23-0000161-01	DUC2M51L0MC																																					

11.3 Switch System Details – Capacity

The capacity tab for a switch provides details about the port usage for the switch. The top left portion of the view shows a breakdown of the ports on the switch broken down by Online, Offline and Error status. The filtered list of ports is broken down by port type including E_Port, TE_Port, F_Port and Unknown. The right-hand side of the window shows a breakdown of attached nodes broken down by Host Ports (FC and NVMe), Storage Ports (FC and NVMe) and Switch ports. The bottom of the page displays a filtered list of ports based on the filters selected in the top half of the page. By default, the page is filtered to show those ports with a status of Online. The following columns are displayed at the bottom of the page:

- Interface – Location of the port, shown as slot/port number. Also, a hyperlink which directs user to port performance charts.
- Alias/Description – Switch port alias, if defined.
- State – Status of the switch port.
- Protocol – Protocol configured for the switch port.
- Switch Port Type – Logical configuration of the switch port.
- Aggregated Interface ID – Value of trunk or port channel if the physical port is being aggregated.
- Partition ID
 - Brocade: If Virtual Fabrics (VF) are enabled, this field displays the VF ID for each VF defined on the switch. If not enabled, this field is set to 128.
 - Cisco: This field shows the VSAN ID.
- Attached Node Type – Describes the device attached to the switch port.
- Attached Device – Worldwide name of the attached device.

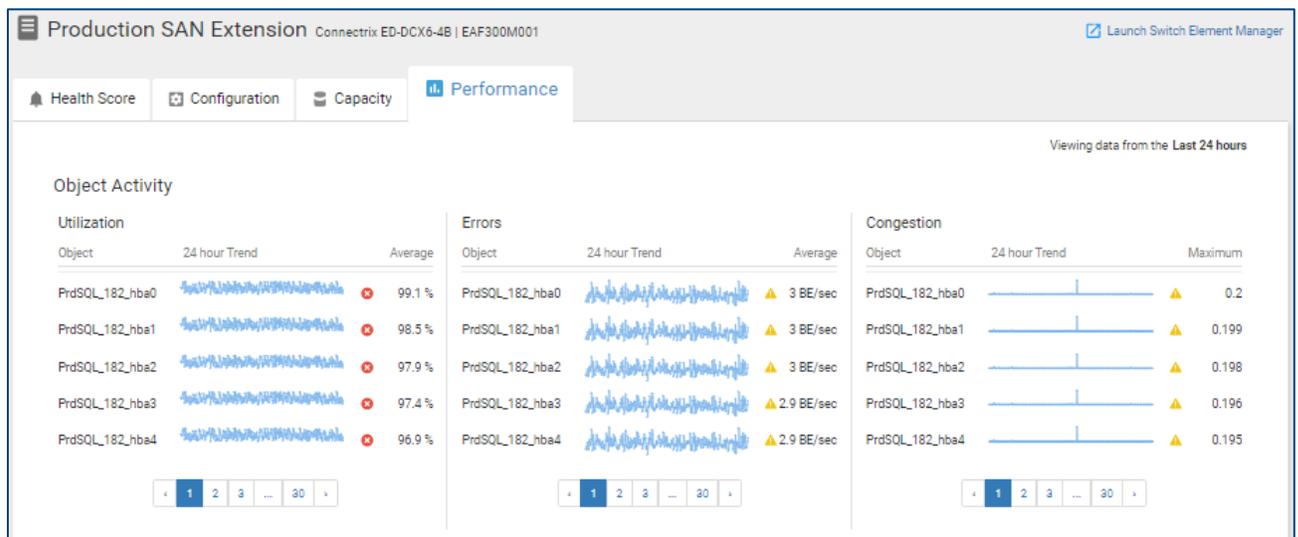


11.4 Switch System Details – Performance

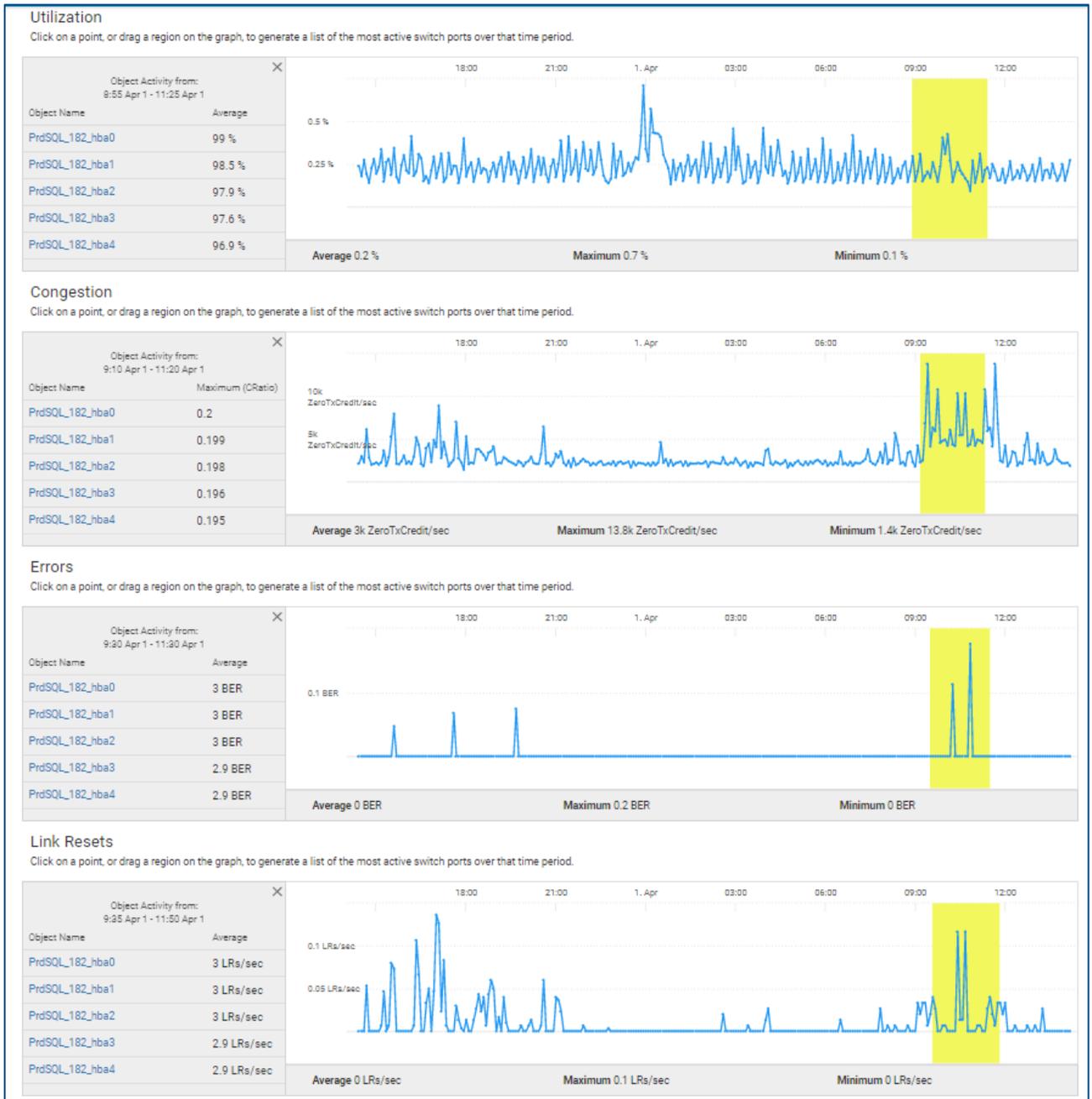
The top section of the Performance tab is Object Activity and it displays the top ports contributing to Utilization, Errors and Congestion sorted by their 24-hour average. This allows the user to quickly identify ports utilizing the most resources and experiencing the most errors in the last 24 hours.

The user can scroll down to see 24-hour charts for the following switch performance metrics:

- Utilization – The percentage of system bandwidth in use. This value represents the percentage of transmit bandwidth being used across all switch interfaces.
- Congestion – The sum of all “time spent at zero transmit” counters across all switch interfaces.
- Errors – The sum of all bit error counters across all switch interfaces.
- Link Resets – The sum of all Link Reset primitives that have been either transmitted or received across all switch interfaces.



Highlighting an area in any of these performance charts shows the top 5 port contributors to that performance metric during that time period in the left-hand side of the chart. The ports listed in the left-hand side of each chart are hyperlinks that direct the user to port-level performance charts.



11.5 Switch Port Details – Performance

Users can access port-level performance metrics by selecting the port from the Interface column in the Switch Capacity page or selecting the port hyperlink in the top object activity as shown in the previous section. Port-level performance metrics are shown in the following charts:

- Interface Statistics
 - Utilization
 - Congestion Ratio
 - Bit Errors
 - Link Resets
 - Class-3 Discards
 - CRC Errors
- Throughput
- Congestion
 - Congestion Ratio
 - Time at Zero Tx Credit
- Bit Errors
- Link Resets





12 Converged System Details

CloudIQ has added the ability to monitor VBlock and VxBlock Converged Systems. Converged Systems are displayed in the Inventory multi-systems view under the CONVERGED tab. Selecting the system name hyperlink for the Converged System opens the system details page. The top of the system details page provides information similar to what is displayed in the multi-system view. The bottom of the page has six tabs: Overview, Compute, Storage, Networking, Virtualization, and Management for more detailed information.

Model	Unity 650F	XtremIO HW X2-R
Name	UNITY650F	X2R-3Brick
Firmware	4.2.0.9433914	6.2.0-81

Note: Users can onboard VMware, Connectrix and Storage components of a VxBlock individually to utilize other CloudIQ features described in this document.

12.1 Overview

The Overview tab (shown in the above screenshot) provides a high-level view of the components, software and firmware versions that make up the converged system. The components include storage, networking, compute and AMP (management).

- Storage – Listing of the types of storage arrays in the Converged System along with the names and firmware versions of the arrays.
- Networking – Listing of the LAN and SAN switches in the Converged System along with switch model, name and firmware version.
- Compute – Listing of compute resources including the fabric interconnects per domain, chassis information, FEX information and server profiles.
- AMP – Storage array in the AMP including the array type, management name and firmware version on the storage array.

12.2 Compute

The Compute tab provides information about the UCS servers in the Converged System and their resources. There can be up to four tabs under computer including server profiles, fabric interconnects, chassis and fabric extenders (FEX).

Server Profiles – Provides number of Cisco UCS servers aggregated by server type as well as the number of UCS blade and rack-mount servers. Also displays server profile information including profile name, number of servers in each profile, type of UCS server, and software version running on the server. The details of each profile can be opened and displays information in the following tabs: Summary and Servers.

- Summary – Displays hardware and software information about the profile including the operating system, storage and MLOMs and mezzanines.
- Servers – Displays the location, serial number, hostname and CPU information for each server in the server profile.

Fabric Interconnects – Provides the number of each type of fabric interconnect switch as well as the number and type of each of UCS server. Also displays a list of FI switches including the switch name, model number, fabric connected to the FI, UCS manager version of the FI and the FI serial number. The details of each FI switch can be opened and displays information in the following tabs: Summary, Configuration, Ports and Hardware.

- Summary – Displays versions of Cisco switch OS and UCS software running on the FI switch.
- Configuration – Displays number of ports for each role, including server, LAN and SAN uplink ports. Also displays LAN and FC aggregate bandwidth for LAN and SAN ports, respectively.
- Ports – Displays port information including connections, port speed and port role. The user can filter the port list.
- Hardware – Displays hardware information about FI switch including number of fan bays, number of fans and number of power supplies.

Chassis – Displays information about the UCS Chassis including the number of each type of UCS Blade servers and the number of used and available slots in the chassis. Also displays high-level chassis information including the UCS domain, chassis name and serial number. The details of the chassis can be opened and displays information in the following tabs: IOMs and Hardware.

- IOMs - Displays the chassis model, serial number, number of active links, aggregated bandwidth and firmware version for each IOM.
- Hardware – Displays number of fans, fan bays and power supplies for the chassis.

Fabric Extenders – Displays the number of each type of UCS server connected to the FEX. Also displays high-level information about the FEX switches including UCS domain name, FEX name, model number, the fabric interconnect to which the FEX is connected and the FEX serial number. The details of each FEX can be opened and displays information in the following tabs: Configuration, Ports and Hardware.

- Configuration – Displays number of ports connected to UCS servers and uplinks as well as the uplink bandwidth and aggregate bandwidth for each fabric.
- Ports – Displays port information including connections, port speed and port role. The user can filter by port role to see only those ports connected to servers or FI uplinks.
- Hardware – Displays hardware information for each FEX including name, product ID, serial number and software version running on the FEX. Hardware Summary provides number of fans and power supplies for the FEX.

The following shows an example of the Server Profiles tab under Compute.

Navigation: Overview | **Compute** | Storage | Networking | Virtualization | Management

Sub-tabs: SERVER PROFILES | FABRIC INTERCONNECT | CHASSIS

UCS Domain: All Domains

Server Types: 6 B200 M5, 3 B200 M4, 3 C220 M4S

Connection Models: 9 Blades, 3 Direct-Connect Rack Mounts

Details	Profile	Servers ↓	Model	Operating Env
	Profile 1	3	UCSB-B200-M5	6.7.0
	Profile 2	3	UCSB-B200-M4	6.7.0
	Profile 3	3	UCSC-C220-M4S	6.7.0
	Profile 4	3	UCSB-B200-M5	6.7.0

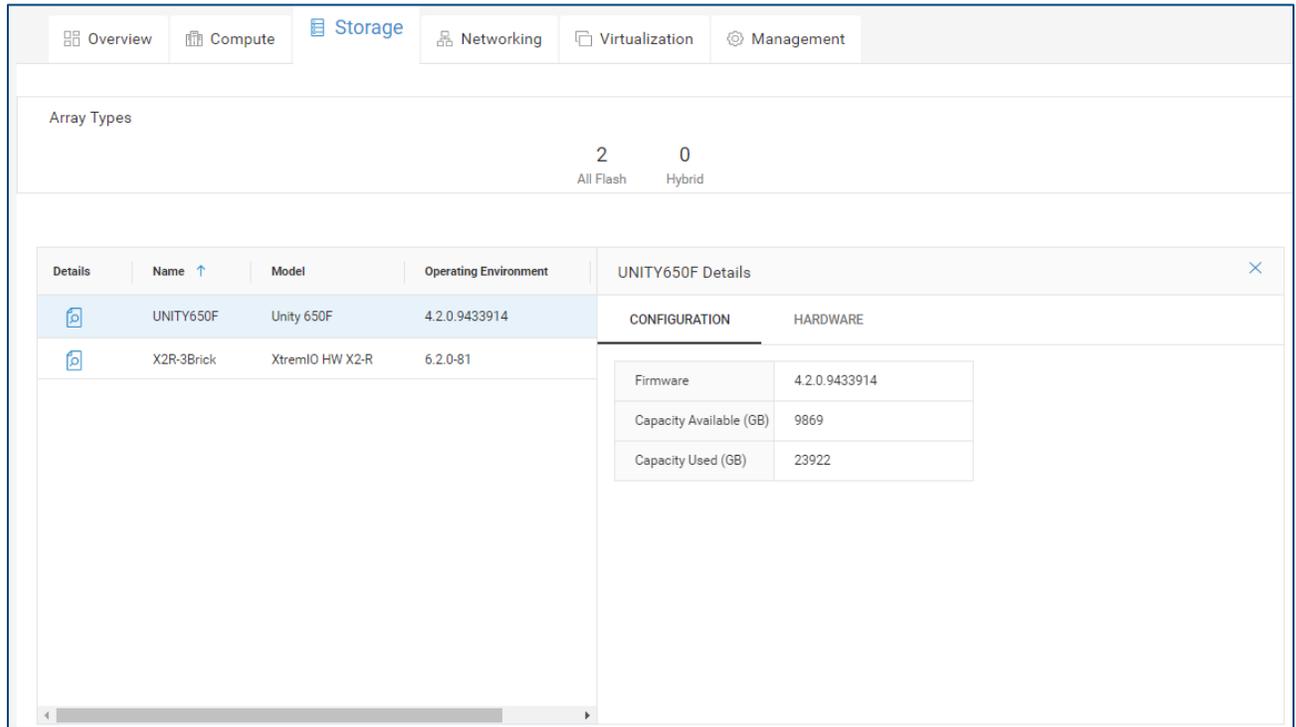
Profile 1 Details

SUMMARY		SERVICES
Overview		
Servers	3	
Model	UCSB-B200-M5	
Server Firmware	4.0(4e)	
Ethernet Version	1.0.29.0-10EM.650.0.0.4598673	
Fibre Channel Version	Version 1.6.0.50, Build: 2494585, Interface: 9.2 Built on: Mar 14 ...	
Operating Environment		
Operating Environment	VMware ESXi	
Operating Environment Build	13004448	
Operating Environment Ver...	6.7.0	

12.3 Storage

The Storage tab provides information about each storage array. Configuration and hardware information is provided for each storage array; additional information will differ depending on the array type.

- Configuration – Listing of software and firmware versions as well as capacity information.
- Hardware – Listing of drive enclosures and disks.



Array Types

2 All Flash 0 Hybrid

Details	Name ↑	Model	Operating Environment	UNITY650F Details	
	UNITY650F	Unity 650F	4.2.0.9433914	CONFIGURATION	HARDWARE
	X2R-3Brick	XtremIO HW X2-R	6.2.0-81		

Firmware	4.2.0.9433914
Capacity Available (GB)	9869
Capacity Used (GB)	23922

12.4 Networking

The networking tab provides information about the network switches in the system including role, name, model, software version and serial number.

Opening the details about each switch provides the following tabs:

- Overview – shows port breakout utilization and port usage
- Ports – shows port, port speed and connected to device
- Hardware – summary of fans, fan bays, power supplies and power supply bays

Details	Role ↑	Name	Model	Version	Serial #	VXB-FRA21-M-9396T-A.qa.lab.dell.com Details		
	LAN	VXB-FRA21-N-9336C-FX2-A.qa.lab.dell.com	N9K-C9336C-FX2	9.3(1)	LAN123	OVERVIEW PORTS HARDWARE		
	LAN	VXB-FRA21-N-9336C-FX2-B.qa.lab.dell.com	N9K-C9336C-FX2	9.3(1)	LAN321			
	OOB-LAN	VXB-FRA21-N-31108-A.lab.dell.com	N9K-C31108TC-V	7.0(3)7(6)	O0B123			
	OOB-LAN	VXB-FRA21-N-31108-B.lab.dell.com	N9K-C31108TC-V	7.0(3)7(6)	O0B321			
	SAN	VXB-FRA21-M-9396T-A.qa.lab.dell.com	DS-C9396TK9	8.3(2)	SAN123	Port	Speed	Connected To ↑
	SAN	VXB-FRA21-M-9396T-B.qa.lab.dell.com	DS-C9396TK9	8.3(2)	SAN321	fc1/1	16 Gbps	FRA21-FI-6332/switch-A - fc1/1
						fc1/8	16 Gbps	FRA21-FI-6332/switch-A - fc1/2
						fc1/15	16 Gbps	FRA21-FI-6332/switch-A - fc1/3
						fc1/19	16 Gbps	FRA21-FI-6332/switch-A - fc1/4
						fc1/25	16 Gbps	FRA21-FI-6332/switch-A - fc1/5
						fc1/31	16 Gbps	FRA21-FI-6332/switch-A - fc1/6
						fc1/38	16 Gbps	FRA21-FI-6332/switch-A - fc1/7

12.5 Virtualization

The Virtualization tab provides information about each VMware vCenter in the Converged System. Summary level information at the top of this view includes number of clusters managed by the vCenter, number of hosts managed by the vCenter and number of datastores associated with the vCenter server. There are two tabs under Virtualization: Summary and Clusters.

Summary – vCenter Configuration information including name of the vCenter server, hostname, vCenter version and workload type (AMP or Production).

Clusters – Name of the cluster, name of the vCenter managing the cluster and the data center name. The details of each cluster can be opened and displays information in the following three tabs: Summary, Hosts and Datastores.

- **Summary** – Summary level information for the cluster as well as HA/DRS configuration.
- **Hosts** – Listing of ESXi hosts that make up the cluster including ESXi version, Ethernet version, Fibre Channel version and server type.
- **Datastores** – Listing of associated datastores for the cluster including datastore name, total capacity and free capacity.

The screenshot shows the Virtualization management interface. At the top, there are navigation tabs: Overview, Compute, Storage, Networking, Virtualization (selected), and Management. Below the tabs, a dropdown menu shows 'vCenter All vCenters'. A summary bar displays: Clusters: 4, Hosts: 12, and Datastores: 12. Below this, there are two tabs: SUMMARY and CLUSTERS. The CLUSTERS tab is active, showing a table of clusters:

Details	Name ↑	vCenter	Data Center
	Cluster2-B200M4	fra21psc02-a.qa.lab.dell.com	FRA21PROD-...
	Cluster3-B200M5	fra21psc02-a.qa.lab.dell.com	FRA21PROD-...
	NSX_Compute	fra21psc02-a.qa.lab.dell.com	FRA21PROD-...
	NSX_Edge	fra21psc02-a.qa.lab.dell.com	FRA21PROD-...

The 'Cluster2-B200M4' row is selected, and its details are shown in a side panel titled 'Cluster2-B200M4 Details'. This panel has three tabs: SUMMARY, HOSTS, and DATASTORES. The SUMMARY tab is active, showing the following information:

Cluster	
vCenter	fra21psc02-a.qa.lab.dell.com
Data Center	FRA21PROD-DC
Cluster	Cluster2-B200M4

Below the Cluster information, the HA/DRS configuration is shown:

HA/DRS	
Proactive HA	Off
vSphere DRS	On
DRS Automation Level	FULLY_AUTOMATED

12.6 Management

The Management tab provides information about the AMP and is divided into the following tabs: Server Profiles, Storage, Virtualization Summary and Workload.

Server Profiles – Includes name of the server profile, number of UCS servers in the server profile, model of UCS servers and firmware version of each UCS Blade server. The details of each profile can be opened and displays information in the following tabs: Summary and Servers.

- Summary – Hardware and software information about the server profile including the operating environment, storage and MLOMs and mezzanines.
- Servers – Displays the serial number, hostname and memory for each server in the server profile.

Storage – Information about the storage for the AMP including the name, model and operating system. The details of each storage system can be opened and displays information in the following tabs: Configuration and Hardware

- Configuration – Displays firmware as well as total and free capacity.
- Hardware – Displays number of drive enclosures and disks.

Virtualization Summary – Virtualization information about the AMP including vCenter configuration as well as virtual resources.

Workload – Provides virtual machine information about the AMP including VM name, ESX host, VM operating system and the running state of the VM

The screenshot shows a web interface with a navigation bar at the top containing tabs: Overview, Compute, Storage, Networking, Virtualization, and Management. Below the navigation bar are sub-tabs: SERVER PROFILES, STORAGE, VIRTUALIZATION SUMMARY, and WORKLOAD. The 'SERVER PROFILES' sub-tab is active, displaying a table with columns: Details, Profile, Servers, Model, and Firmware. A row for 'Profile 1' is selected, showing 3 servers, model UCSC-C220-M4S, and firmware 4.0(4e). To the right of this table is a 'Profile 1 Details' panel with a close button (X). This panel has two sub-tabs: SUMMARY and SERVERS. The SUMMARY sub-tab is active, showing a list of details: Servers (3), Model (UCSC-C220-M4S), Server Firmware (4.0(2f)), Operating Environment (VMware ESXi), Operating Environment Build (13004448), Version (6.7.0), VM Cluster (AMP-CORE), and MLOM (UCSC-MLOM-CSC-02).

Details	Profile	Servers	Model	Firmware
	Profile 1	3	UCSC-C220-M4S	4.0(4e)

Profile 1 Details	
SUMMARY	SERVICES
Servers	3
Model	UCSC-C220-M4S
Server Firmware	4.0(2f)
Operating Environment	VMware ESXi
Operating Environment Build	13004448
Version	6.7.0
VM Cluster	AMP-CORE
MLOM	UCSC-MLOM-CSC-02

13 VMware Details

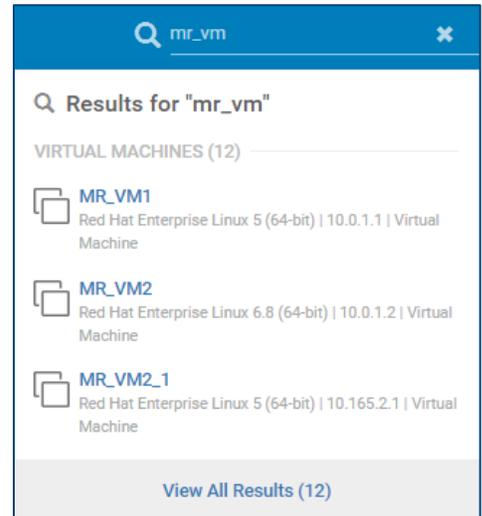
CloudIQ has the ability to monitor VMware environments. It leverages a local collector that communicates to vCenter using a read-only privilege and the collector then sends the data back to CloudIQ through the Secure Remote Services Gateway.

In addition to seeing Virtual Machines in the Virtual Machines tabs detailed earlier in this document, the user can utilize global search to find a VM and access the Virtual Machines Details page.

The search results immediately provide some initial information about the VM including name, OS and IP address. Selecting “View All Results” provides additional details including vCenter, ESX, Datacenter, and ESX Cluster.

Note that the search feature will find the following VM related properties:

- VM name
- vCenter
- ESX Server
- ESX Cluster
- Datacenter



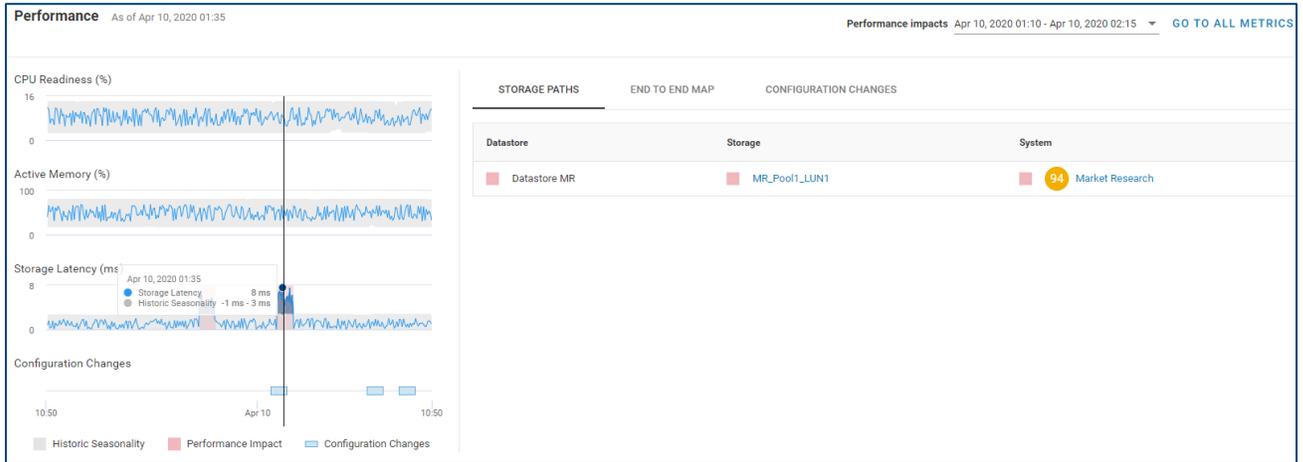
Selecting the VM name hyperlink directs the user to the Virtual Machine Details page.

The top of the VMware Details page contains various property and attributes for the VM. It includes capacity information to understand how much storage is allocated and used by the VM as well as vCenter and ESX cluster information to understand where the VM resides. The downward pointing carat in the top right of the window will minimize this section of the UI.

MR_VM1				LAUNCH VSPHERE	
Virtual Machine	MR_VM1	Power State	Powered On	vCenter	10.0.0.100
IP Address	10.0.1.1	Operating System	Red Hat Enterprise Linux 5 (64-bit)	Datacenter	Round Rock Datacenter
Allocated Capacity	18.1 GB	OS State	Running	Cluster	Research Cluster
Used Capacity	12.6 GB	Guest Tools State	Running	ESXi	LocalESX1
				Collector	ciqc.prod.emc.com

As of Apr 10, 2020 10:05

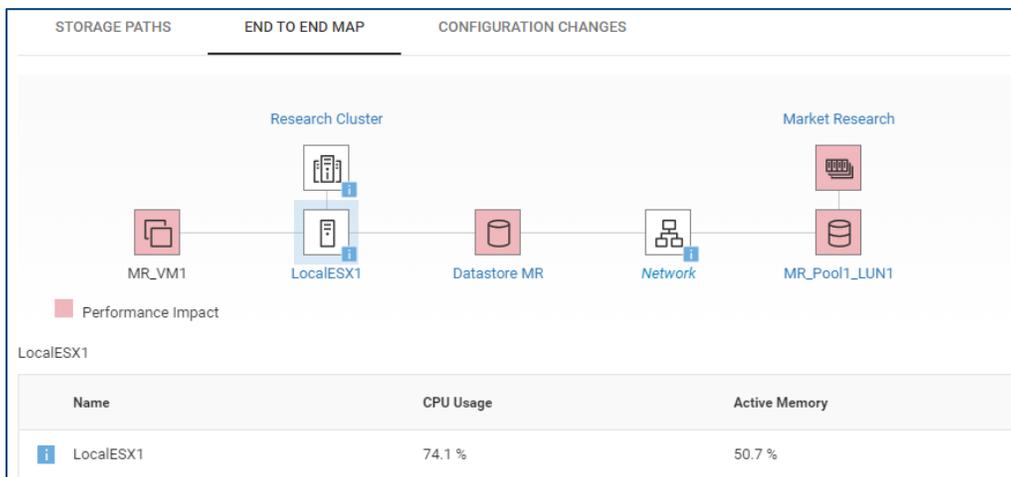
The bottom half of the page is dedicated to performance and storage path information. The left-hand side of the window displays three 24-hour charts for the following key performance metrics: CPU Readiness (%), Active Memory (%), and Storage Latency (ms). Performance anomalies are identified in any of the charts as shaded blue areas. CloudIQ also identifies performance impacts on the storage latency chart. There is also a 24-hour chart identifying configuration changes. Selecting a box along the axis provides details of the configuration change in a pop-up window. Selecting a point in the performance charts displays a popup showing the values of the historic seasonality and actual value at that point in time.



The right-hand side of the window has three tabs: Storage Paths, End to End Map and Configuration Changes.

Storage Paths (shown above) – This tab maps each datastore to the storage object (LUN, volume, or storage group) on each system. This is useful to map different datastores to different storage objects. Also note that if a performance impact is selected in the performance charts, the impacted components are highlighted with a pink square.

End to End Map – This tab is an interactive end-to-end map of the virtual machine, ESX Server, ESX Cluster, Datastore, Network, Storage Object (LUN, volume or storage group) and Storage System. Key performance metrics are displayed for the selected items in the map. By default, the latest value is displayed for each metric. However, if the user selects a point in time in the VM performance charts on the left, this view is updated to show the corresponding values at the selected time. This allows the user to select a point of interest in the VM performance charts (during a performance impact for example) and then select the various objects in the data path to view their corresponding performance metrics.



Configuration Changes – This tab provides a summary of VM related and infrastructure related configuration changes over that last 24-hour time period.

STORAGE PATHS	END TO END MAP	CONFIGURATION CHANGES
Last 24 Hours		
VM/ESXi	0 <i>vMotion/DRS</i>	2 <i>CPUs/RAM</i>
Related Infrastructure	1 <i>Storage</i>	1 <i>Network</i>

Selecting the number in the Configuration Changes view opens a window that displays details about the configuration change(s). This allows the user to correlate configuration changes in the environment with potential performance impacts.

Date	Property	Previous Value	New Value
Apr 10, 2020, 9:11:00 AM	Memory Size	8.0 GB	12.0 GB
Apr 10, 2020, 9:11:00 AM	Number of CPU	1	2

CLOSE

14 Mobile Application

CloudIQ also has a mobile application available for both iOS and Android phones. The mobile app has an Overview screen that shows similar information to the Overview Page in the browser version of the UI. It also includes support for Health, Capacity and Performance details for the supported Dell EMC storage platforms. The user can also configure push notifications to be updated in the app for any health change notifications.

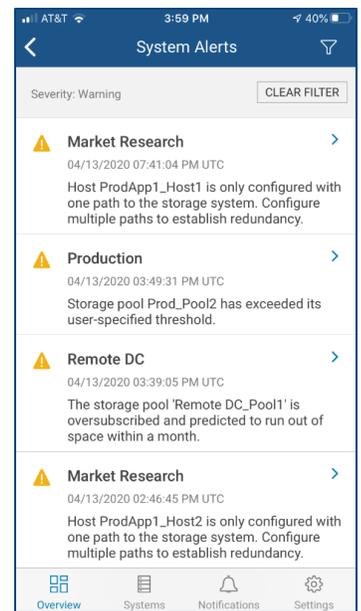
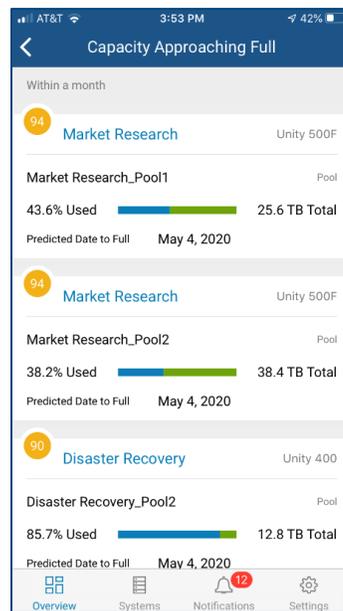
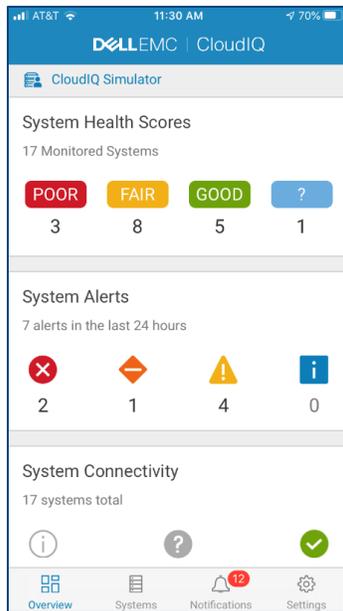
Users can drill in to see additional details of the health for any given system and can even text or email the recommended remediation to a colleague for help with performing the resolution.

Users can also see if there are any connectivity issues in the environment.

Finally, users can manage push notifications by turning them on or off and can also submit feedback to the CloudIQ team.

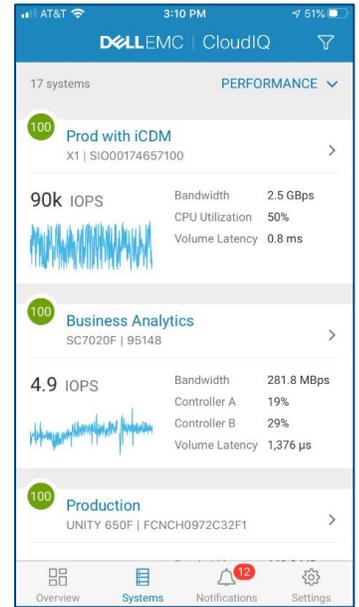
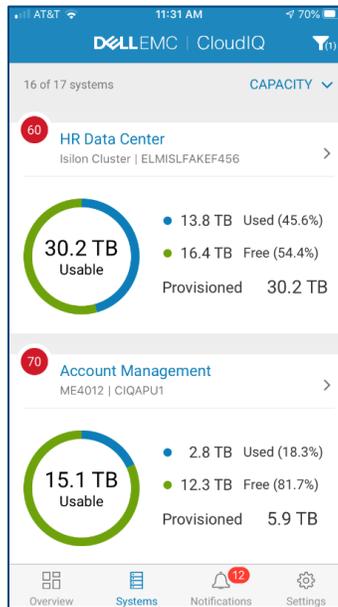
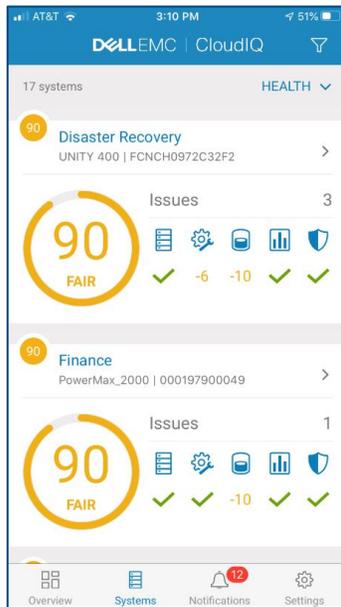
14.1 Overview

The Overview screen of the mobile app summarizes the health scores, alerts, system connectivity and capacity approaching full, similar to the tiles on the Overview page of browser version of CloudIQ. Selecting items in the Overview screen will show additional details. The following shows the Overview screen in the first screenshot, the drill down into the System Alerts tile in the second image, and a drill down into Capacity Approaching Full tile in the third image.



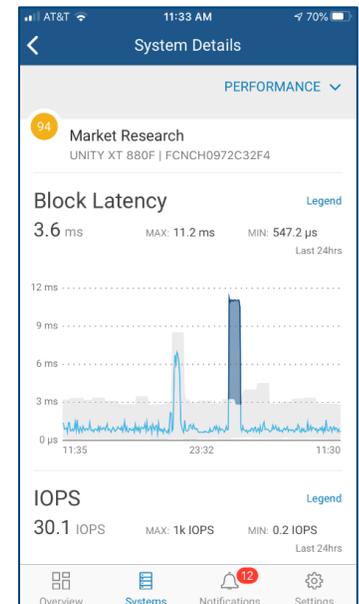
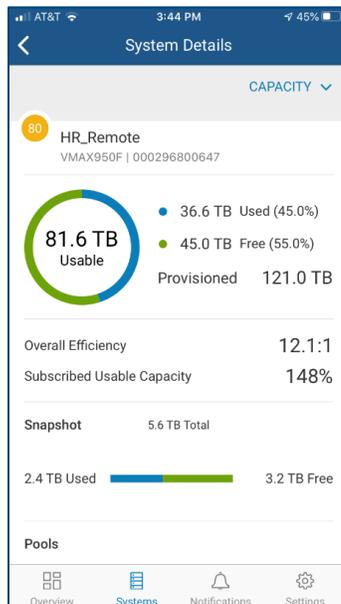
14.2 System Views

The user can select Systems at the bottom of the screen to see System level views for Health, Capacity and Performance. Utilize the pull-down menu in the top left of the screen to switch between the various view types.



14.3 System Details

The user can drill down into single system details for Health, Capacity and Performance. This includes the identification and remediation recommendations for health issues, capacity summaries including efficiencies and pool details and 24-hour performance charts for key system level performance metrics.



15 CloudIQ Administration

15.1 Customization

CloudIQ allows end users to temporarily pause host connectivity health checks and file system capacity checks from being included in the system health score. This can be done for non-production hosts or during times of maintenance when single-pathed hosts may be expected. Host connectivity checks are supported for both Unity and SC Series systems. File system capacity checks are supported for Unity systems.

15.2 Collectors

The CloudIQ Collector is used to collect VMware and/or Connectrix data and send that data back to CloudIQ via Secure Remote Services Gateway. This area shows the connectivity status and versions of installed collectors as well as a download link to obtain the collector. The user can select the hyperlink in the Collector Name column to open the Collector Details page.

Issues	Connectivity Status	Name	Technology	Secure Remote Services Type	Collected Systems	Collector Configuration	Update Status
	Connected	ciqc.conn.emc.c...	Connectrix	Centralized	6	Launch	1.2
	Connected	ciqc.prod.emc.c...	VMware	Centralized	2	Launch	1.1
2	Connected	ciqc.test.emc.com	VMware	Integrated	1	Launch	1.2

Download a collector

Deploying a new CloudIQ Collector may be needed when:

- Your existing collectors are below the required version and you do not want to update them.
- There are more than 60,000 virtual machines or 128 physical switches/virtual fabrics/VSANs collected on a single instance.
- You are collecting from datacenters on multiple unrelated virtual networks.

- Download the Collector vApp.
- Deploy the vApp.
- Follow the onboarding wizard, which will guide you to set up the vApp.
- Continue to the Collector Management UI to configure systems from which to collect data.

VMware data will appear in CloudIQ within 24 hours and will be accessible:

- On a system configuration page.
- On a hosting storage object like a Pool, LUN/Volume or Storage Group and on a Host/Server properties page.
- Via the Global Search tool by searching the IP address of a VM or by the name of a VM, vCenter, ESX server, Cluster, or Datacenter.

Connectrix data will appear in CloudIQ within 24 hours and will be accessible on the System SAN tab.

To set up the CloudIQ Collector:

[Download Collector vApp](#)

This page provides health related information for the selected collector as well as an inventory of the vCenters and/or Connectrix switches for which it is configured.

ciqc.conn.emc.com LAUNCH COLLECTOR CONFIGURATION

Serial Number: CIQC-ELMCIQ...
 Version: 1.2
 SRS Type: Centralized
 SRS gateway Serial Number: ELMESRCON...
 Update Policy: Download Only
 Last Update: Feb 4, 2020
 Connectivity Status: Connected
 Last Contacted: Feb 6, 2020 9...

Total Issues: 0
 Performance: ✓

All health checks were successful.

6 collected Switches

St...	Switch Name	Serial Number	Firmware Version	Management IP Address	Last Contact Time
✗	Production SAN Extens...	EAF300M001	v8.2.1a	10.0.12.1	about 20 hours ...
✓	Stretch Cluster Extension	EAF300M003	v8.2.1a	10.0.12.3	12 minutes ago
✓	SRDF LINK	EAF300M000	v8.2.1a	10.0.12.4	6 minutes ago
✓	Dev SAN	JPG2128002T	8.3(2)	10.0.12.2	11 minutes ago
✓	Production East	JPG194000DK	8.3(2)	10.0.12.5	11 minutes ago
✓	Production West	JPG194001DK	8.3(2)	10.0.12.6	6 minutes ago

15.3 Connectivity

The Connectivity page shows customers all systems that are connected, have lost connection or need additional configuration work before CloudIQ can display data for them. It also provides links to onboard SC Series, PowerVault and VxBlock systems. These systems require the user to enter information into CloudIQ in order to complete the onboarding process. See Appendix B for additional onboarding details.

Connectivity Status	Identifier	Product/Model	Type	Site ID	Location	Last Contacted	Instructions
Connected	FCNCH0972C32F3	Unity/UnityVA	Storage System	ACME Branch Office	Hopkinton, MA	Tue, Feb 4 2020, 6:54:52...	—
Connected	FCNCH0972C32F2	Unity/UNITY 400	Storage System	ACME Branch Office	Hopkinton, MA	Tue, Feb 4 2020, 6:54:52...	—
Connected	FCNCH0972C32F4	Unity/UNITY XT 880F	Storage System	ACME Headquarters	Round Rock, TX	Tue, Feb 4 2020, 6:54:52...	—
Connected	FCNCH0972C32F1	Unity/UNITY 650F	Storage System	ACME Headquarters	Round Rock, TX	Tue, Feb 4 2020, 6:54:52...	—
Connected	95148	SC Series/SC7020F	Storage System	Site-95148	Round Rock, TX	Tue, Feb 4 2020, 6:54:52...	—
Connected	92252	SC Series/SC5020F	Storage System	Site-92252	Hopkinton, MA	Tue, Feb 4 2020, 6:54:52...	—
Connected	000187900049	VMAX/PowerMax_2000	Storage System	ACME Headquarters	Round Rock, TX	Tue, Feb 4 2020, 6:54:52...	—

15.4 Settings

The Settings section allows customers to control asset visibility, enable access to partners and Dell EMC advisors and set up email notifications.

15.4.1 Controlling Asset Visibility

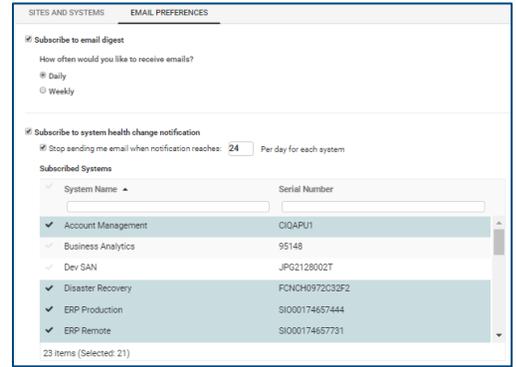
Users can set filters on which systems are visible to their account in the CloudIQ user interface as well as the mobile app. For example, if an administrator is only interested in monitoring the status of the VMAX and PowerMax arrays in the environment, they can set a filter so that all other systems are excluded from their view. The filtering is set on a per-user basis and can be configured based on site, product type, or at the individual system level. This feature is accessible under the Sites and Systems tab via Admin > Settings > Your Account menu pick. This view shows a user that has removed the visibility of their XtremIO systems.

Enable	Site Name	Site ID	Location	Systems	Enabled
<input checked="" type="checkbox"/>	ACME Branch Office	67895555	Hopkinton, MA	7	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	ACME Headquarters	12345555	Round Rock, TX	9	<input checked="" type="checkbox"/>

Enable	System Name	Model	Serial Number	Connect.
<input checked="" type="checkbox"/>	Production	Unity 880F	FCNCH0972C32F1	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Production	Unity 500F	FCNCH0972C32F4	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Business Analytics	SC7020F	95148	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Business DC	SC5020F	92252	<input checked="" type="checkbox"/>

15.4.2 Email Preferences

Users can set their email preferences to receive a daily or weekly digest summarizing the health and connectivity status of the systems. They can also configure CloudIQ to send an email notification when a change occurs in health score. In this case, the user can filter and choose which systems to monitor for health score changes.



A Enabling CloudIQ at the System

A.1 Dell EMC Unity, XtremIO, PowerMax/VMAX, and PowerScale/Isilon systems

The Dell EMC Unity, XtremIO, PowerMax/VMAX and PowerScale/Isilon systems leverage Secure Remote Services for CloudIQ data collection. This must be enabled and configured successfully on each individual Dell EMC storage system before users can send data to CloudIQ. Once Secure Remote Services has been configured within the Element Manger interface, CloudIQ must be enabled.

- Dell EMC Unity
 - For Dell EMC Unity 4.2 and later, navigate to **Settings > Support Configuration > CloudIQ**, and then select Send data to CloudIQ.
 - For Dell EMC Unity 4.1, navigate to **Settings > Management > Centralized Management**, for the **CloudIQ** tab in **Centralized Management**, ensure the checkmark to **Send data to CloudIQ** is checked, and then click **Apply**
- XtremIO
 - For XMS 6.2 and higher, access the Top Menu Bar and click the System Settings Icon to display cluster-level and XMS-level setting options. Next, select **XMS > Notifications > CloudIQ Reporting**, and ensure that **CloudIQ Reporting** is set to **YES**.
- PowerMax/VMAX
 - For Unisphere 9.0.1, navigate to **Settings > Management > CloudIQ**, ensure the checkmark to **Send data to CloudIQ** is checked, and then click **Apply**
- PowerScale/Isilon
 - For PowerScale/Isilon systems, connectivity to Secure Remote Services and CloudIQ is established with the following CLI command:

```
isi esrs modify --enabled=true --primary-esrs-gateway=<gateway-server>
--gateway-access-pool=subnetx:poolx --username=<username>
[--password=<password>]
```

The user can then simply proceed to <https://cloudiq.dell EMC.com> and log in with their valid service account credentials to view their systems in CloudIQ. The amount of time it takes for a system to appear in CloudIQ will vary, but typically will be visible within one hour.

For more information about enabling Secure Remote Services, see the [EMC Secure Remote Services for Dell EMC Unity Requirements and Configuration](https://support.emc.com/docs/EMC_Secure_Remote_Services_for_Dell_EMU_Unity_Requirements_and_Configuration) document that can be found at <https://support.emc.com>.

For detailed information about onboarding the Dell EMC storage arrays, see the following documents:

Dell EMC Unity – <https://support.emc.com/kb/481102>

XtremIO – <https://support.emc.com/kb/525984>

PowerMax/VMAX – <https://support.emc.com/kb/526005>

PowerScale/Isilon - <https://support.emc.com/kb/539319>

A.2 Dell EMC PowerStore

Dell EMC PowerStore systems utilize SupportAssist for CloudIQ data collection. This must be enabled and configured successfully on each appliance in the PowerStore cluster.

To configure SupportAssist in PowerStore Manager, navigate to **Settings > Support > SupportAssist**. Toggle the SupportAssist setting to “Enabled” and configure one of the SupportAssist options. Ensure the checkmark next to Connect to CloudIQ is selected.

For detailed information about onboarding PowerStore systems, see <https://support.emc.com/kb/543081>.

A.3 Dell EMC SC Series

The Dell SC Series CloudIQ solution leverages Dell EMC’s SupportAssist for CloudIQ data collection. This must be enabled and configured successfully on each individual Dell SC Series system before users can send data to CloudIQ.

To configure SupportAssist in Unisphere Central for Dell SC Series, open the Data Collector menu and select **Monitoring > SupportAssist > Turn On SupportAssist**.

To configure SupportAssist in the DSM thick Client, click **Storage > Edit Storage Center Settings > SupportAssist** tab.

Collect the following information from Unisphere as it will be required to complete the onboarding process in CloudIQ:

- System Serial Number
- Service Tag
- Storage Center Version

Login to the CloudIQ UI and navigate to the **Admin > Connectivity** page. Select the **ADD SC SERIES** button and step through the wizard which prompts the user for the Serial Number, Service Tag and Storage Center Version that was previously collected.

For detailed information about onboarding Dell SC Series arrays, see: <https://support.emc.com/kb/520264>.

A.4 Dell EMC PowerVault ME4

The Dell EMC PowerVault ME4 systems utilize SupportAssist for CloudIQ data collection. This must be enabled in the PowerVault ME Storage Manager.

To configure SupportAssist in ME Storage Manager, go to **System Settings > SupportAssist**, select the SupportAssist box and verify the system is successfully connected.

Select the **CloudIQ Settings** tab and select the Enable CloudIQ box.

Collect the following information from ME Storage Manager as it is required to complete the onboarding process in CloudIQ:

- WWN

- Service Tag
- Firmware Version

Alternatively, login to the system and utilize the CLI to collect the above information.

Login to the CloudIQ UI and navigate to the **Admin > Connectivity** page. Select the **ADD POWERVAULT** button and step through the wizard which prompts the user for the WWN, Service Tag and Firmware Version that was previously collected.

For detailed information about onboarding Dell EMC PowerVault systems, see:

<https://support.emc.com/kb/538112>.

A.5 Dell EMC VxBlock/VBlock

Dell EMC Converged systems utilize Secure Remote Services for CloudIQ data collection. This must be enabled and configured successfully within VxBlock Central.

To configure SRS in VxBlock Central, navigate to **Dashboard > SRS**. Configure the SRS Gateway information is properly configured and check the boxes for Send Data to SRS and Send Data to VxBlock Central Lifecycle Management (LCM) powered by CloudIQ.

Collect the following information from VxBlock Central as it is required to complete the onboarding process in CloudIQ:

- System Serial Number
- Network Switch Serial Numbers

Login to the CloudIQ UI and navigate to the **Admin > Connectivity** page. Select ADD VXBLOCK and step through the wizard which prompts the user for the System Serial Number, Core Network Switch A Serial Number and Core Network Switch B Serial Number.

For detailed information about onboarding Dell EMC VxBlock/VBlock systems, see:

<https://support.emc.com/kb/538978>.

A.6 Connectrix Switches

Connectrix switches utilize the CloudIQ Collector to collect the data from the switches and send the data back to CloudIQ via Secure Remote Services Gateway. The collector is a vApp that is downloaded from the Admin > Collectors menu in the CloudIQ user-interface or from <https://support.emc.com>. It is then installed locally in the datacenter.

Once the Collector vApp is deployed, the collector is configured to communicate to the Secure Remote Services Gateway and the Connectrix switches by accessing the collector administration UI via a web browser: <https://<collector hostname or IP>>.

Communication between the Collector and the switches is done via REST API. The following guidelines can be used to verify and/or enable the REST API interface for both Brocade and Cisco.

Brocade

The following command can be used to verify that the REST API is enabled:

```
mgmtapp --show

REST Interface State: Enabled

REST Session Count: 3

REST Throttling Configurations:

    Sample Requests      : 30
    Sample Time (in sec) : 30
    Idle Time (in sec)   : 3

KeepAlive : Disabled

KeepAliveTimeout : 15sec
```

The following command can be used to enable REST API if it is not enabled:

```
mgmtapp --enable rest
```

Cisco

The following commands can be used to ensure that REST API is enabled:

```
switch# config t

switch(config)# feature nxapi
```

For detailed information about onboarding Connectrix switches, see: <https://support.emc.com/kb/534462>.

A.7 VMware

VMware utilizes the CloudIQ Collector to communicate to vCenter and send data back to CloudIQ via Secure Remote Services Gateway. The collector is a vApp that is downloaded from the Admin > Collectors menu in the CloudIQ user-interface or from <https://support.emc.com>. It is then installed locally in the datacenter. The collector requires read-only privileges to access and pull data from vCenter.

Once the Collector vApp is deployed, the collector is configured to communicate to the Secure Remote Services Gateway and vCenter by accessing the collector via a web browser: <https://<collector hostname or IP>>.

For detailed information about onboarding VMware, see: <https://support.emc.com/kb/526579>.

B CloudIQ Security

B.1 CloudIQ Security Summary

CloudIQ takes numerous steps to protect your information in transit and at rest. In addition, CloudIQ has been developed using architectural controls as part of the Dell EMC standard secure development lifecycle. This standard defines the security-focused activities Dell EMC product teams must follow when building and releasing products, to enable Dell EMC products to minimize the risks to our products and customer environments from security vulnerabilities.

B.2 CloudIQ Data in Transit to Dell

CloudIQ subscribes to notifications from Dell EMC's Secure Remote Services (SRS) and Dell Phone Home services when storage system metadata (e.g., system logs, system configuration, system capacity and performance metrics) arrives via those channels. No customer data is sent, only data generated by the customer's systems. Customers control which systems send information via these channels.

All data arriving through those channels is protected in transit by industry-standard best practices. Both channels use digital certificates and customer-controlled access policies to establish point-to-point encryption and ensure all data is securely transported to the Dell EMC IT managed infrastructure. In addition, SRS provides for dedicated VPN and multi-factor authentication. Once the data arrives, CloudIQ stores data relating to those systems which have CloudIQ management enabled in its own Dell EMC IT managed infrastructure.

B.3 CloudIQ Data at Rest

CloudIQ data is stored on Dell EMC infrastructure, which is highly available, fault tolerant, and provides a 4-hour Disaster Recovery SLA. Dell EMC's Global Security Organization (GSO), led by a Chief Information Security Officer is responsible for security and protection of Dell EMC's information technology infrastructure. This is accomplished via establishment of governing security policies and procedures, and enforcement of Information Security control. This includes measures such as multi-layered firewalls, intrusion detection systems, industry-leading antivirus and malware protection.

The Dell EMC cybersecurity team is involved in running continuous vulnerability scans on the application and underlying environment. Any required remediation is handled through an ongoing vulnerability remediation program such as software upgrades, patches, or configuration changes.

All data sent to CloudIQ is stored on infrastructure hosted in Dell EMC data center. The Information Security Policy ensures that all Dell EMC information and resources are properly protected, information owners must ensure all resources are accounted for, and each resource has a designated custodian. All infrastructure is located in the core network behind corporate firewalls, not exposed to external direct access. No individual direct login to the database server and database is allowed, except for the members of System Administrator and Database Administrator teams. Database application accounts are managed using standard database password authentication.

Dell EMC has implemented an industry best practice Change Management process to ensure that Dell EMC production line assets are stable, controlled and protected. Change Management provides the policies,

procedures, and tools needed to govern these changes, to ensure that they undergo the appropriate reviews, approvals, and are communicated effectively to users.

B.4 Accessing CloudIQ Data

CloudIQ access requires that each user has a valid Dell EMC support account. Customers use their existing support account to login to CloudIQ. Authentication is handled by Dell EMC's Single-Sign-On (SSO) infrastructure.

CloudIQ leverages information in the user profile stored in Dell EMC Service Center related to company and site mapping for access control. The user profile is created and associated with a valid company profile when the user registers for an account with Dell EMC.

CloudIQ provides each customer with an independent secure view of their systems and ensures that they will only be able to see their own data via CloudIQ. Each user can only see those systems in CloudIQ which are part of that user's site access as per the configuration of that user in Dell EMC Service Center.

C Data Collection Frequencies and Samples

The following chart provides the data collection frequency per system type.

	Performance	Capacity	Configuration
PowerMax/VMAX	5 minutes	1 hour	1 hour
PowerStore	5 minutes	1 hour	1 hour
PowerScale/Isilon	5 minutes	1 hour	1 hour
PowerVault	15 minutes	1 hour	1 hour
Unity	5 minutes	1 hour	1 hour
XtremIO	5 minutes	1 hour	1 hour
SC Series	5 minutes	1 hour	1 hour
VxBlock	N/A	N/A	24 hours
Connectrix	5 minutes	5 minutes	5 minutes
VMware	5 minutes	5 minutes	5 minutes

The following charts display the collected metric types for various components of the systems. The P column represents performance metrics and the C column represents capacity metrics. Please see Section 6.2 – Metrics Browser for a full list of individual performance metrics collected for each component type.

Storage Systems

	System		Node / Appliance		Pool		Volume / LUN		File System		Storage Group		Drives		Host / Initiator	
	P	C	P	C	P	C	P	C	P	C	P	C	P	C	P	C
PowerMax / VMAX	✓	✓			✓	✓					✓	✓				
PowerStore	✓	✓	✓	✓			✓	✓	✓	✓			✓		✓	✓
PowerScale / Isilon	✓	✓	✓	✓		✓										
PowerVault	✓	✓			✓	✓	✓	✓					✓	✓	✓	✓
Unity	✓	✓			✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
XtremIO	✓	✓					✓	✓								
SC Series	✓	✓			✓	✓	✓	✓					✓	✓	✓	✓

Connectrix Switches

	Switch		Partition		Zone		Attached Devices		Interface	
	Perf	Cap	Perf	Cap	Perf	Cap	Perf	Cap	Perf	Cap
Connectrix	✓	✓							✓	

VMware

	ESX Cluster		ESX Server		Datastore		Virtual Machine	
	Perf	Cap	Perf	Cap	Perf	Cap	Perf	Cap
VMware	✓		✓		✓	✓	✓	✓