Dell CloudIQ: A Detailed Review

A Proactive Monitoring and Analytics Application for the Dell Environment

July 2022

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White Paper

Abstract

This white paper details Dell CloudIQ, the cloud-based AIOps proactive monitoring and predictive analytics application for Dell systems. It describes how it uses machine learning and other algorithms, notifications, and recommendations to help you optimize compute, storage, data protection and network health, performance, and capacity.

Dell Technologies

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Executive summary

Overview

With our busy daily lives, it is important to find easier and faster ways to manage IT infrastructure. With CloudIQ, Dell Technologies seeks to simplify the user experience when it comes to proactively monitoring the Dell environment.

With support for a large number of products, Dell Technologies provides a single interface to simplify the user experience in every possible way.

CloudIQ is designed to deliver faster time to insights[1] for customers, such as:

- Up to 10x faster to predict capacity approaching or almost full[1]
- Up to 16x faster to identify HA problems[1]
- Up to 50% fewer steps to identify anomalies in system performance[1]
- Up to 1.4x faster to identify a “noisy neighbor” LUN[1]
- Up to 42x faster to find reclaimable storage[1]

This white paper describes the CloudIQ features that are available in a consolidated user interface through any HTML5 browser. Users can also access CloudIQ on their iOS or Android mobile device.

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

Audience

This white paper is intended for Dell Technologies customers, partners, and employees who are interested in understanding CloudIQ features and how to monitor the following Dell systems:

- PowerEdge
- PowerStore
- PowerMax (including VMAX)
- PowerScale (including Isilon)
- PowerVault
- Unity XT family (including Dell Unity and Unity XT)
- XtremIO
- SC Series
- PowerProtect DD
- PowerProtect Data Manager

1 *Based on an April 2020 Principled Technologies Report commissioned by Dell Technologies, "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 Unity array. Actual results may vary. Full report: http://facts.pt/m8a5u3v

- VxBlock
- VxRail
- PowerFlex
- PowerSwitch
- Connectrix
- APEX Data Storage Services

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
November 2020	• Updated to reference support.dell.com and cloudiq.dell.com • Updated with details on enabling Dell Trusted Advisors and Partners • Updated with Lifecycle Management for Converged Systems
May 2021	• Updated with support for PowerProtect DD and PowerProtect Data Manager • Updated with support for VxRail • Updated with support for custom tags and custom reports
July 2021	• Updated with support for APEX Offerings • Updated with Cybersecurity
January 2022	• Updated with support for PowerFlex, PowerEdge, and PowerSwitch • Updated with support for Webhooks
January 2022	Updated template
July 2022	Updated with REST API Updated with Virtualization View Updated with VxRail multi-system update Updated with support for Secure Connect Gateway Updated with Cybersecurity support for PowerEdge and templates Updated with support for PowerProtect DD performance Updated with support for PowerSwich performance Deprecated Hosts from Inventory tab Deprecated Metrics Browser Updated with Report Browser metrics per device type Updated with Connectrix Optics support Converted CloudIQ Advanced role to CloudIQ DevOps

We value your feedback

Dell Technologies and the authors of this document welcome your feedback on this document. Contact the Dell Technologies team by email.

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Note: For links to other documentation for this topic, see the Data Storage Essentials Info Hub.

Terminology

The following table provides definitions for some of the terms that are used in this document.

Table 1. Terminology

Term	Definition
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 using 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 using REST API and uses a nonprivileged user. A single collector can be used for both VMware and Connectrix.
Secure Remote Services	Provides the remote connectivity that enables Dell storage platforms, Dell Converged and Hyperconverged systems, and the CloudIQ Collector to connect to CloudIQ. Secure Remote Services allows Dell 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	Embedded in Unisphere for Unity XT family arrays. It is recommended for Unity XT customers who do not want to use 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 Secure Remote Services 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 SC Series, PowerStore, PowerVault, and PowerSwitch systems to connect to CloudIQ and send associated data packets for performance, capacity, and health monitoring. SupportAssist allows Dell to securely transfer files, such as alerts, performance stats, capacity, and configuration information from the systems.
Secure Connect Gateway	New remote connectivity technology replacing Secure Remote Services. Allows Dell devices to securely transfer files such as logs and system telemetry to Dell Support and CloudIQ.

Term	Definition
Unisphere	The graphical management interface that is built into Dell storage systems for configuring, provisioning, and managing the systems' features. For Unity XT family, and PowerMax/VMAX, systems, Unisphere connects to CloudIQ using Secure Remote Services; for SC Series, it connects using SupportAssist.
PowerVault Manager	The graphical management interface for PowerVault storage systems. Connectivity to CloudIQ is established in the Settings section of PowerVault Manager using SupportAssist.
PowerStore Manager	The graphical management interface for PowerStore storage systems. Connectivity to CloudIQ is established in the Settings section of PowerStore Manager using SupportAssist
Web UI	The graphical management interface for XtremIO storage arrays. Web UI is part of XMS – XtremIO Management Server, which connects to CloudIQ using Secure Remote Services.
DD System Manager	The graphical management interface for PowerProtect DD systems. Connectivity to CloudIQ is established in the Maintenance section of DD System Manager using Secure Remote Services.
VxRail Manager	A plug-in for VMware vCenter that enables users to manage VxRail clusters including life-cycle management and the hardware platform. Connectivity to Secure Connect Gateway and CloudIQ is established under the Support tab in VxRail Manager.

CloudIQ overview

Introduction

CloudIQ is a cloud-based application that provides for simple and proactive monitoring and troubleshooting of your Dell IT infrastructure including integration with VMware. It leverages machine learning to proactively monitor and measure the overall health of servers, storage, and switches through intelligent, comprehensive, and predictive analytics. CloudIQ is available at no additional charge for products with a valid ProSupport (or higher) contract. CloudIQ is hosted on Dell Technologies Private Cloud, which is highly available, fault-tolerant, and guarantees a 4-hour Disaster Recovery SLO.

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 Service Center. Customers register their 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 about the product type and the latest features, consult **Online Help**, which is updated with each new feature added into CloudIQ.

Key values of CloudIQ

Reduce Risk – CloudIQ makes daily IT 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 IT Administrators deal with regularly, using features such as: Proactive Health Scores, Performance Impact Analysis and Anomaly Detection, and Workload Contention Identification. It also identifies security risks by comparing system configurations to a configurable evaluation test plan.

Plan Ahead – CloudIQ helps you stay ahead of business needs with short-term Capacity Full Prediction, Capacity Anomaly Detection, and longer-term Capacity Forecasting. It allows users to leverage subject-matter expertise to identify potential risks before they impact the environment and machine learning to pinpoint deviations for faster resolution.

Improve Productivity – CloudIQ helps users improve productivity of your IT resources, staffing, and equipment by:

- Providing a Single Pane-of-glass view of your environment that extends view into virtual infrastructure with our VMware integration
- Enabling Trusted Advisor access for added oversight
- Delivering immediate time-to-value with easy, web-based access and a mobile app
- Integrating with existing IT tools and processes with Webhooks and REST API

CloudIQ requirements

CloudIQ is available to all customers with the following Dell Technologies systems under a ProSupport or higher contract:

Type of data	Product models	Minimum code version
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)
Converged Infrastructure	VBlock 340, 350, 540, 740 VxBlock 340, 350, 540, 740, 1000	VxBlock Central 2.5 and later VMware 6.5 and later
Unity XT family	XT, All Flash, Hybrid, and UnityVSA – Professional Edition	Dell Unity OE 4.1 and later
PowerEdge	C Series, FC Series sleds and chassis, R Series, T Series, XE Series, XR and XR2 Series, MX Modular sleds and chassis, M Modular compute sleds and chassis, VRTX Series sleds and chassis	OpenManage Enterprise 3.7 and later[3]
PowerFlex	PowerFlex software and Ready-Nodes PowerFlex Rack and PowerFlex Appliance	V 3.6.x and later PowerFlex Manager 3.7 and later
PowerMax/VMAX	VMAX 10K, 20K, 40K, 100K, 200K, 400K, 250F, 450F, 850F, 950F PowerMax 2000, 8000	Unisphere 9.0.2.10 and later[2]
PowerProtect Data Manager	-	PowerProtect Data Manager 19.0 and later
PowerProtect DD	DD9900, DD9400, DD6900, DD3300, DD9800, DD9500, DD9300, DD6800, DD6300, DD7200, DD4500, DD4200, Data Domain Virtual Edition (DDVE)	DDOS 7.4.0.5 and later
PowerScale/Isilon	Gen 5 and Gen 6	OneFS 8.2 and later
PowerStore	PowerStore X and PowerStore T	PowerStoreOS 1.0 and later[1]
PowerSwitch	S3048-ON, S4048T, S4112F-ON, S4112T-ON, S4128F-ON, S4128T-ON, S4148F-ON, S4148T-ON, S4148U, S5296F-ON, S5248F-ON, S5232F-ON, S5224F-ON S5212F-ON, S5448F-ON, Z9100, Z9264F-ON, Z9332F-ON, Z9432F-ON	OS10 v10.5.3 and later[4,5]
PowerVault	PowerVault ME4 PowerVault ME5	Firmware GT280R004 and later for ME4 All versions of ME5
SC Series	SC All Flash and SC Hybrid	7.3.1 and later
VMware	-	ESXi 5.5 and higher (some metrics available at 6.0+)
VxRail	-	4.5.215 and later 4.7.100 and later 7.0 and later
XtremIO	X1 and X2	XMS 6.2.0 and later

[1] Cybersecurity requirements: PowerStoreOS 2.0 or higher.

[2] Cybersecurity requirements: For host-based Unisphere, v9.2.1 or higher is required. For embedded Unisphere, v9.2.1 or higher and operating system 5978.711.711 are required.
[3] OpenManage Enterprise 3.9 or higher required for Cybersecurity support and modular chassis support.
[4] OS10 v10.5.3.2 or later required for error, utilization, and CPU utilization metrics.
[5] OS10 v10.5.4 or later required for memory utilization metrics.

CloudIQ data collection

Details on configuring Dell infrastructure, Connectrix, and VMware for CloudIQ can be found in Appendix A: Enabling CloudIQ at the system. After the Dell systems or Connectrix switches have established connection to CloudIQ, data will be collected and available to the user in the CloudIQ user interface. Dell systems are connected through Secure Connect Gateway, Secure Remote Services (SRS), or SupportAssist. CloudIQ receives Connectrix and VMware data through a local CloudIQ collector that sends the data through Secure Connect Gateway or SRS 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 Unity XT family 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 at 5-minute intervals
2. Daily “all-in” collection

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

Alerts: 2 years

Configuration: 2 years at hourly intervals

	5 min interval	Hourly interval	Daily interval
System level	100 days	2 years	2 years
Object level	22 days	90 days	2 years

CloudIQ features

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

- Centralized monitoring of performance, capacity, system components, configuration, and data protection. CloudIQ also provides details about Storage Systems, Storage Pools, Block and File Storage Objects, Connectrix, PowerSwitch,

Converged, Hyperconverged, PowerEdge, Data Protection, and VMware environments.

- Predictive Analytics that enable intelligent planning and optimization of capacity and performance utilization.
- Proactive Health Scores for monitored storage systems, servers, and switches. CloudIQ identifies potential issues in the infrastructure and offers practical recommendations based on best practices and risk management.
- Cybersecurity feature that monitors and implements security assessments for Dell systems by comparing configurations to a set of security-related evaluation criteria, notifying users when there are deviations from the configured plan.
- Multi-system update feature implemented for VxRail, allowing users to run update pre-checks, code downloads, and system updates from CloudIQ.

Centralized monitoring

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

Predictive analytics

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

Performance anomaly and impact detection

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

Besides detecting performance anomalies, CloudIQ goes one step further and identifies performance impacts (supported for APEX Block Data Storage Services, PowerMax or VMAX, PowerStore, VxRail, Unity XT family , and PowerFlex systems). CloudIQ analyzes increases in latency against other metrics such as IOPS and bandwidth to determine if an increase in latency is caused by a change in workload characteristics or competing resources. In the case where an impact is identified, CloudIQ also identifies the most likely storage objects causing the resource contention. By differentiating between changes in workloads characteristics and workload contention, CloudIQ enables users to narrow the focus of troubleshooting on when actual impacts to performance may have occurred.

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: CloudIQ uses a daily analysis of capacity usage to help users avoid short-term data unavailability events by starting to predict, within a quarter, when capacity is expected to reach full.
- Capacity Anomaly Detection: CloudIQ uses an hourly analysis of capacity usage to identify a sudden surge of capacity utilization that could result in data unavailability. This anomaly detection 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: CloudIQ helps users more intelligently project capacity utilization so that they can plan future capacity requirements and budget accordingly.

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 system 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 on the five categories shown in the following table. Some examples of how Proactive Health mitigates risk are:

Category		Sample Health Issues
	Components	Physical components with issues: for example, faulty cables and fans
	Configuration	Non-HA Hosts connections
	Capacity	Pools or Clusters that are oversubscribed 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 and ME5 Series systems.
- The Data Protection category does not apply to VxRail systems.
- Only the Components category is currently used for PowerEdge, Connectrix, and PowerSwitch.

Cybersecurity

Cybersecurity is a feature in CloudIQ that identifies potential security violations. System configurations are continuously monitored and compared to a user configurable evaluation plan at which point a risk level is assigned to each system. Users can quickly get a visual representation of system security risk by seeing the identified issues and can remediate security violations using the provided recommended remediations.

Multi-system updates

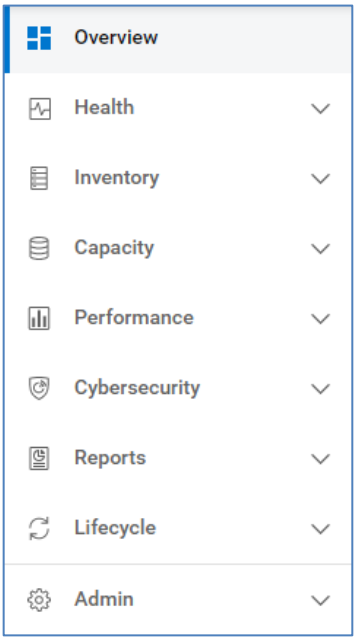
The multi-system update feature pertains to VxRail clusters. Users can now initiate VxRail cluster update pre-checks, software downloads, and system updates from the CloudIQ UI. This feature provides more operational efficiency while maintaining security and consistency.

CloudIQ UI layout

This section discusses the layout of the user interface.

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 necessary information.



The navigation bar consists of the following selections:

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

Health – View the multisystem System Health page for Storage, Networking, Hyperconverged, Server, and Data Protection showing the proactive health scores across the environment. View an aggregated list of all health issues, alerts, and available system updates and perform VxRail update pre-checks, software downloads, and cluster updates.

Inventory – View the multisystem Inventory page for Storage, Networking, Converged, Hyperconverged, Server, and Data Protection showing the system code versions, location, site, and contract status for systems in CloudIQ. The Virtualization View provides users a more traditional VMware tree style navigation similar to what administrators are familiar with in vCenter.

Capacity – View the multisystem Capacity page for Storage, Networking, Hyperconverged, and Data Protection showing system level capacity information. This view includes the overall efficiencies to support the Dell 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 – View the multisystem Performance page for Storage, Networking, Hyperconverged, and Server showing system level performance KPIs for all systems and switches. Also access the Metrics Browser for more detailed performance analysis. The Metrics Browser will be deprecated in the future.

Cybersecurity – View security risk levels, active and resolved security issues, and configure security evaluation policies for cybersecurity-enabled systems. This feature is supported for PowerMax, PowerStore, and PowerEdge systems.

Reports – Create and view custom reports**.** Reports can consist of both tables and line charts. They can be exported on demand or scheduled to be emailed to a specified list of recipients.

Lifecycle – View service contracts and life-cycle milestones for the components in VxBlock Converged Systems. This view includes timelines that display the following milestone dates: General Availability, End of Life, End of Support, End of Renewal, End of Service Life.

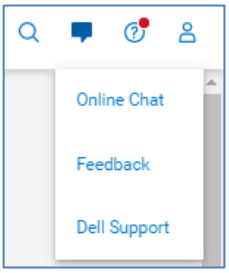
Admin – Includes links to various administrative tasks. The Customization section allows users to temporarily pause connectivity health checks for hosts connected to Unity XT family and SC Series systems and capacity health checks for Unity XT file systems. The Connectivity page shows the connectivity status of all CloudIQ capable systems and allows users to onboard SC Series, PowerVault, PowerSwitch, and VxBlock Converged 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 Jobs page shows the status of VxRail tasks initiated from CloudIQ. The HCI Settings page allows users to enable access controls and enter credentials to vCenter for system updates. The Settings menu is used to configure access for User Community and Customer Support and email notification settings. The Settings section also allows users to set filters on which systems they want to see in both the CloudIQ user interface and the mobile app. The Integrations section provides access to Webhooks and REST API settings. The User Access section allows CloudIQ administrators to set access controls for standard CloudIQ users.

Global Search

The Global Search feature helps users quickly find Systems, Hosts, Pools, Storage Resource Pools, Storage Groups, LUNs/Volumes, File Systems, Virtual Machines, and MTrees/Storage Units. 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.

Online Chat, Feedback, and Dell Support

Selecting the comment icon allows the user to open a chat session with Dell Customer Support, submit feedback to the CloudIQ product team, or open the Dell Support website.

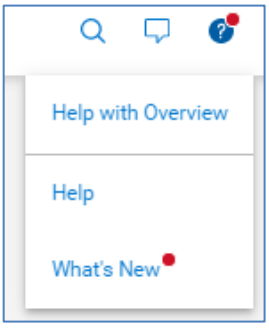


When opening a live chat session, the user will need to provide the serial number of the system in question.

Help and What's New in CloudIQ

CloudIQ is updated frequently to deliver helpful new content to users. Use the CloudIQ Simulator (https://cloudiq.dell.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 appear 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 the user icon allows the user to switch companies if they have access to multiple sites and sign out of the UI.

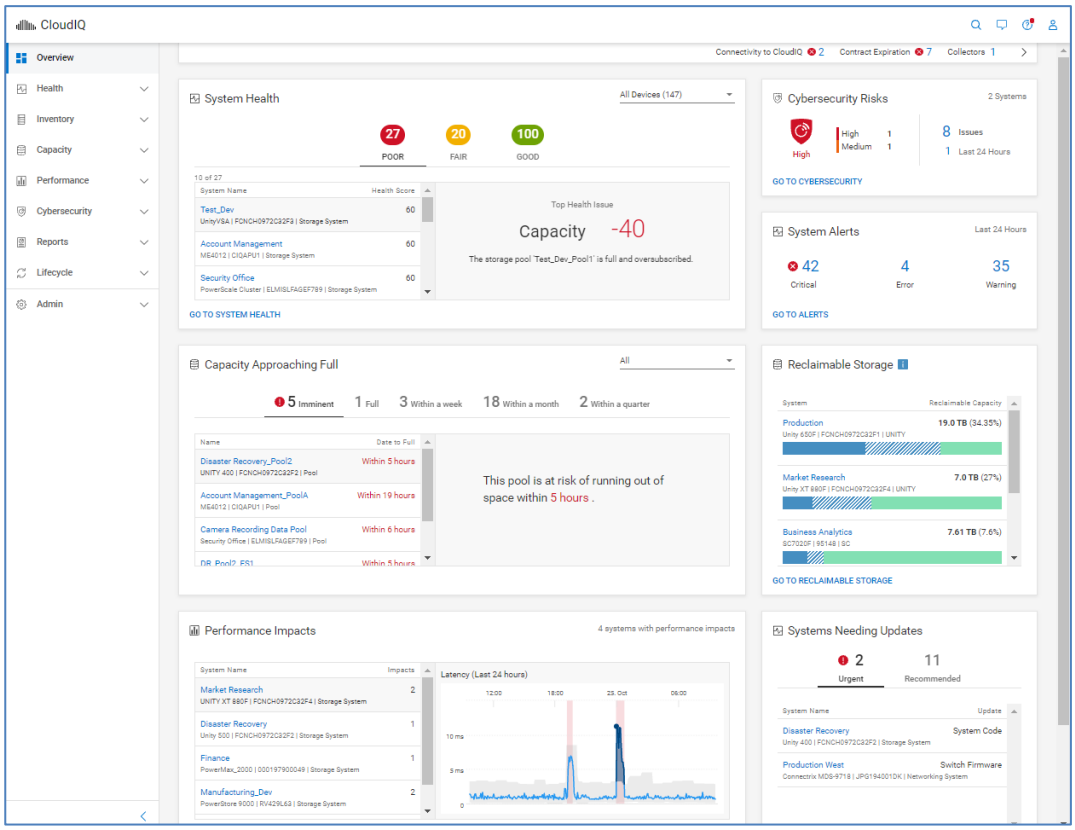
Overview page

Overview

The **Overview** page provides a consolidated view of the Dell environment. This page 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 IT infrastructure.

There are three tiles along the top of the Overview page (minimized in the above image, but shown below).

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:



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 systems and collectors corresponding to that connectivity status.

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

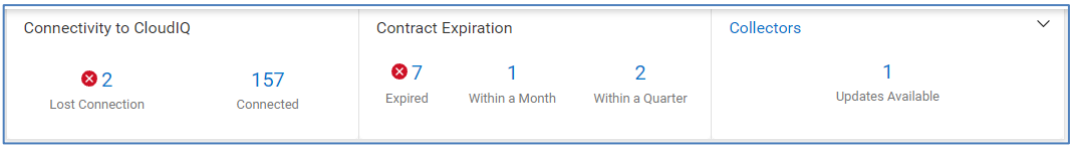
- Expired
- Expire within a month
- Expire within a quarter

The user can select the number to open a window with the list of systems that meets the expiration criteria. Systems whose contracts have expired will be removed from other standard CloudIQ views.

Collectors – Displays number of CloudIQ Collectors that have

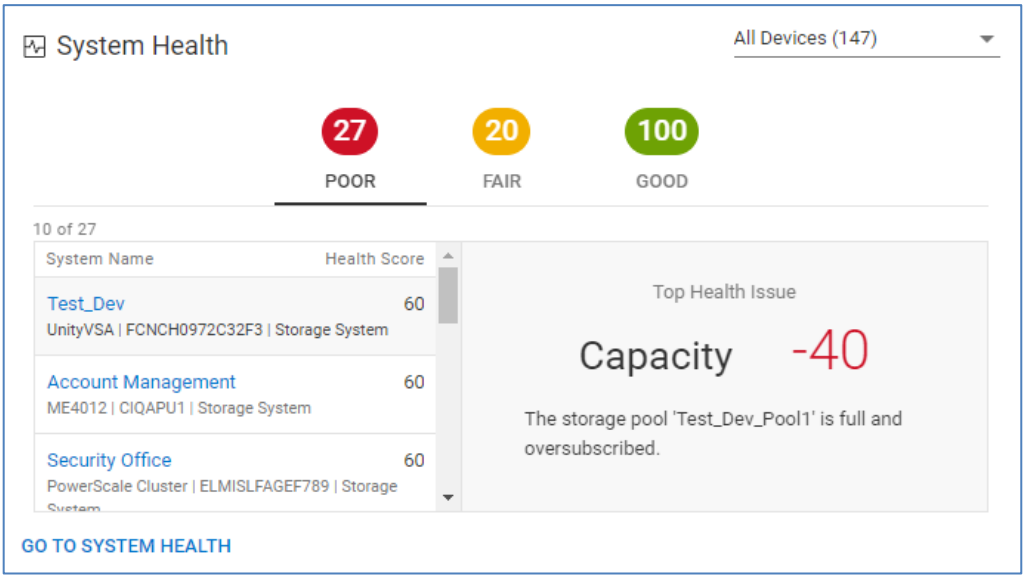
- Issues that need to be resolved
- Available Updates

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 products into three ranges of health scores:

- **Poor**: 0-70
- **Fair**: 71-94
- **Good**: 95-100
- **Unknown**: List of systems whose health score cannot be calculated. This situation could indicate a connection issue.



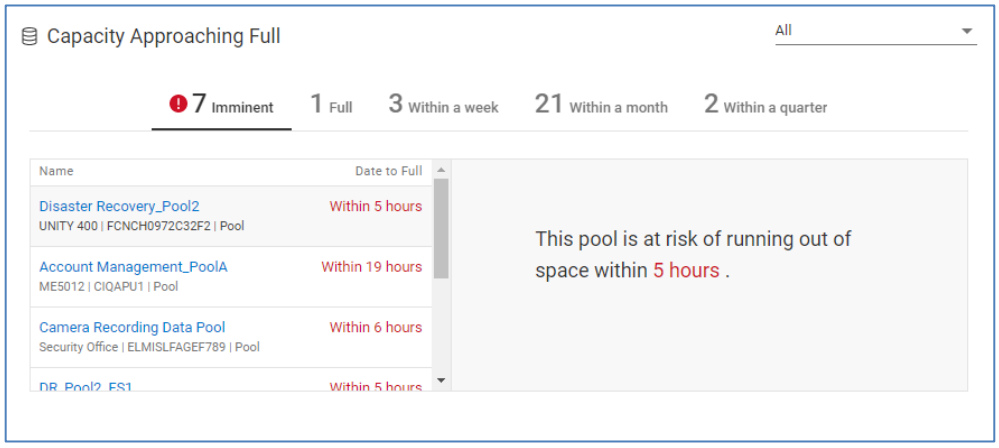
Selecting a range's number along the top of the tile displays the system names and health scores for that range, sorted from low to high. The chart is interactive allowing the user to select a system in the list to display its Top Health Issue in the right pane. This window displays the most impactful issue affecting the health score. Selecting the system name hyperlink directs the user to the Health Score tab of the systems details page. There is also a filter that allows the user to filter this tile on the following product types:

- Storage Systems

- Networking Systems
- HCI Systems
- Data Protection Systems
- Servers

Capacity Approaching Full – Leverages predictive analytics to identify the storage pools, clusters, file systems, and subscriptions running out of space. The chart is interactive allowing the user to select each object to display a trend line of the historical capacities. For Unity XT family and PowerVault storage pools, PowerMax storage resource pools, PowerStore, VxRail, PowerScale/Isilon, and XtremIO clusters, Unity XT File Systems, and APEX subscriptions, a forecast capacity chart is also shown. The estimated time range until each pool, cluster, or 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



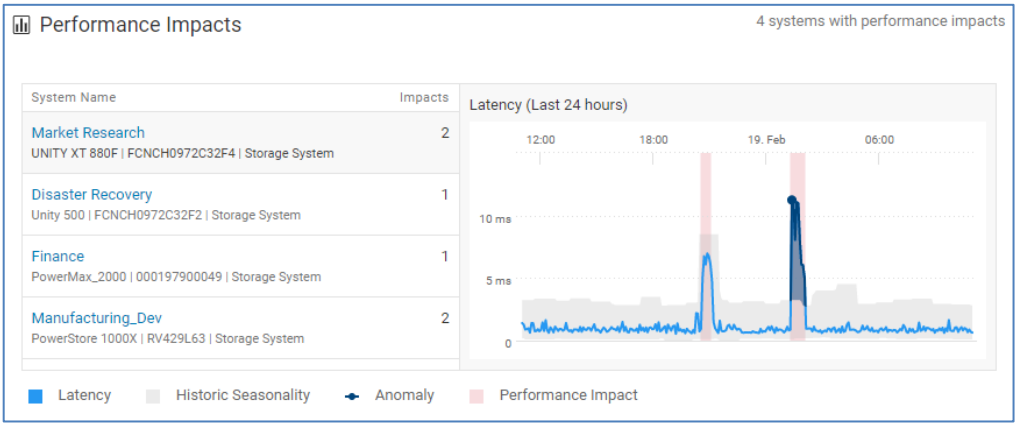
There is a drop-down menu that allows the user to filter the tile based on object type: Appliances, File Systems, Pools, Clusters, or Subscriptions.

The Imminent risk category is supported for Unity XT family, PowerVault, PowerMax/VMAX, PowerScale, and VxRail systems.

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.

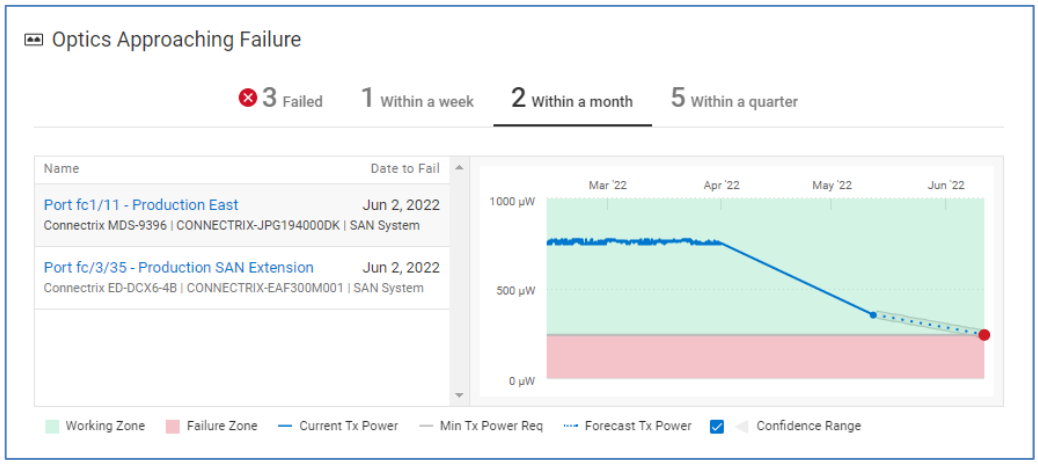
Performance Impacts – Currently supported for APEX Block Services, PowerMax, PowerStore, PowerFlex, and Unity XT family systems. Utilizes CloudIQ analytics to identify when there are performance impacts on a system due to a possible workload contention. It will also identify the existence of performance anomalies where the current system workload is outside of expected boundaries based on historical workloads. The chart is interactive allowing the user to select an impacted system 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.



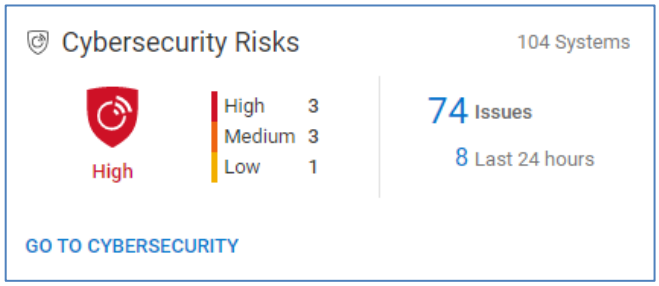
Optics Approaching Failure – Uses predictive analytics to provide a list of Connectrix ports with impending optic failures. The measured and predicted Tx power is analyzed and charted along with the working and failure zones. The estimated time to failure is categorized in each of the following time frames:

- Failed
- Within a week
- Within a month
- Within a quarter

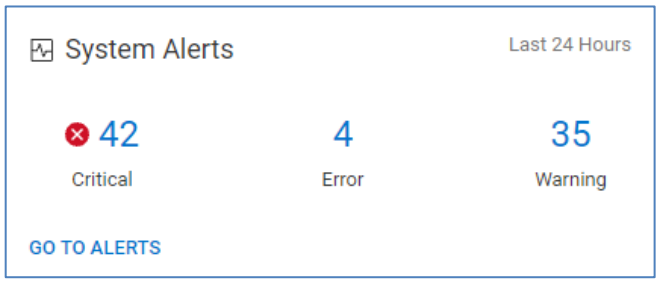


Cybersecurity Risks – Summarizes the active cybersecurity risks in the environment. The overall environment has an assigned risk level. A breakdown of the number of

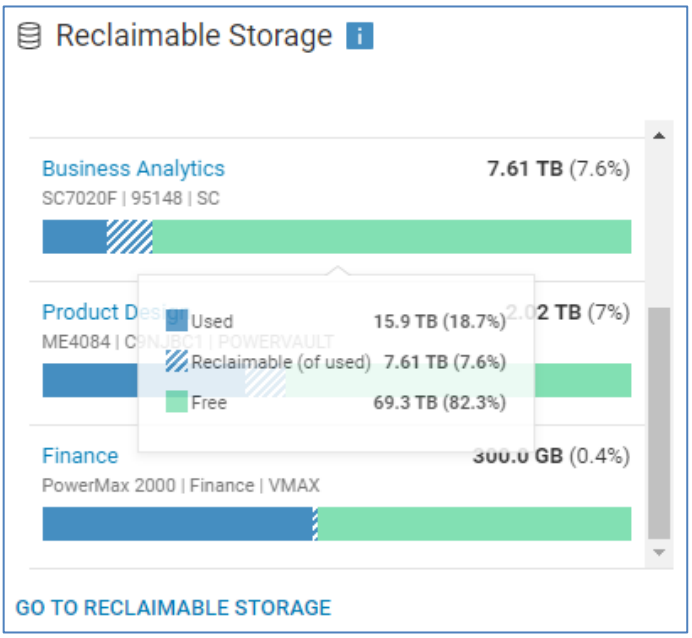
systems per risk level is provided as well as total issues and issues identified in the last 24 hours. Links to the System Risk page and the Cybersecurity Issues page are available.



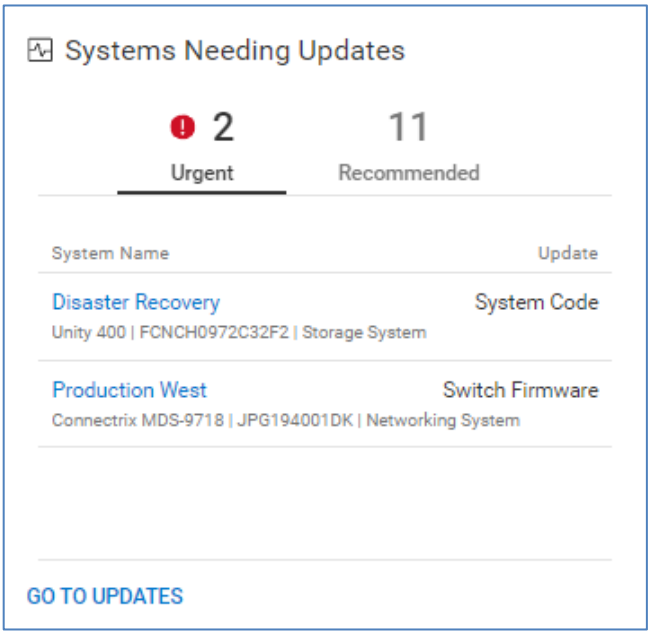
System Alerts – Summarizes the alerts collected by CloudIQ over the last 24 hours across the Critical, Error, and Warning severity levels. Clicking a number opens a list of alerts in the Alerts window filtered by the selected severity level. Selecting the “GO TO ALERTS” link navigates the user to a filtered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



Reclaimable Storage – This tile summarizes PowerMax, Unity XT family , 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.



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 and the type of update. Selecting the “GO TO UPDATES” link opens the System Updates page. This page shows all available code, firmware, and software updates across all systems and includes links to download the updates. Selecting the system name hyperlink directs the user to the Inventory tab on the system details page.



Health

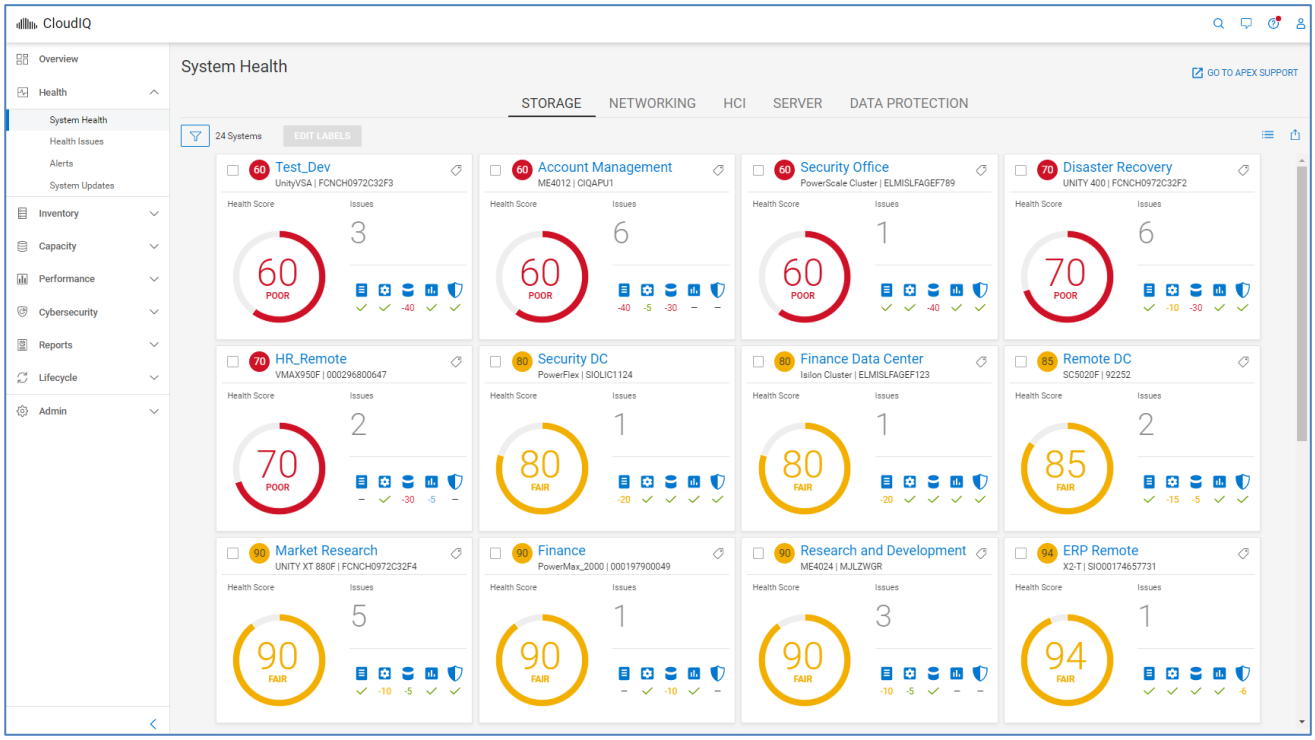
System Health

The System Health page displays the Proactive Health Score for all systems across all products in a consolidated view. There are up to five tabs: STORAGE, NETWORKING, HCI, SERVER, and DATA PROTECTION. These tabs organize the systems 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.

CloudIQ uses up to five categories to determine the Proactive Health Score presented on the System Health page: **Components** (), **Configuration** (), **Capacity** (), **Performance** (), and **Data Protection** ().

Note:

- PowerMax and VMAX systems do not include health issues in the Components or Data Protection categories. CloudIQ will display a dash (—) for these categories.
- PowerVault ME4 systems do not include the Performance or Data Protection categories. CloudIQ will display a dash (—) for these categories.
- VxRail systems do not include the Data Protection category.
- Connectrix, PowerSwitch, and PowerEdge currently use only the Components category.



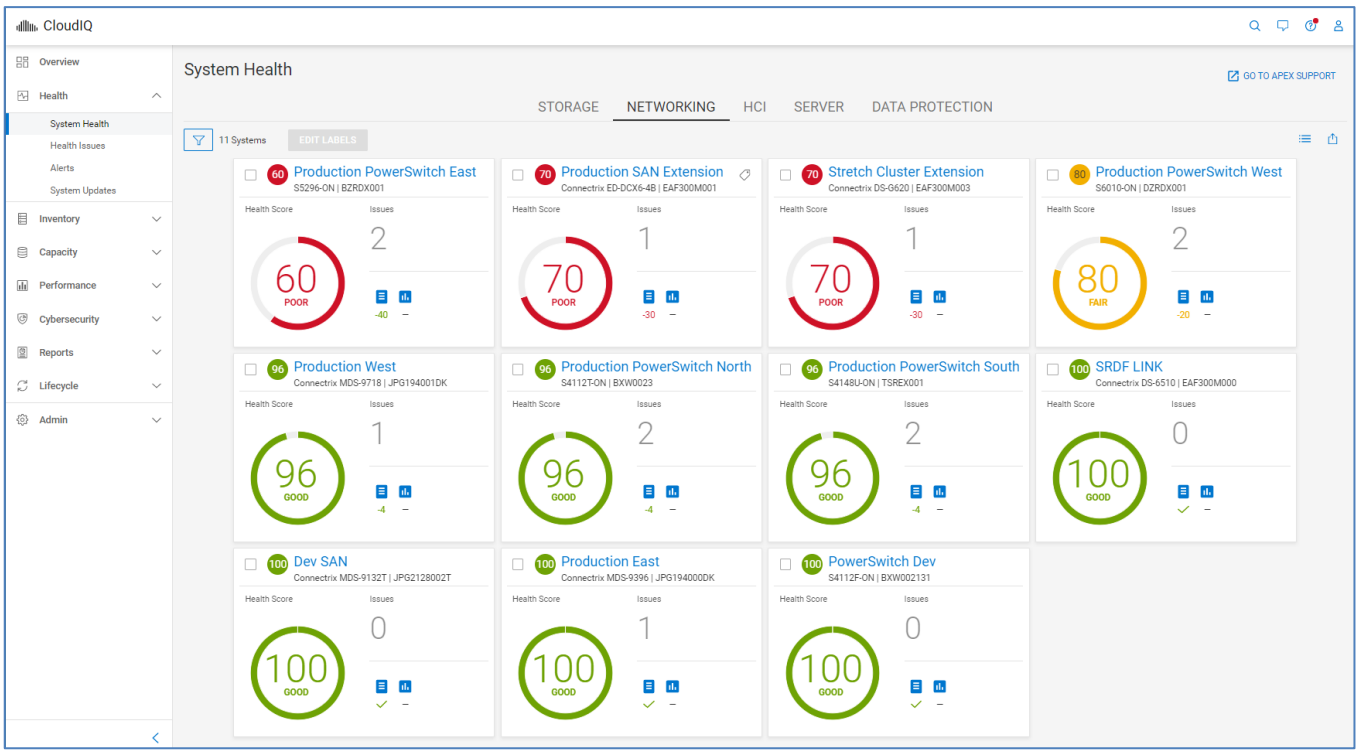
Each system has a health score displayed in the circle (ranging from 100 to 0) which is calculated as 100 minus the issue with the greatest impact. Each of the five categories has either a green check mark, a negative number, or a dash. The green check indicates no issues are present for that category. 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 users focus on the most

significant issue for the system, so that they 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 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 previously for both Storage and Networking, is the default view for this page. Users can alternatively choose the **List** view, by selecting the List View Icon ( ) in the upper right of the window. The list view is shown on the next page for Storage. This view may be more useful for larger environments because it allows for a more condensed view of the information and the ability to sort columns. Users can now view and edit custom tags from either the Card view or the List view. Custom tags are covered in detail in Custom tags and reports.

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 upper right of the view. Exporting the data from any of the multisystem views exports the data from all the multisystem views including the information displayed in the Health, Inventory, Performance, and Capacity views. The

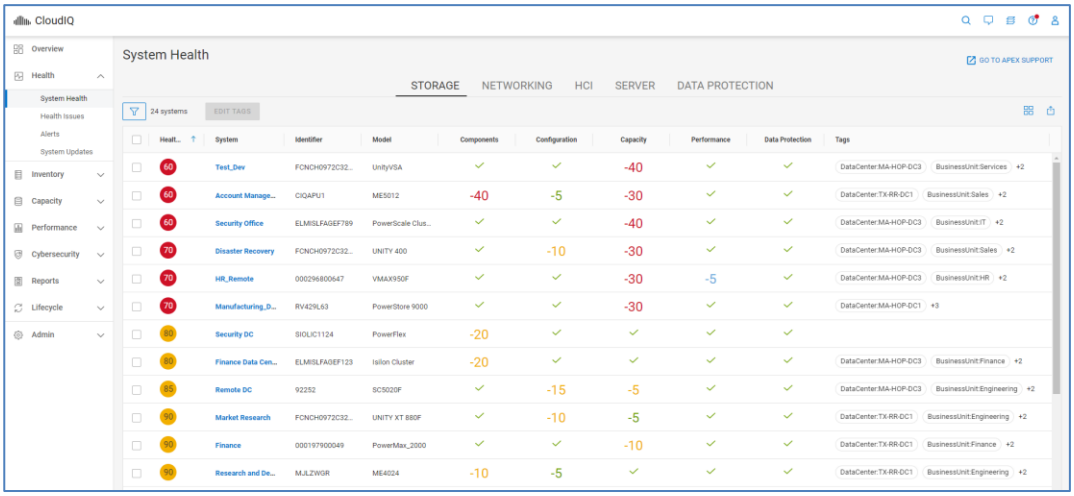
exported information includes either the Storage, SAN, HCI, or Data Protection views depending on where the user initiates the export.

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, Heath Score, Custom Tag, 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:

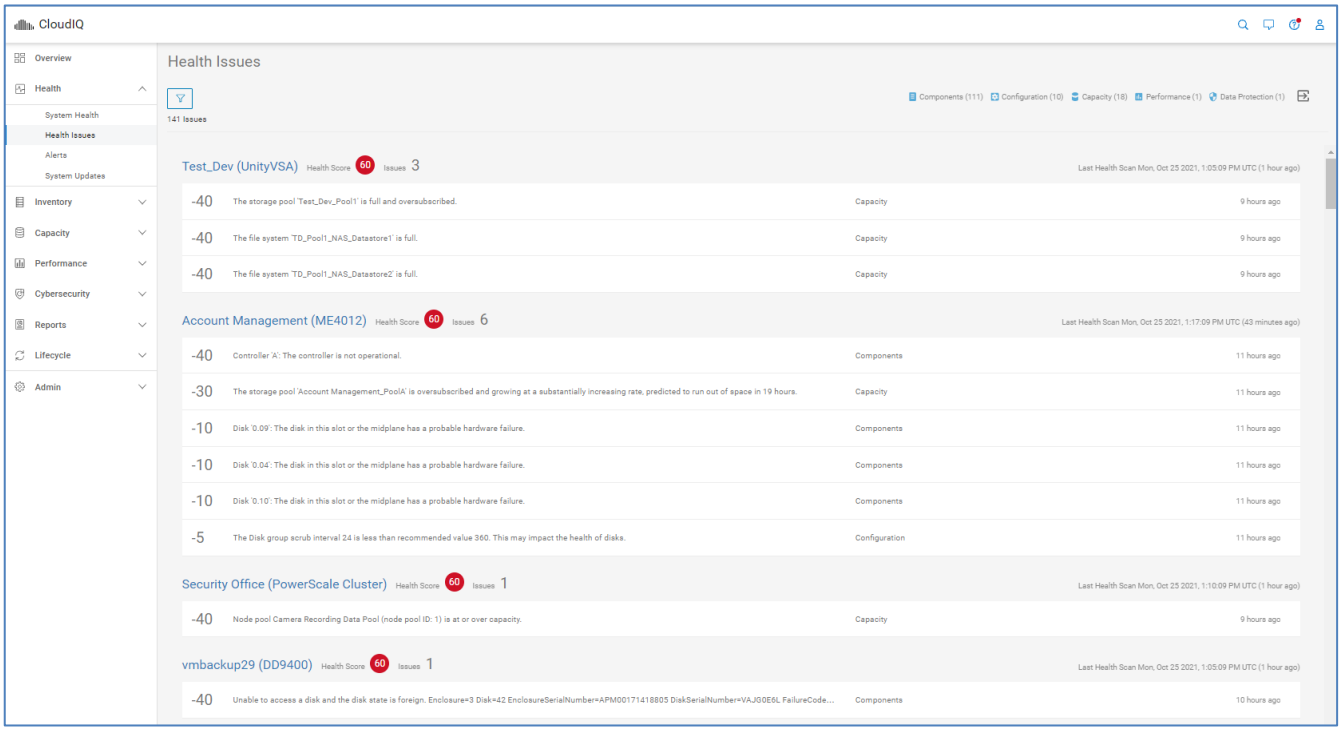
- **Score** – CloudIQ Proactive Health Score for system
- **Name** – User-defined name of system
- **Model** – Specific model of system
- **Serial number** – Unique serial number or identifier for the system

Selecting an individual system from either the card view or list view navigates the user to the system details page. These pages are discussed for each system type later in this paper.



Health Issues

The Health Issues page displays a comprehensive view of all the current health issues across the environment. The user can click the Filter icon to show a subset of systems based on the system name or product type. When the user starts typing the name of the system, a prepopulated list of system names is displayed that contains the entered text.

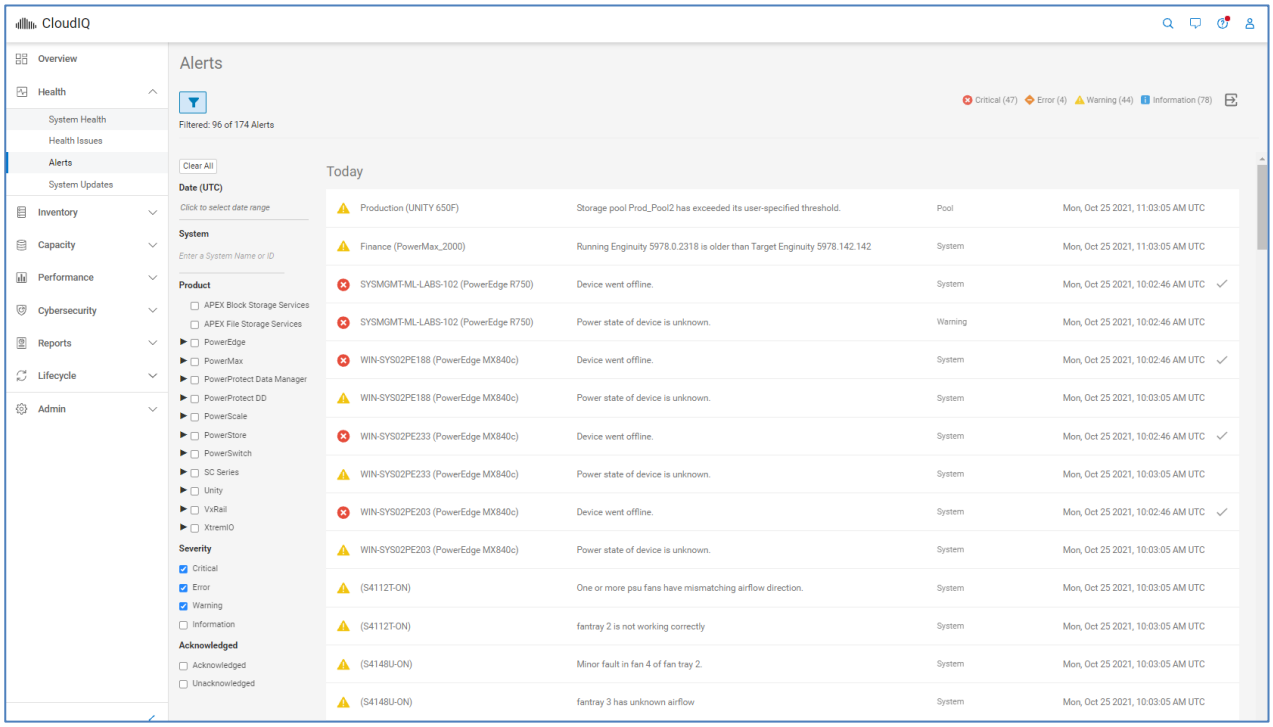


Alerts

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

- **Date** – Date range
- **System** – System Name or ID
- **Product** – Product type
  - APEX Block Storage Services
  - APEX File Storage Services
  - PowerEdge
  - PowerMax
  - PowerProtect Data Manager
  - PowerProtect DD
  - PowerScale
  - PowerStore
  - PowerSwitch
  - SC Series
  - Unity XT family
  - VxRail
  - XtremIO

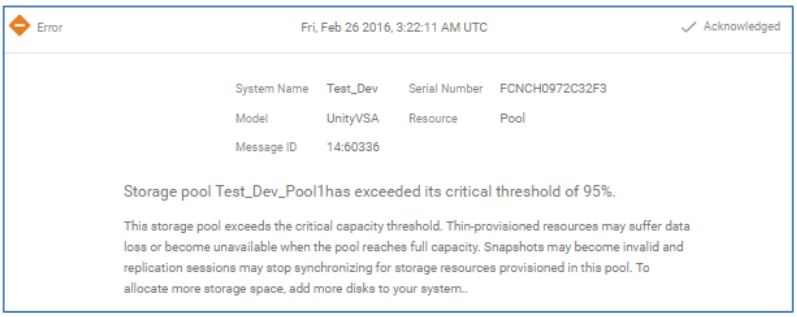
- **Severity**
  - Critical – Event that has significant impact on the system and needs to be remedied immediately
  - Error – Event that has minor impact on the system and needs to be remedied
  - Warning – Event that administrators should be aware of but has no significant impact on the system
  -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



Note:

- Alerts shown in CloudIQ originate from the system and can only be acknowledged, unacknowledged, and cleared on the system.
- Alerts for PowerFlex, PowerVault, 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.



System Updates

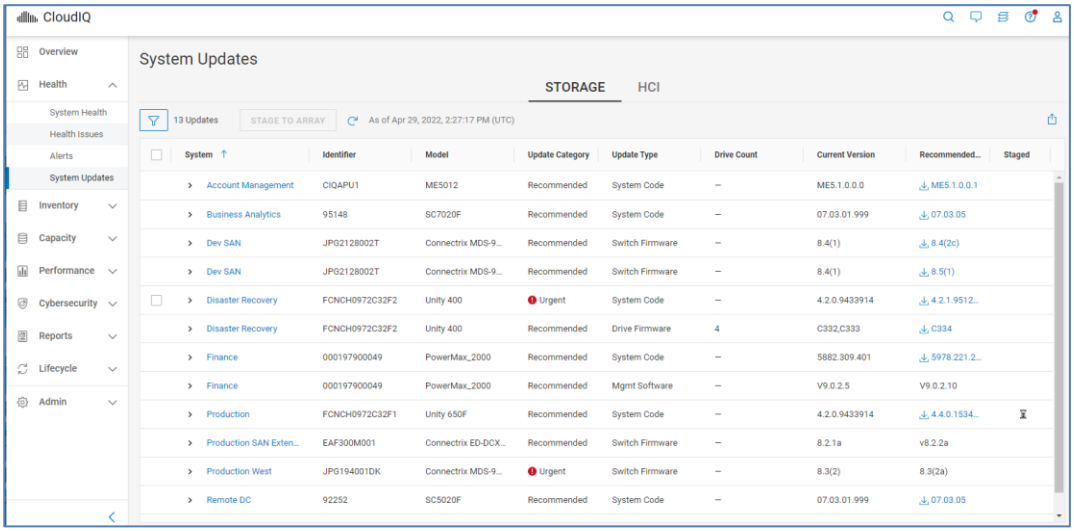
The System Updates page has two tabs: Storage and HCI.

Storage

The Storage tab displays a list of all available system code, management software, drive firmware, and switch firmware updates across all supported systems. It includes the system name, update category, update type, 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 and a link to the release notes for the system update.

This page also allows users to stage Unity XT code updates to the array. By selecting the Unity XT family arrays and the Stage to Array button, the code in the Recommended Update column is downloaded to the arrays. The user can log in to Unisphere and initiate the code upgrade at an appropriate time.

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

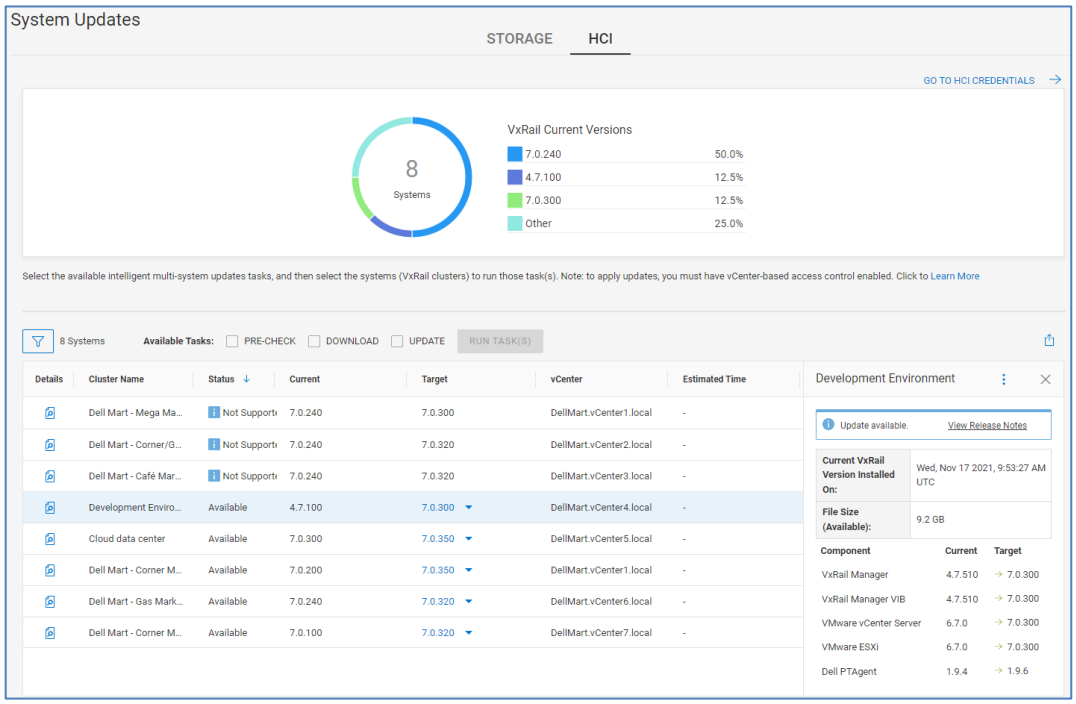


Note:

- The System Updates listing in CloudIQ does not support PowerScale/Isilon, PowerFlex, XtremIO, PowerProtect DD, PowerEdge, and PowerSwitch.
- System Updates are not applicable to APEX Data Storage Services since Dell Technologies Managed Services Account Teams maintain these systems.

HCI

The HCI tab allows users to initiate multi-system updates from CloudIQ. Users can run pre-check, code download, and system update tasks on their VxRail clusters. The top of the page provides a chart with the VxRail software distribution for all monitored VxRail clusters. The bottom of the page lists each cluster along with various information such as current version, target version, and vCenter hostname. CloudIQ intelligently provides a list of all possible target versions based on the current cluster version. Selecting the details icon provides additional information about the current installation timestamp, the update file size, and the component current and target versions.



When preparing for a cluster update, users can run the Pre-check task. The Pre-check task determines the cluster's readiness for a system update and includes the checks found in VxVerify. The Pre-check task produces a pass/fail status with a job report that lists the details of each check. If a check fails, the job report provides a link to a knowledge base article that users can review to help remediate the issue before proceeding with a code download and system update. This is covered in more detail in the CloudIQ administration section of this paper.

The Download task downloads and stages the update bundle onto the VxRail Manager VM of the cluster. This operation performs a change analysis between the existing software version running on the cluster and the selected target version. It then identifies and bundles only the necessary component files needed for the system update. This intelligent bundling can significantly reduce file transfer size and download times for all clusters, and particularly for those clusters at remote sites with limited bandwidth.

Once the Pre-check and Download tasks are successful, users can confidently run the Update task. Users can select a combination of tasks at once. For example, instead of running each task individually, they could select both the Pre-check and Download tasks and then come back and initiate the Update task. They could also select all three tasks. In the event of a task failure, the remaining tasks will not run.

Inventory

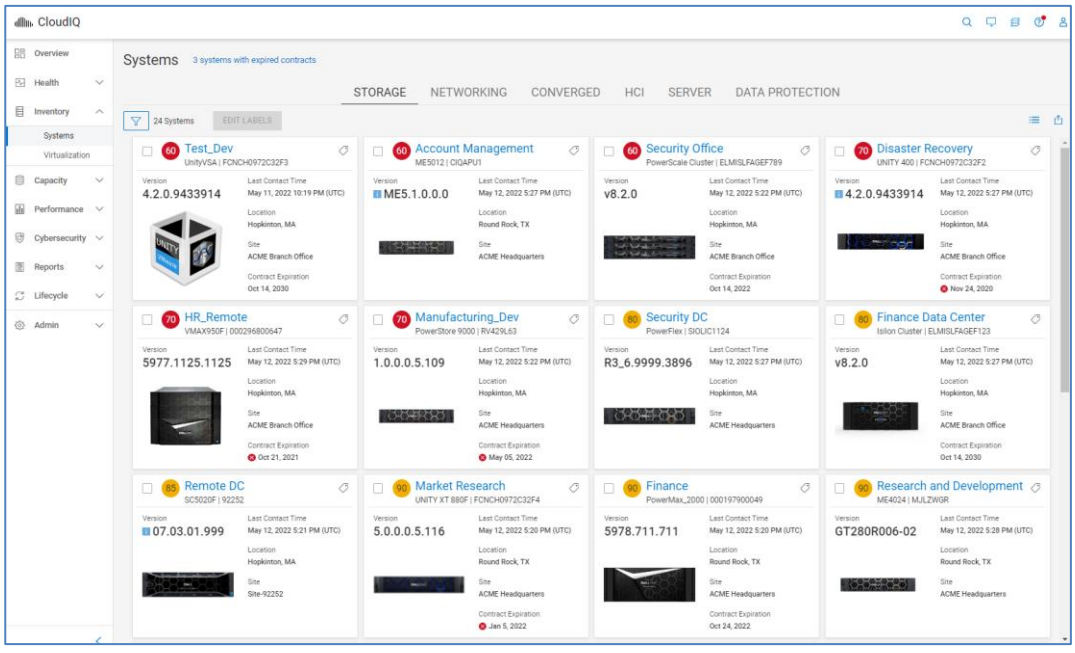
Systems

The Systems page is the multisystem view showing the configuration information for all systems in the environment. With the addition of recently added products, there can be five tabs in the multisystems inventory view: STORAGE, NETWORKING, CONVERGED, HCI, SERVER, and DATA PROTECTION. The information displayed on the Systems pages includes:

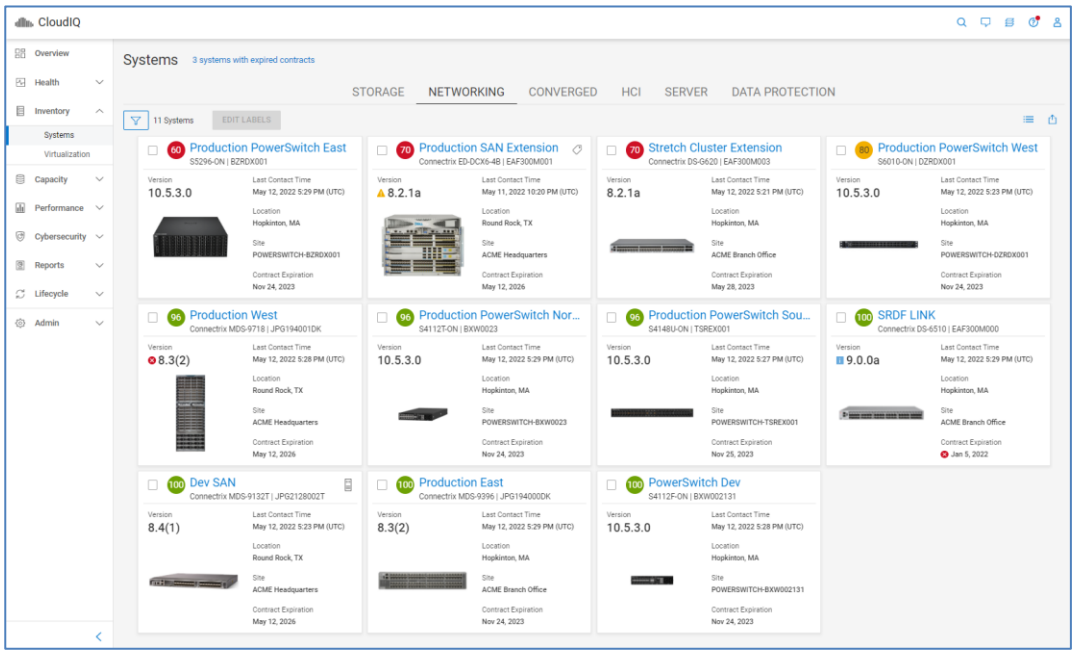
- Version (vCenter Version for Converged) – Version of installed software
- Last Contact Time – The last time that CloudIQ received data from the system
- Managed by (Converged only) – Type of AMP managing the Converged System
- Location – Location where the system is installed
- Site – Site ID with which the system is associated
- Contract Expiration (Warranty Expiration for PowerEdge)– Expiration date for the service contract. Contract expiration is not supported for PowerFlex, PowerVault, SC Series, or PowerProtect DM. It is not applicable to APEX Data Storage Services.

For systems that support the identification of system updates, there will also be an indication when a code update is available. Hovering over the information icon ( ) opens a window showing the update version. Clicking the “Learn More” link from within the window opens a dialog with summary information and links to the Release Notes and the software download.

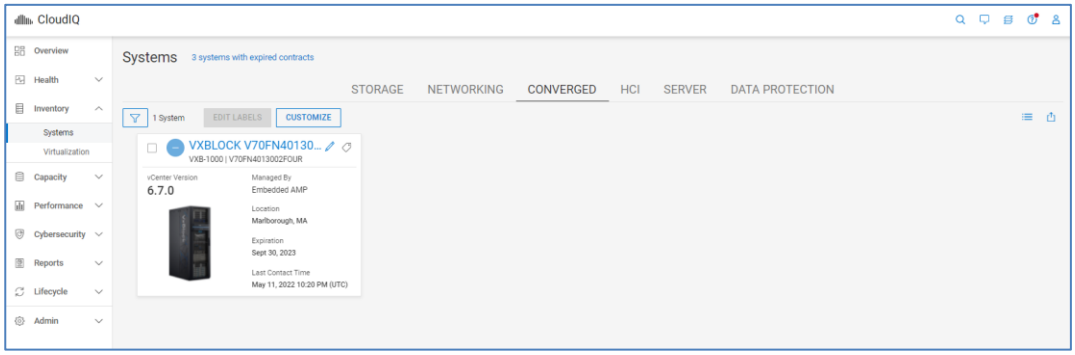
The following shows an example of the STORAGE tab.



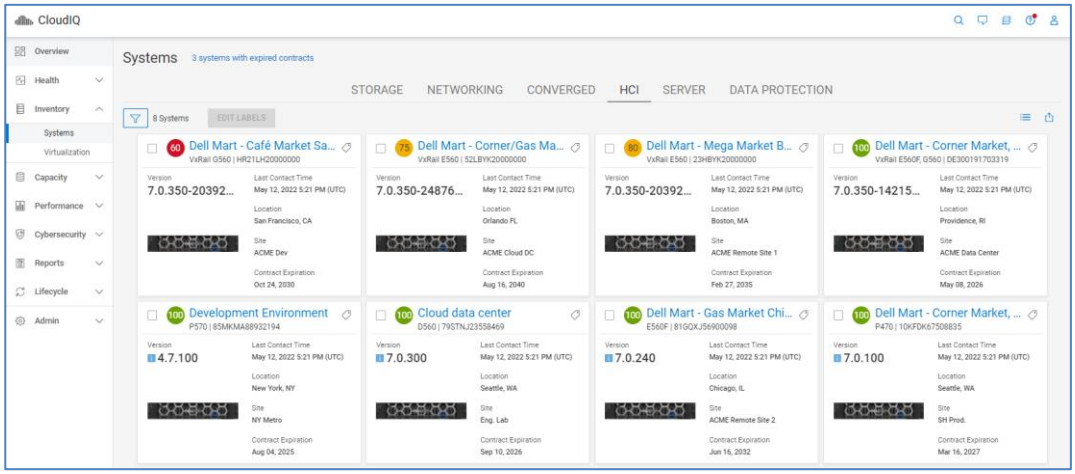
An example of the NETWORKING tab is displayed below showing similar attributes to those displayed in the STORAGE tab.



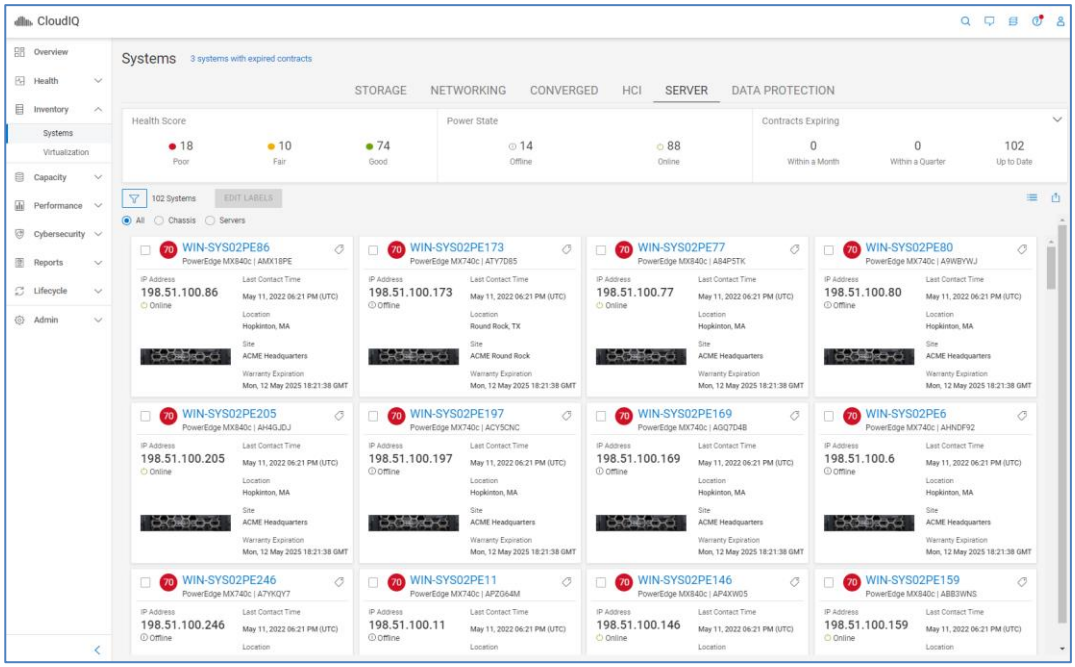
An example of the CONVERGED tab is shown below. The user can edit the system name in the card to provide a more user-identifiable name and differentiate it when multiple systems are being monitored. Users can also use the Customize button to display different attributes in the card view.



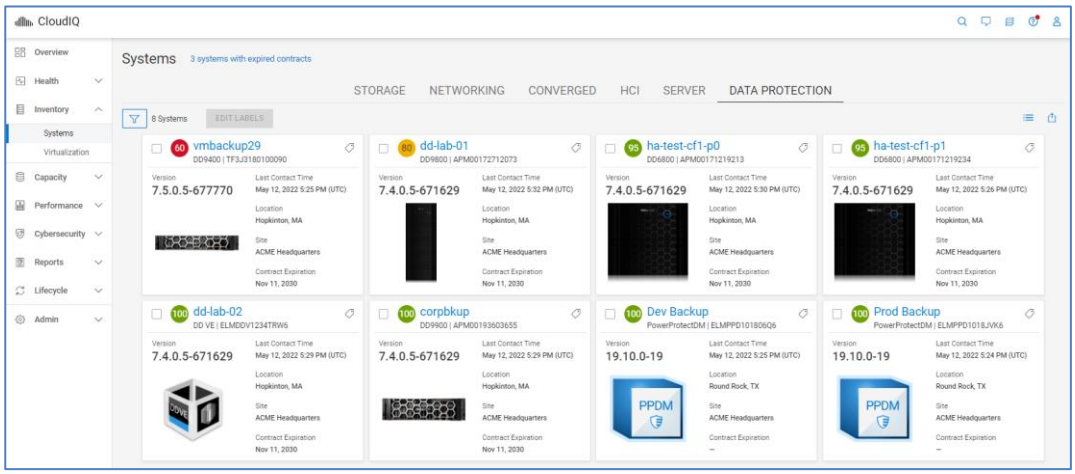
An example of the HCI tab shown below displays the inventory of VxRail systems.



The following shows an example of the SERVER tab. There is a top banner summarizing total number of servers by Health Score, Power State, and Contracts Expiring. This banner is available for servers due to the potentially large number of devices that could be monitored by CloudIQ.



An example of the Data Protection tab shows both PowerProtect DD systems and PowerProtect Data Manager instances monitored by CloudIQ.

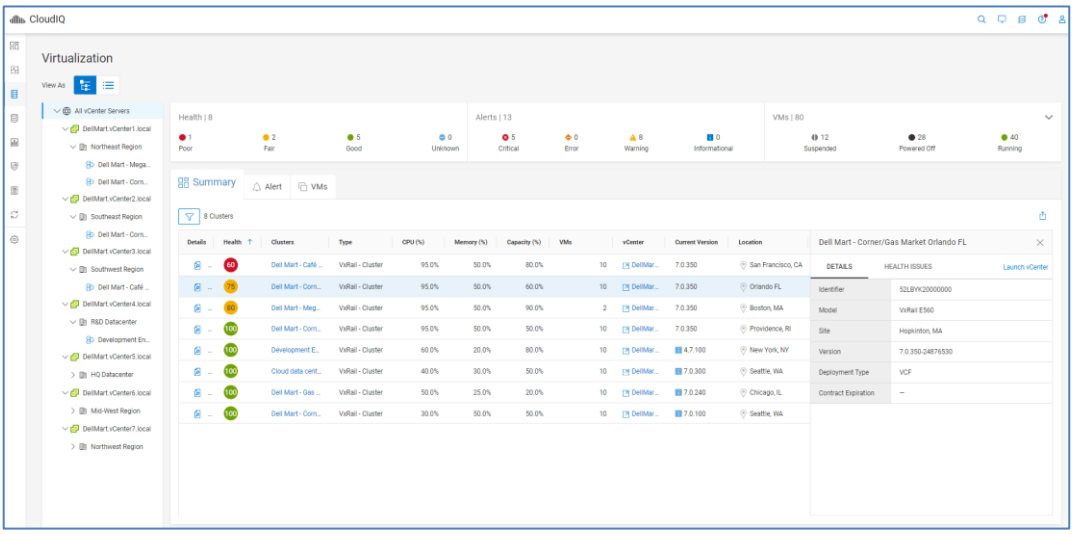


Virtualization

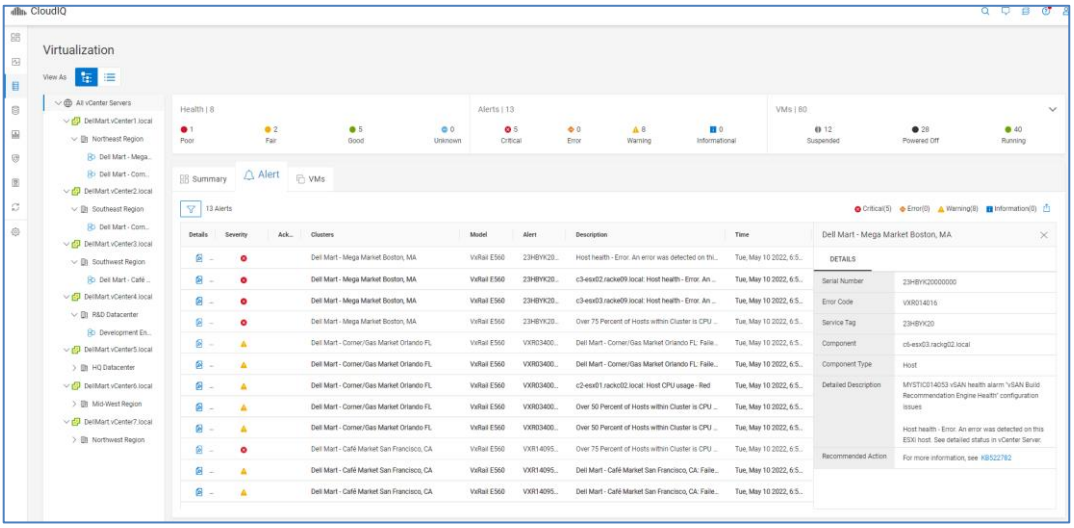
The Virtualization view allows users to view VMware related information in a hierarchal navigation model similar to vCenter. Initially, it is supported for VxRail clusters but will soon expand to cover VMware data from other sources such as PowerEdge servers and the CloudIQ Collector.

The left side of the screen shows all the vCenter servers, the VMware data centers, and the VxRail clusters. The top-right side provides a banner with a summary of clusters in each health category, a summary of alerts by severity, and a summary of VM status. The summary is based on the selected object in the left tree. For example, if **All vCenter Servers** is selected, the banner shows all the clusters, alerts, and VMs in the environment. If an individual vCenter is selected, the banner summarizes only those clusters, alerts, and VMs in that vCenter.

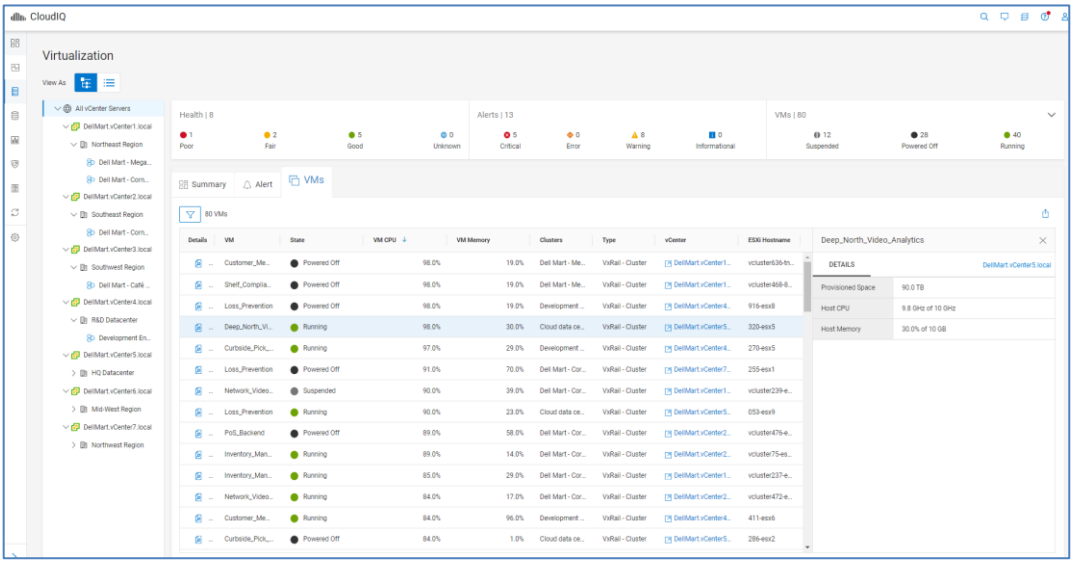
The bottom-right side has three tabs: Summary, Alerts, and VMs. The Summary tab shown below provides the health score of each VxRail cluster along with CPU, Memory, and Capacity metrics, the number of VMs on each cluster, current version, location, and a link to launch vCenter. The details icon opens a window with more details for the cluster in the Details tab and a listing of the issues and associated remediations in the Health Issues tab.



The Alert tab lists the associated alert information including the description and timestamp. The Details icon opens the alert details window which includes the recommended action.



The VMs tab lists the virtual machines with their state, CPU and Memory metrics, and associated cluster and ESXi server. The Details icon opens the VM details window which shows more specific capacity, CPU, and Memory metrics.



Capacity

System Capacity

The System Capacity view displays the system level storage capacity for traditional storage systems, APEX Data Storage Services, VxRail hyperconverged systems, and PowerProtect DD systems. For Connectrix and PowerSwitch, it displays port capacity.

An example of each of the tabs in the System Capacity page is shown below.

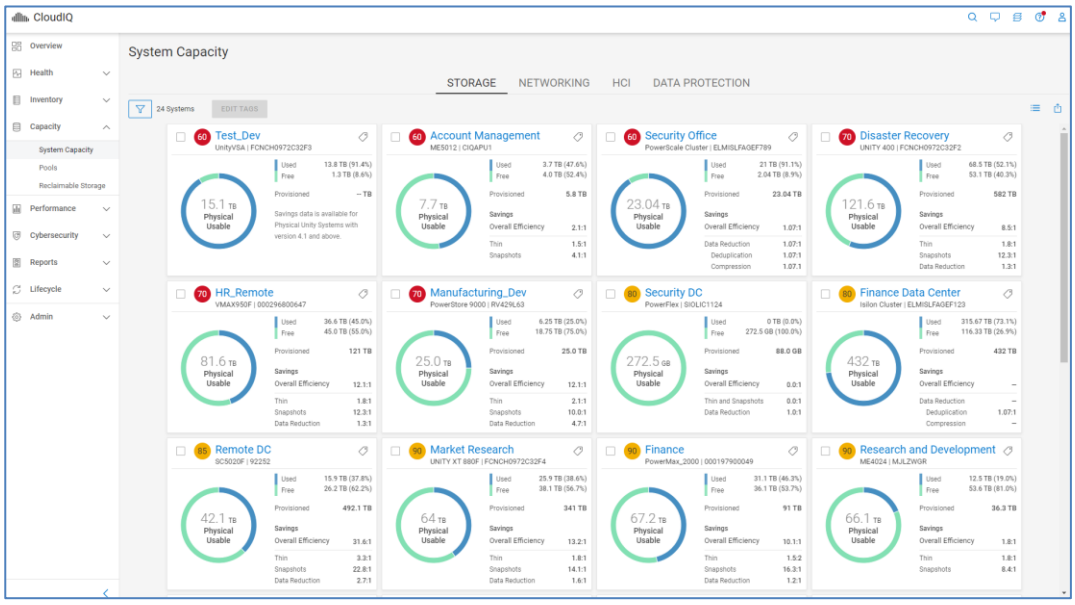
The information for traditional storage systems includes:

- **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 (Unity XT family, PowerStore, SC Series, VMAX/PowerMax, PowerVault ME4)
  - **Snapshots** – Ratio of snapshots on the system (Unity XT family, 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 or deduplication. (Not supported for PowerVault ME4)
  - **Deduplication** – Ratio gained by savings from deduplication (PowerScale/Isilon only)

The information for APEX Data Storage Services includes:

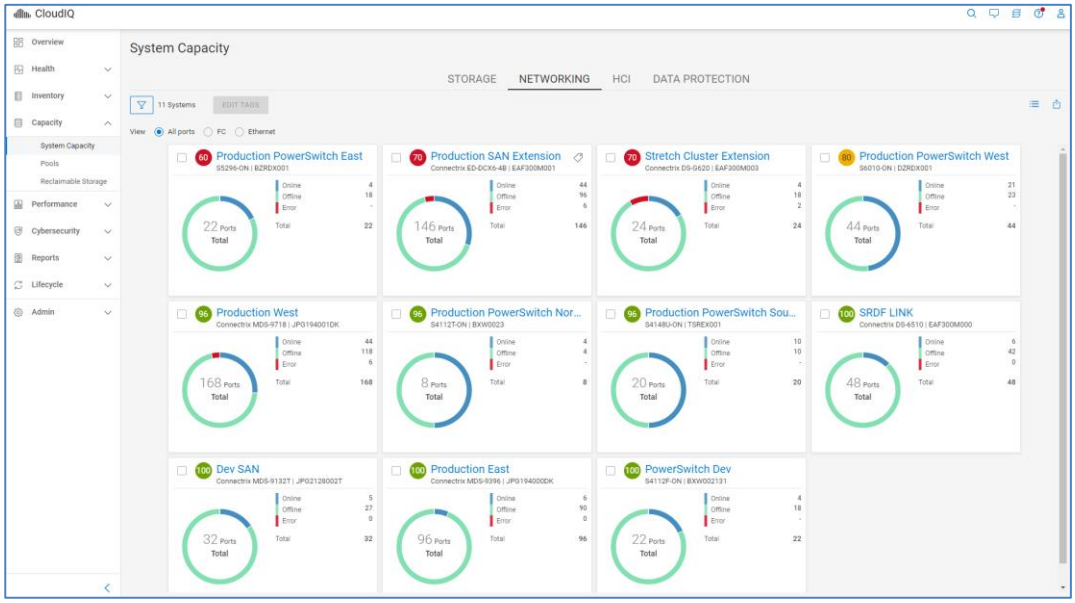
- **Effective Usable** – Total of Base and On-Demand Usable capacity
- **Used** – Amount of host written data including both Base and On-Demand capacity
- **Free** – Remaining available space from the combined total of Base and On-Demand capacity
- **Subscriptions** – Number of subscriptions for a given cluster (APEX File Storage Services)
- **On-Demand Used** – Amount of used capacity from On-Demand



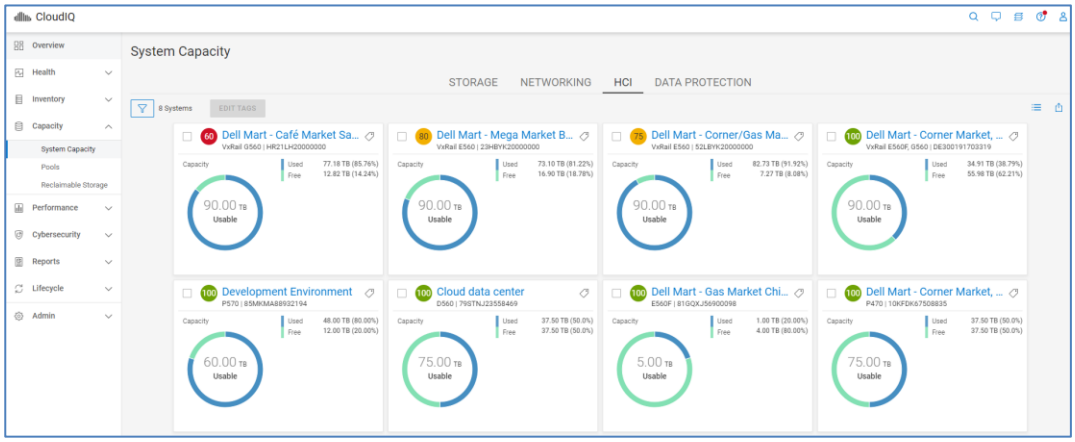
Note: For Unity XT family systems running version 4.3 and later and SC Series running version 7.3, Data Reduction includes Compression or Deduplication.

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

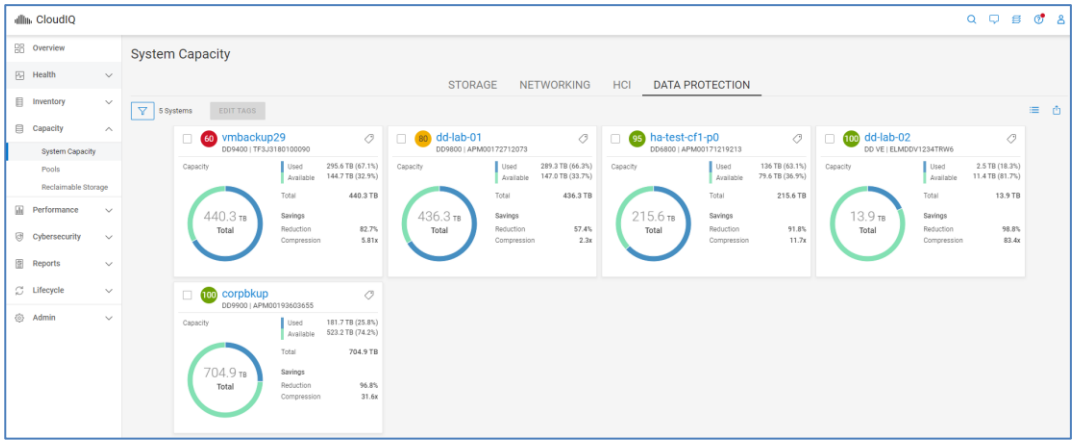
- **Total Ports** – Total number of ports (All ports, FC ports, or Ethernet ports depending on previous selection)
- **Online** – Number of ports in an online state
- **Offline** – Number of ports in an offline state
- **Error** – Number of ports in an error state



For VxRail systems, CloudIQ displays Usable and a breakdown of Used and Free capacity.



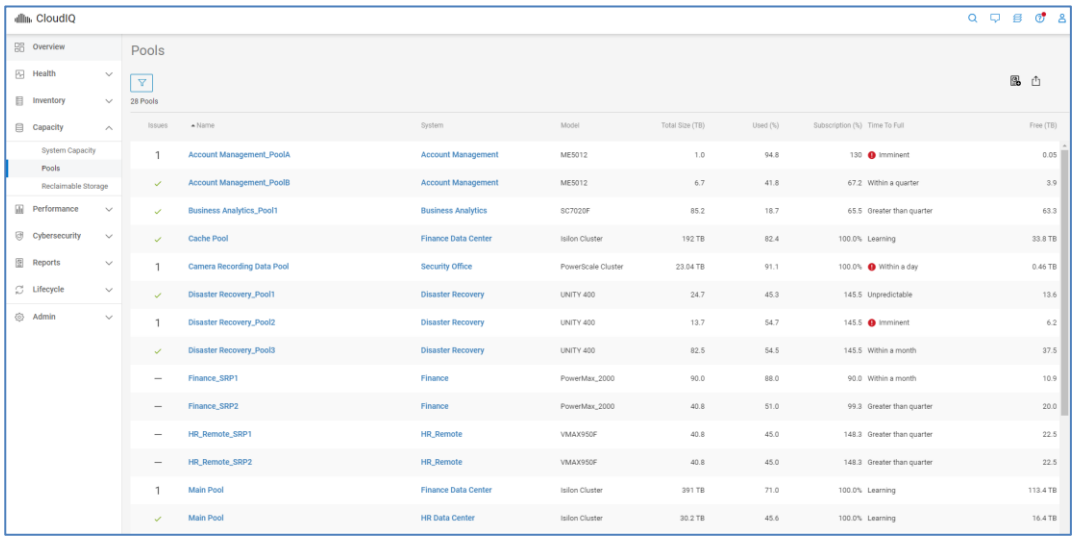
The Data Protection tab summarizes the capacity for DD systems. Total storage is broken down to Used and Available. Savings due to Reduction and Compression is also provided for each system.



Pools

The **Pools** page provides an aggregated listing of storage pools including PowerMax storage resource pools. The Issues column displays 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 XT family, 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 on 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.



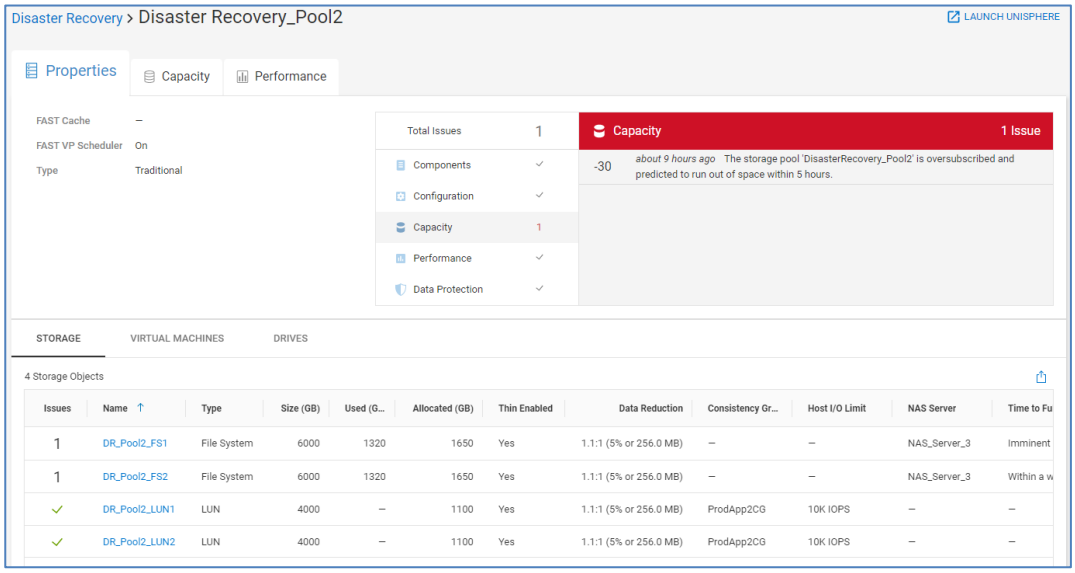
Pool details – Properties

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 upper 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.

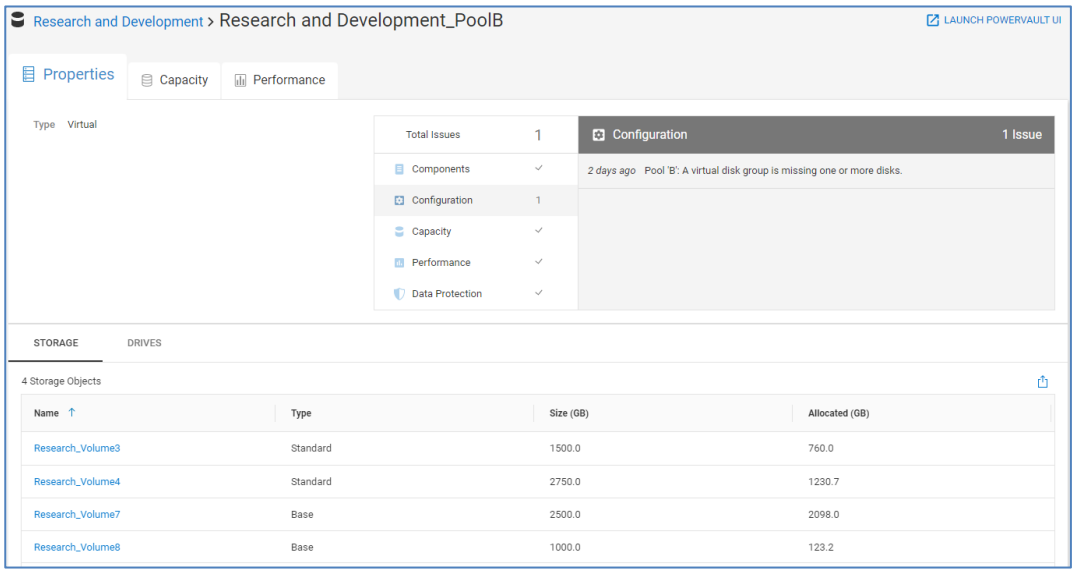
Unity XT family and SC Series:

- Storage
- Virtual Machines
- Drives



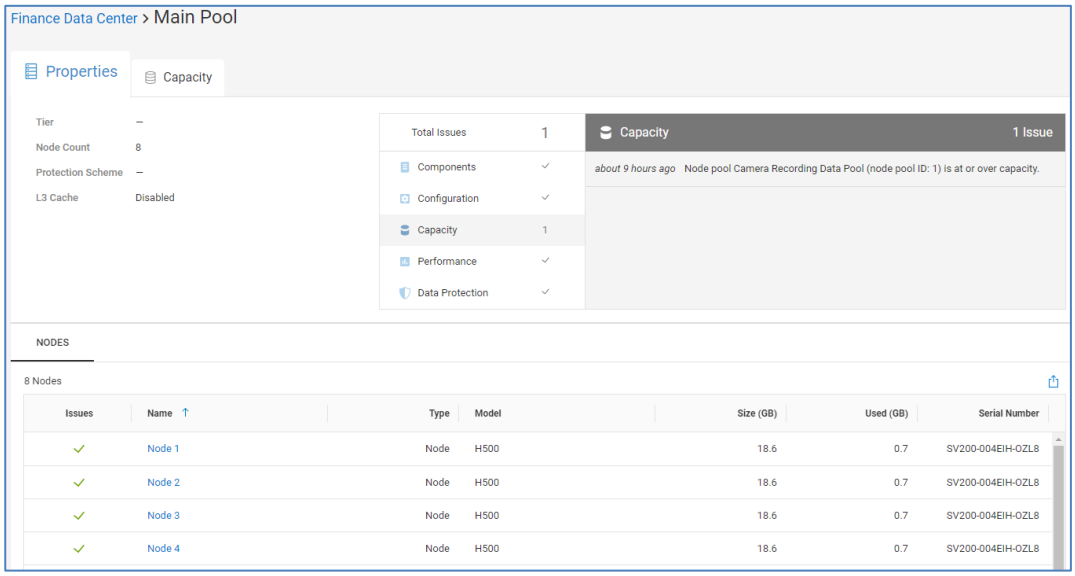
PowerVault:

- Storage
- Drives



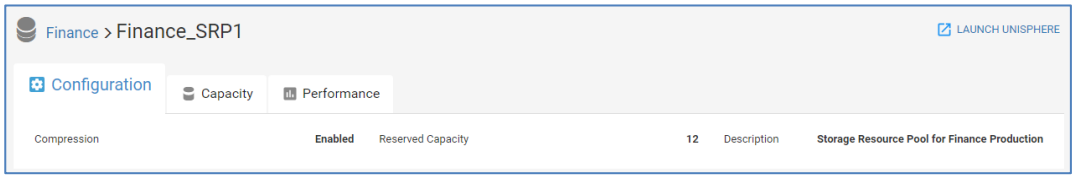
PowerScale and Isilon:

- Nodes



PowerMax:

- No tabs

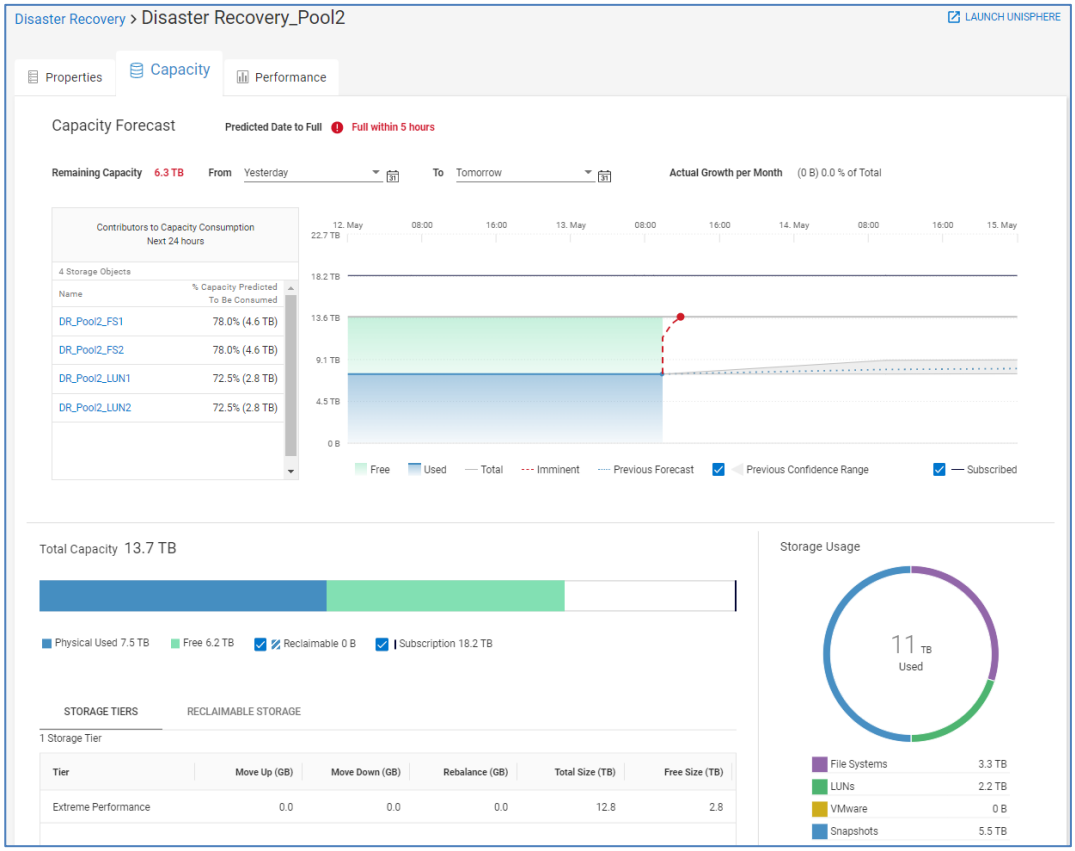


Pool details – Capacity

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

Unity XT family, PowerScale, Isilon, PowerVault

The graph along the top displays the historical pool capacity data and the Predicted Date to Full date (Unity XT family, PowerVault, and PowerScale/Isilon). The graph shows Free, Used, Total, Forecast Used, Confidence Range, and Subscribed. The Confidence Range represents the confidence level in predicting the date to full; the wider the range, the lower the confidence level. When an imminent full condition exists, the graph also shows the Previous Forecast and Previous Confidence Range. It also shows the top storage objects predicted to contribute to capacity consumption over the next 24 hours as shown below. If the pool is in a Learning, Full, or Unpredictable state, only the historical trend 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.” For pools at imminent risk, the “From:” field is set to yesterday. The following times are available from the pull-down:

- Yesterday
- 1 week ago
- 1 month ago
- 3 months ago (default)
- 6 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)
- Tomorrow
- 1 week from today
- 1 month from today
- 3 months from today
- 6 months from today
- Predicted Full (default)
- Custom

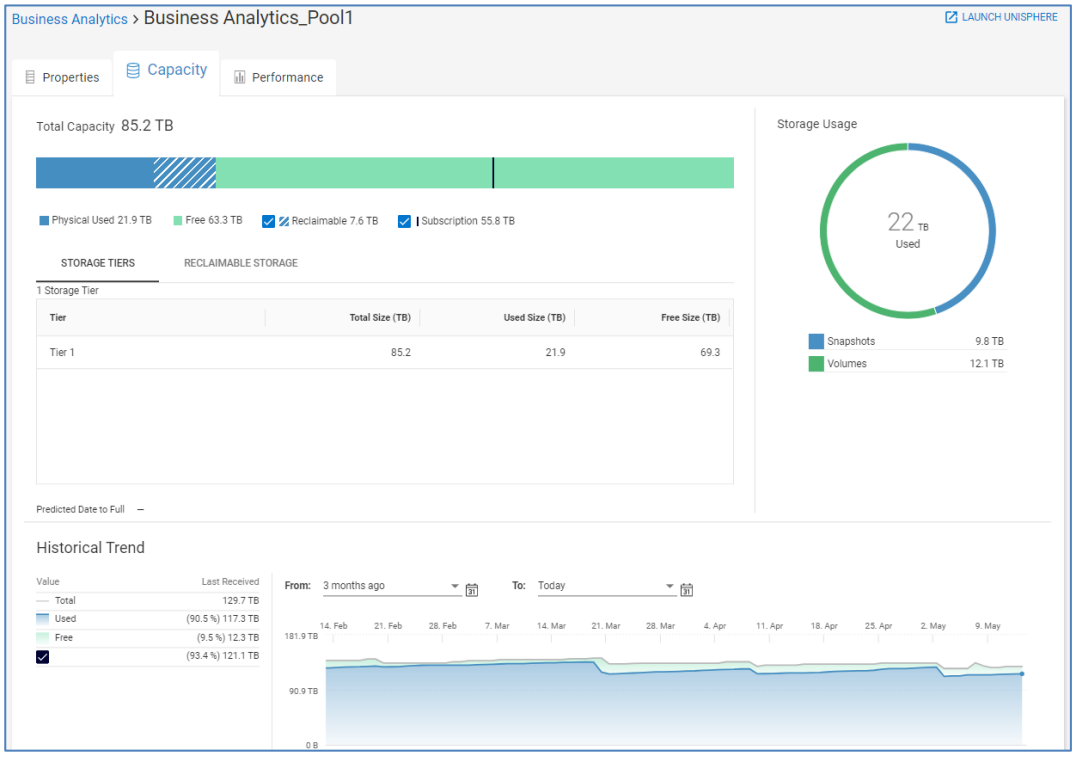
The **Subscribed** checkbox enables the user to view or hide the pool subscription data on the graph.

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 Used, Free, Reclaimable, and Subscribed. The Storage Usage ring shows how the used storage is configured.

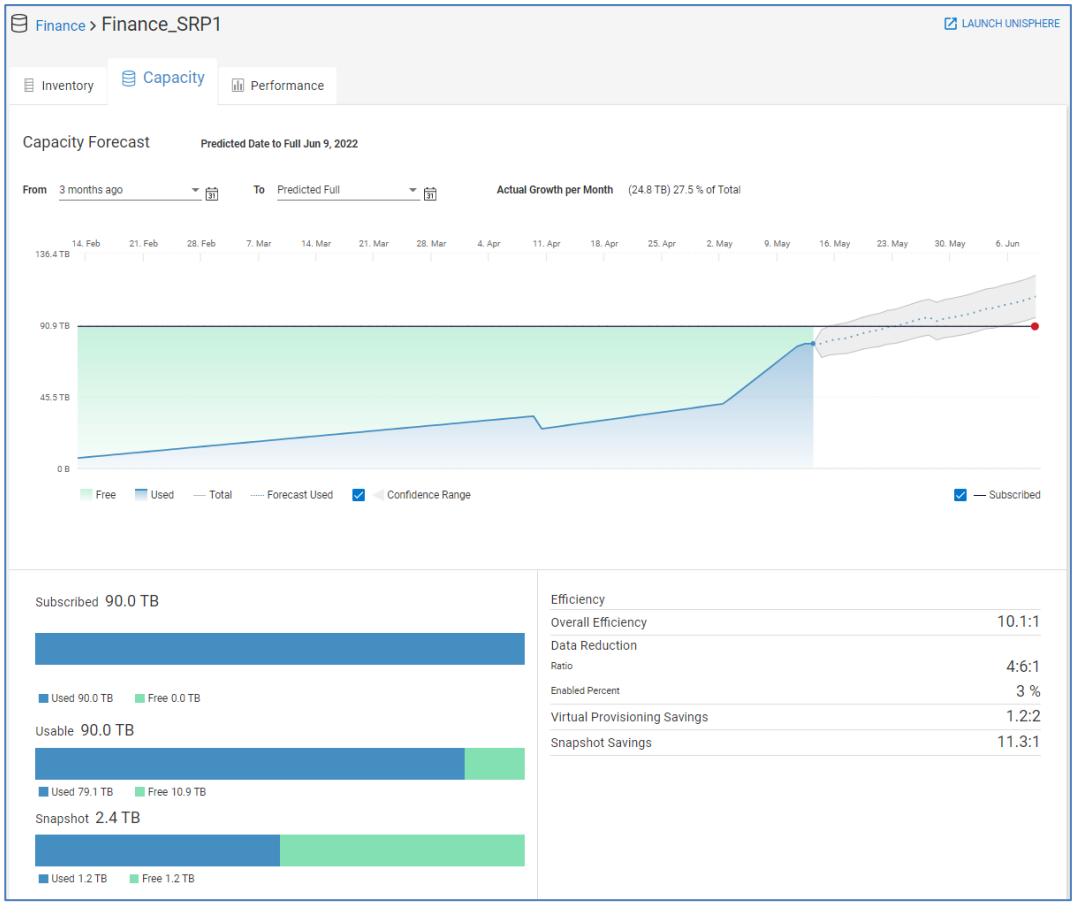
SC Series

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



PowerMax and VMAX3

For PowerMax and VMAX3 arrays, the Capacity tab displays a capacity forecast chart for storage resource pools. The bottom half of the page shows Used and Free storage in bar charts for Subscribed, Snapshot, and Usable space. It also displays the Overall Efficiency ratio. This ratio is calculated as the sum of all TDEVs plus snapshot sizes (based on 128 K 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.

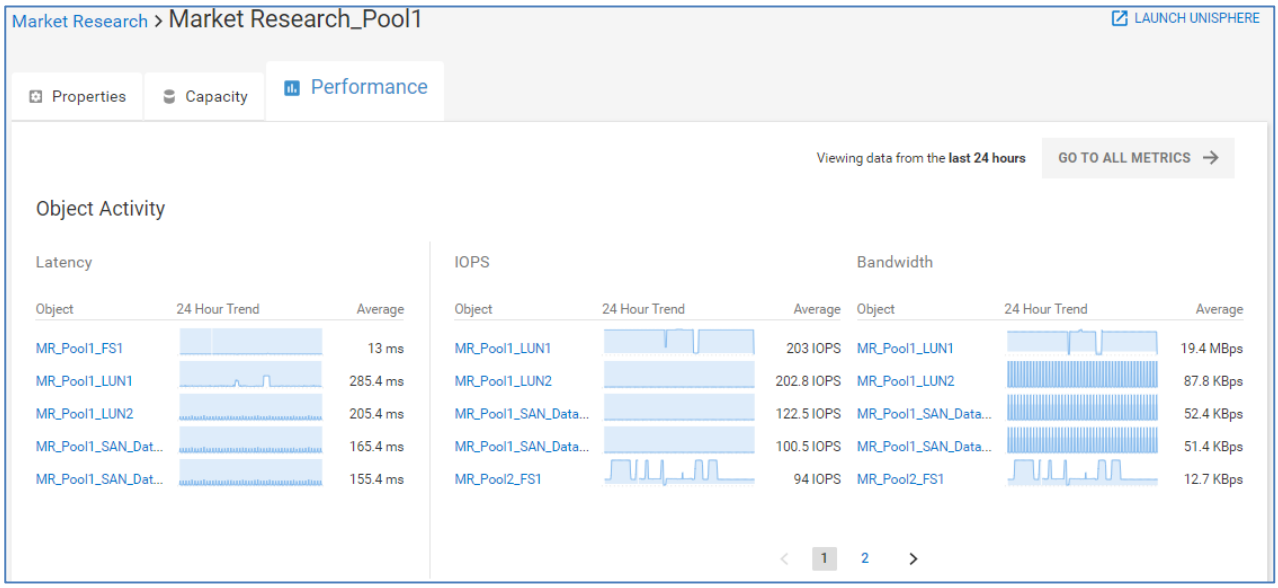


Pool details – Performance

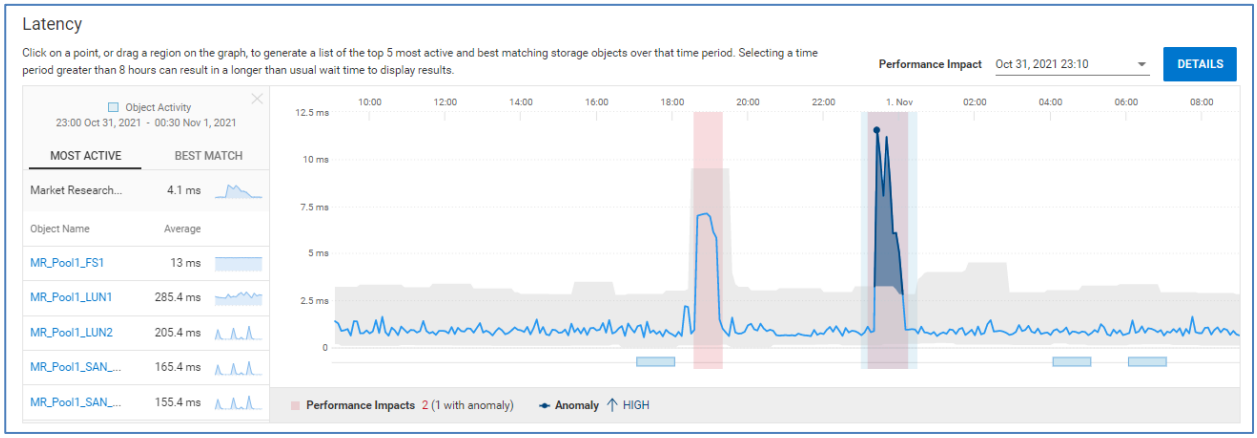
The **Performance** tab for pools is available for Unity XT family, SC Series, PowerMax/VMAX, and PowerVault systems. The information under the Performance tab differs slightly for each supported array type.

Unity

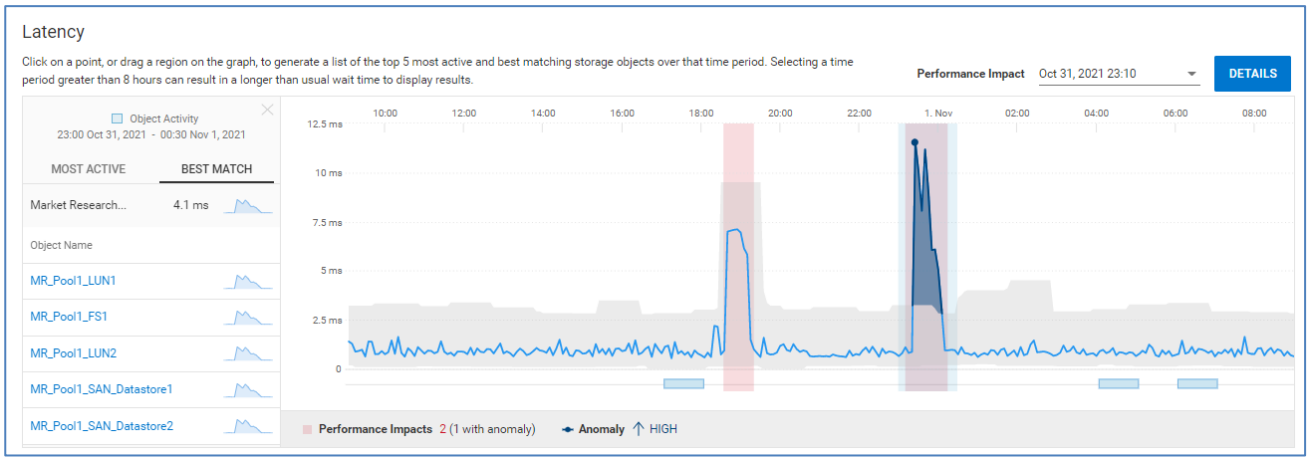
For Unity XT pools, the top of the page displays 24-hour trend lines and a 24-hour average for Latency, IOPS, and Bandwidth for both block objects and file systems. CloudIQ presents the top five objects associated to the pool. The user can scroll to see additional objects.



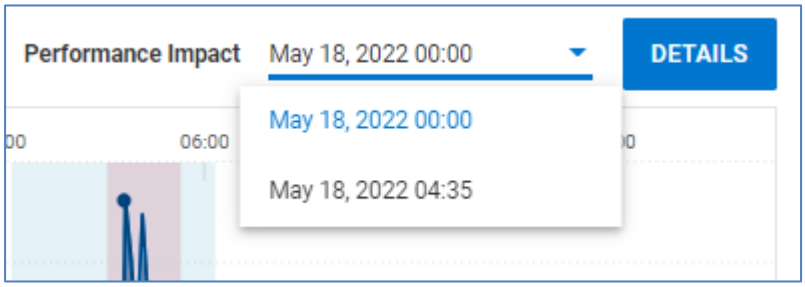
Scrolling down this view provides the user with detailed performance graphs for Latency, IOPS, Bandwidth, and Backend IOPS (one chart per tier). CloudIQ identifies and highlights not only performance anomalies on the Latency chart, but also performance impacts. Performance anomalies are highlighted in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



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



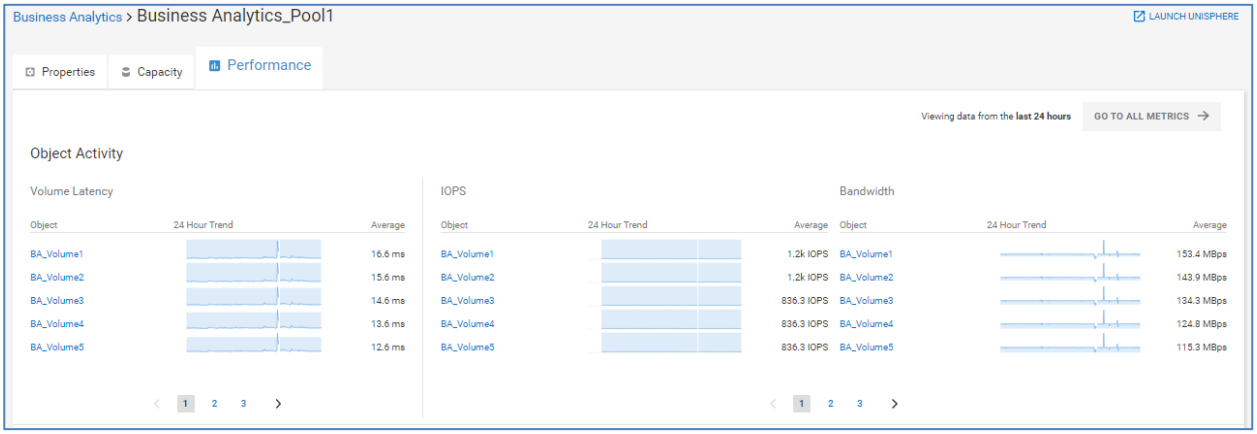
When there are performance impacts detected by CloudIQ, the user can view details of them by selecting the Details button in the upper right of the chart. If there are multiple performance impacts displayed on the chart, the user can select which impact to investigate by selecting the drop-down menu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



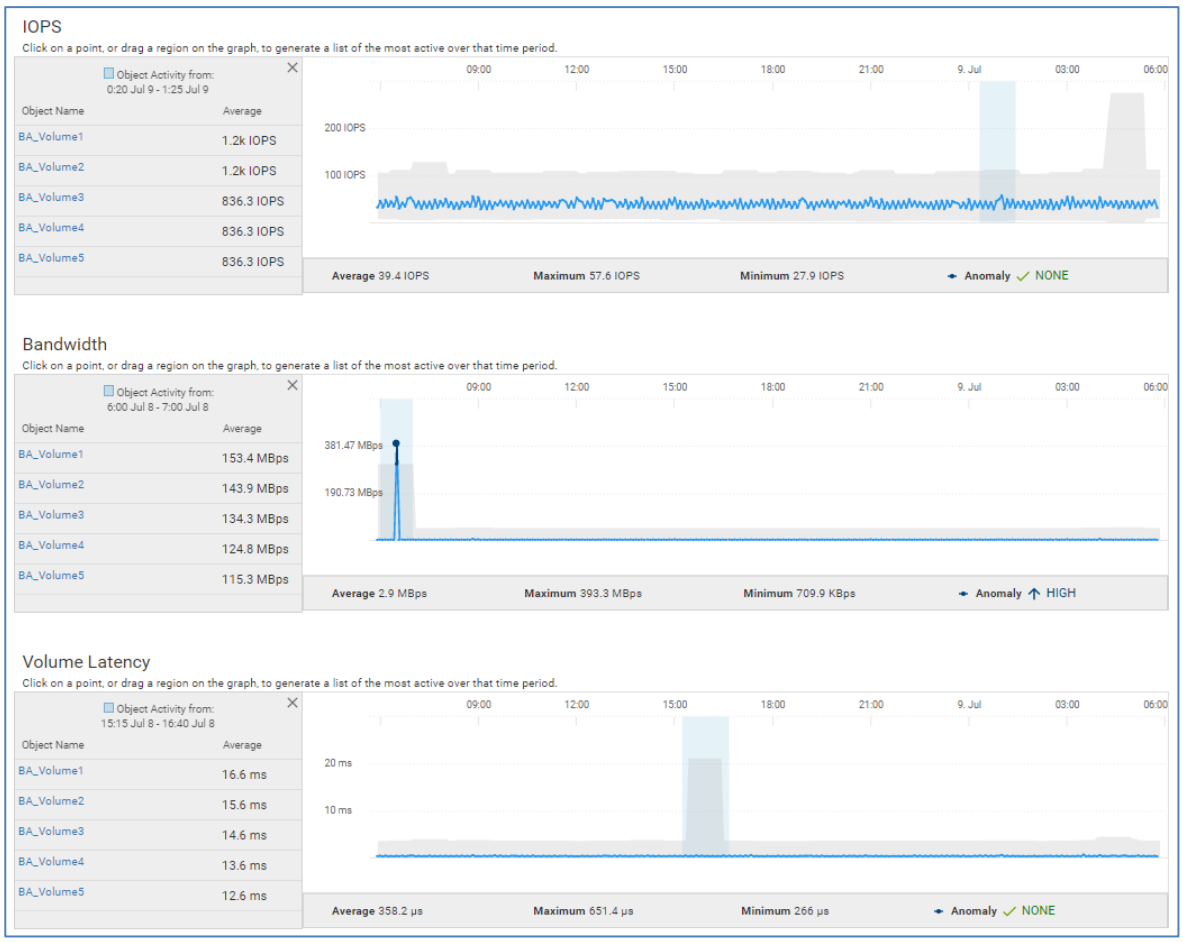
The following shows the results of the details of a performance impact. The right side of the chart shows the time of the selected performance impact and identifies the most likely causes (competing workloads) for the impact and if there is any resource contention.

SC Series

Similar to the Unity XT family, 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.

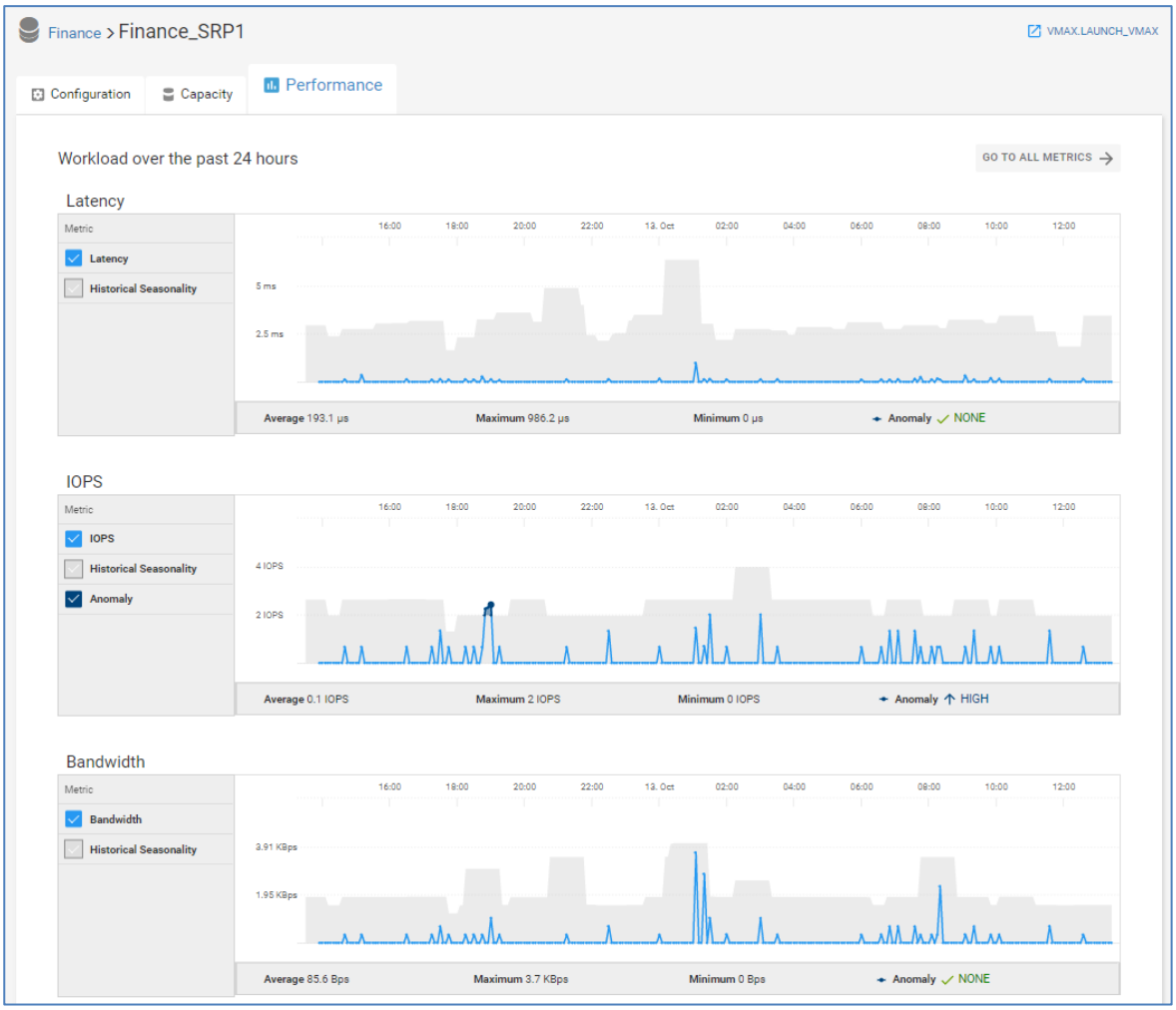


Scrolling down provides displays 24-hour performance graphs for IOPS, Bandwidth, and Volume Latency. CloudIQ identifies and highlights performance anomalies on each performance chart for SC Series pools. Highlighting an area in any of these graphs identifies the top volumes contributing to that metric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



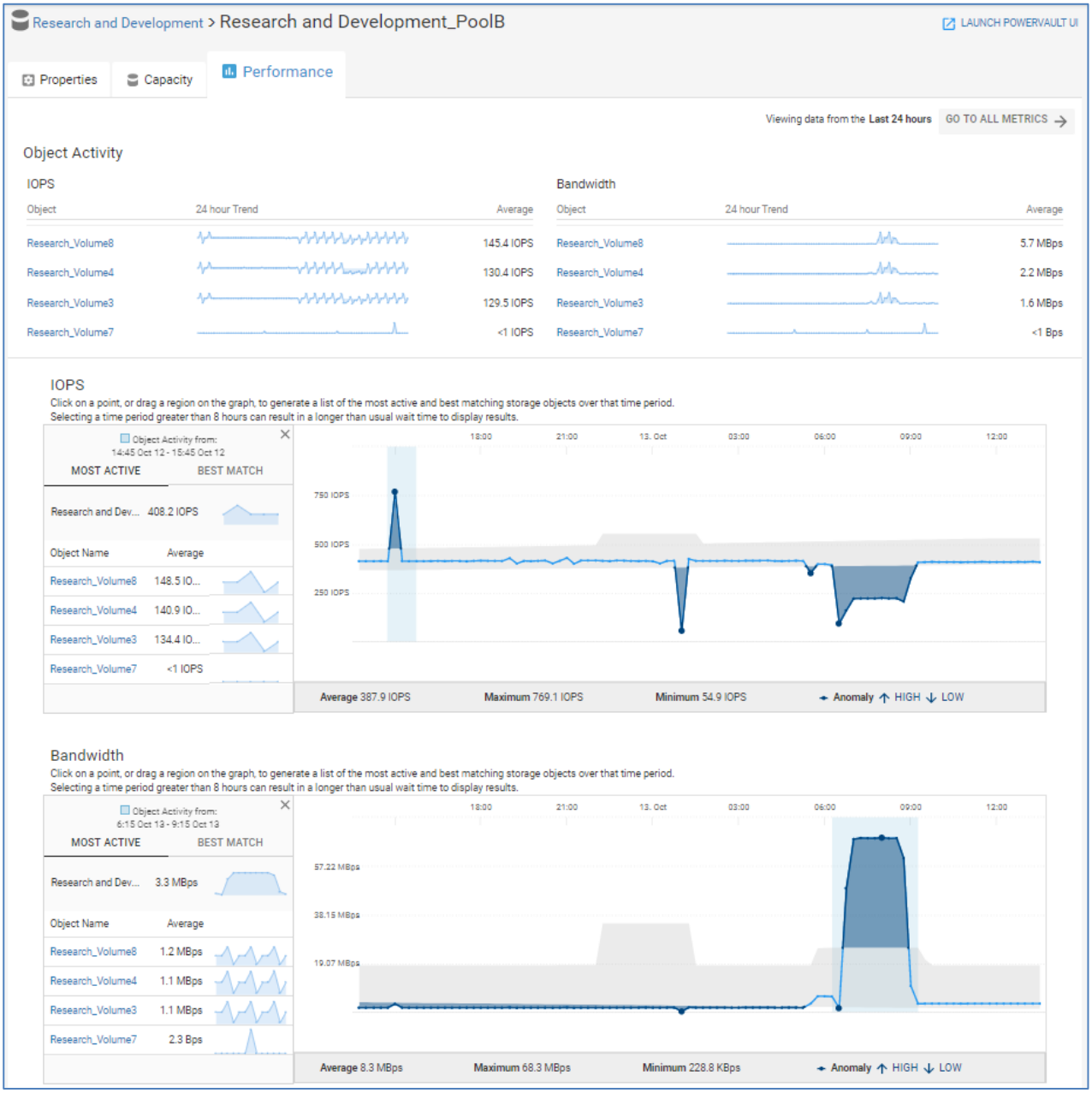
PowerMax

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



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 during that time period under the Most Active tab. The Best Match tab shows up to five objects with the highest correlation to the selected period.



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

Reclaimable Storage

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

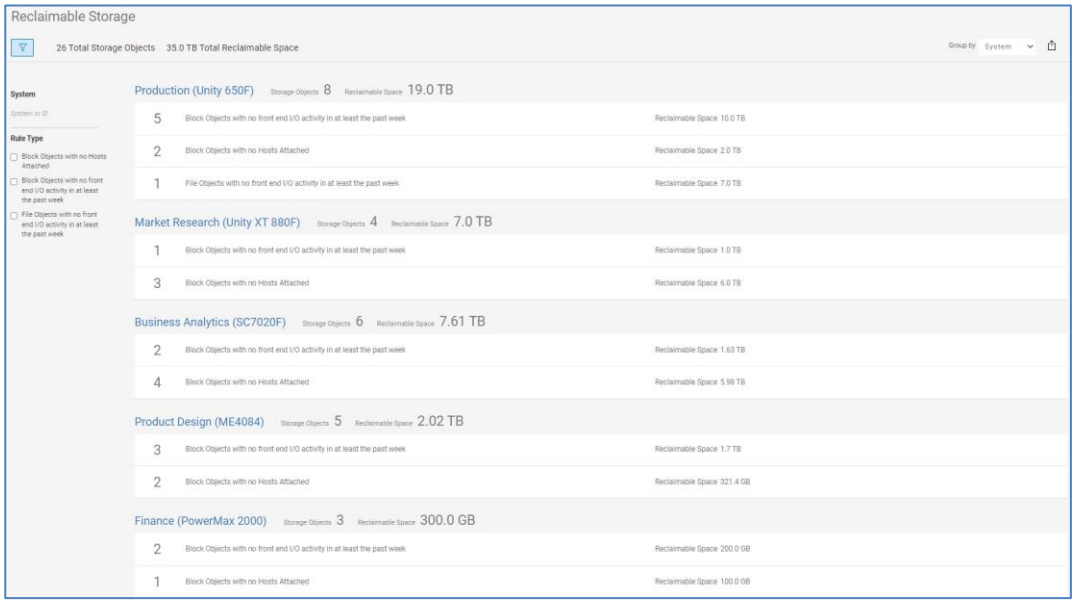
- Block Objects with no front-end I/O activity in the past week or longer
- File Objects with no front-end I/O activity in the past week or longer
- Block Objects with no hosts attached

Note: The Reclaimable Storage report intelligently filters out objects that are array-based replicas, since those replicas are not attached to hosts and do not have front-end I/O.

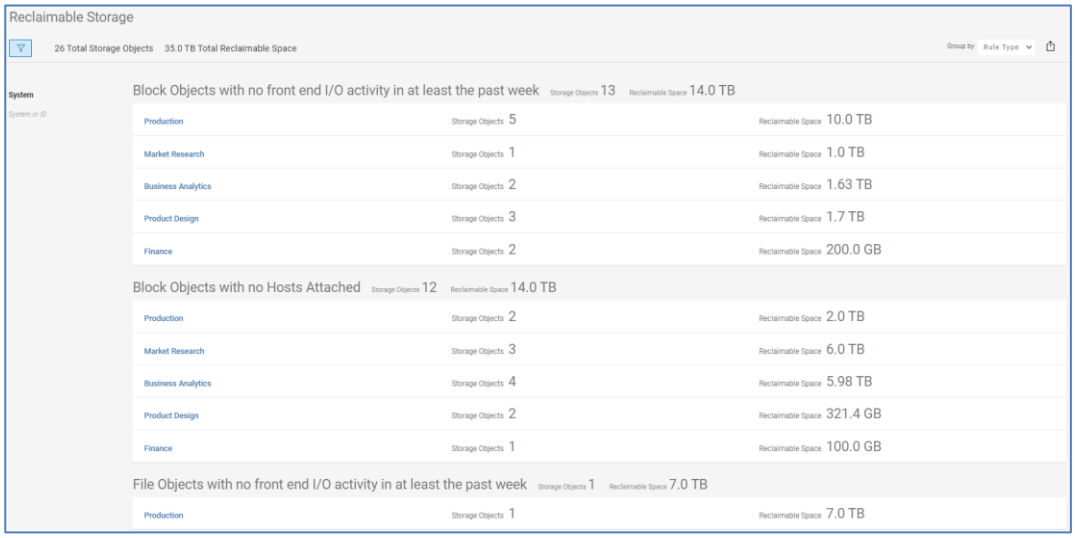
The **Group By** drop-down menu in the upper right of the page allows the user to group the storage objects by storage system or by the rule types mentioned above.

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 **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.



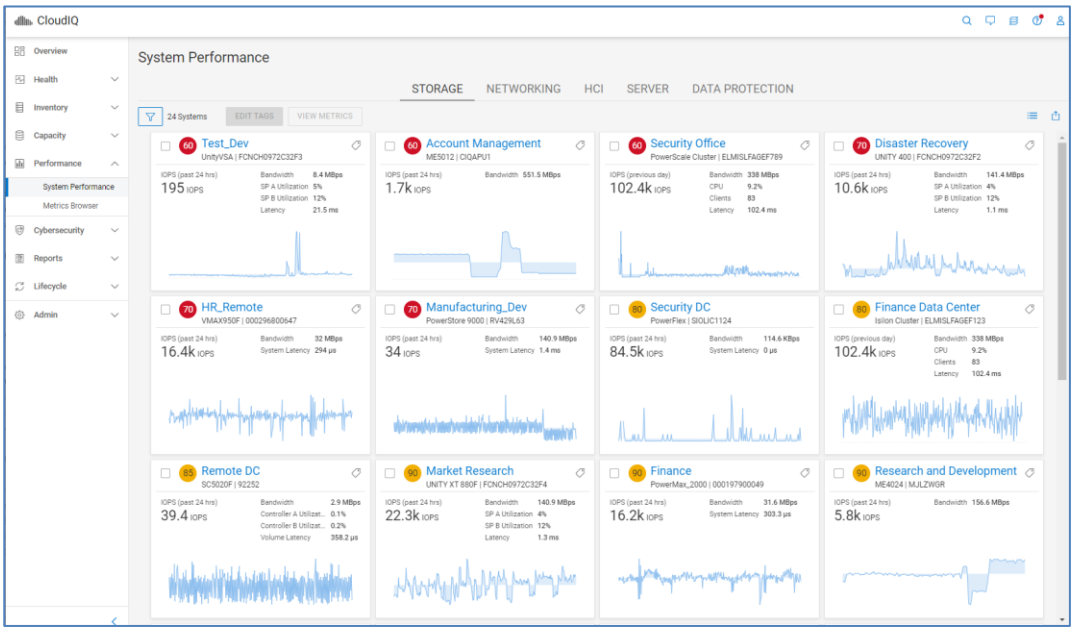
Performance

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 XT family) 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 objects over the last 24-hour period. 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).

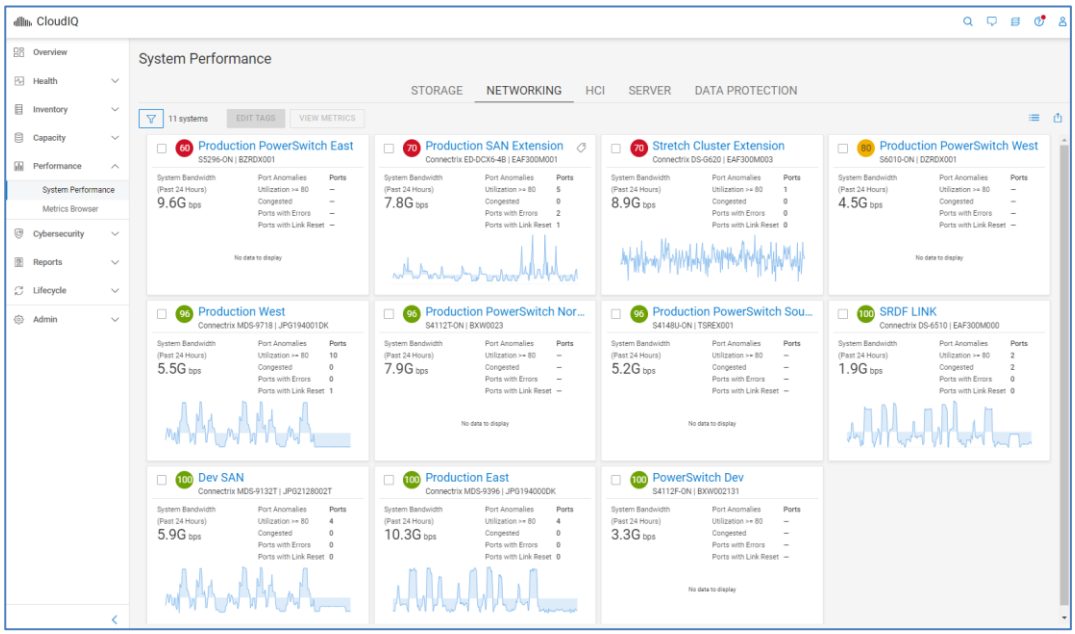


The System Performance information displayed for switches includes:

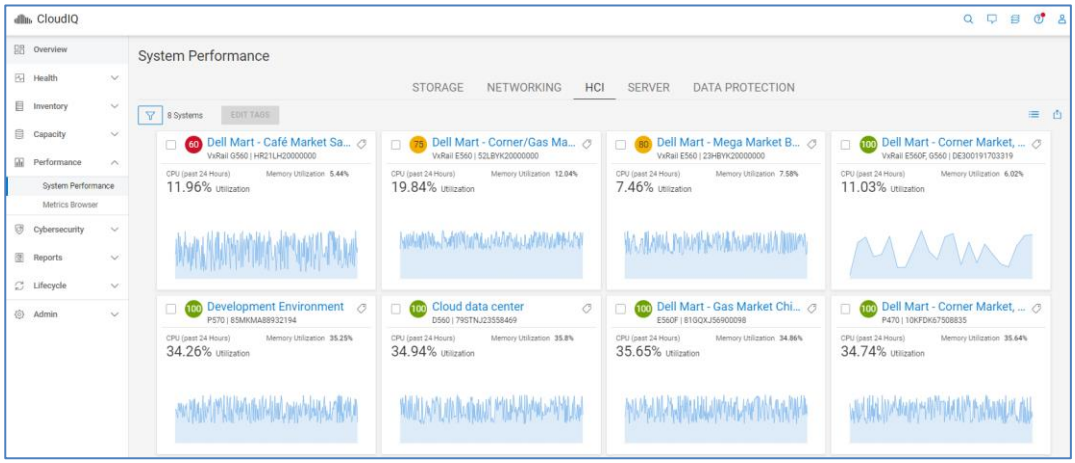
- **System Bandwidth** – Average bandwidth for the switch over the last 24-hour period.[1]
- **Utilization >= 80%** – Number of ports with utilization greater than or equal to 80%[1]
- **Congested** – (Connectrix only) Number of ports with congestion
- **Errors** – Number of ports with errors[1]
- **Link Reset** – (Connectrix only) Number of ports with link resets

[1] PowerSwitch OS10 v10.5.3.2 or later required

Note: The 24-hour bandwidth chart is displayed for Connectrix only.

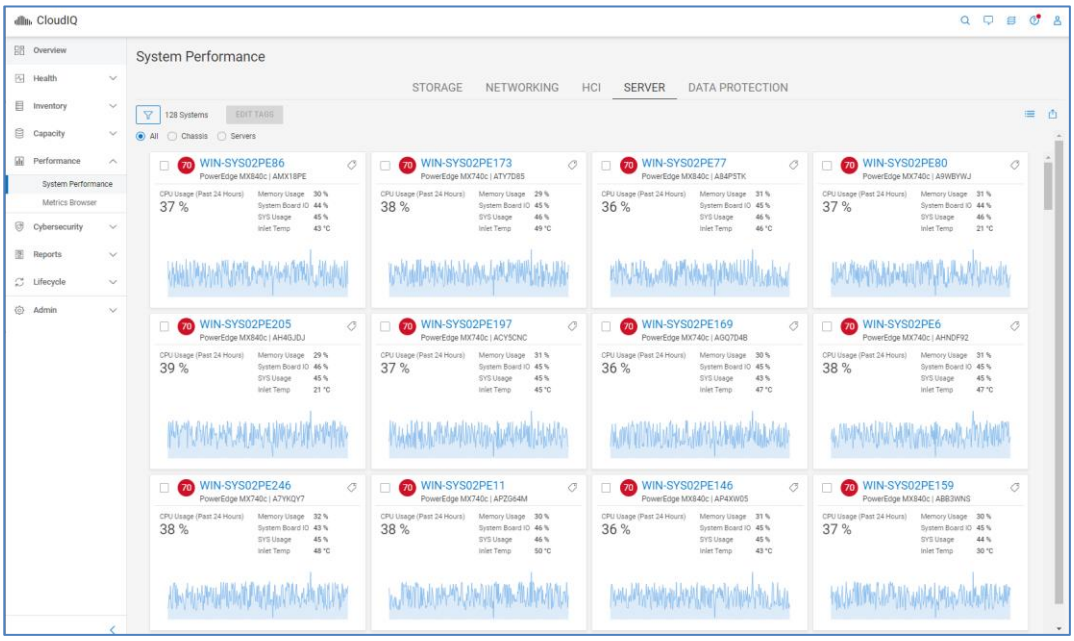


VxRail systems display a 24-hour chart of CPU utilization and the 24-hour average for CPU and Memory Utilization.



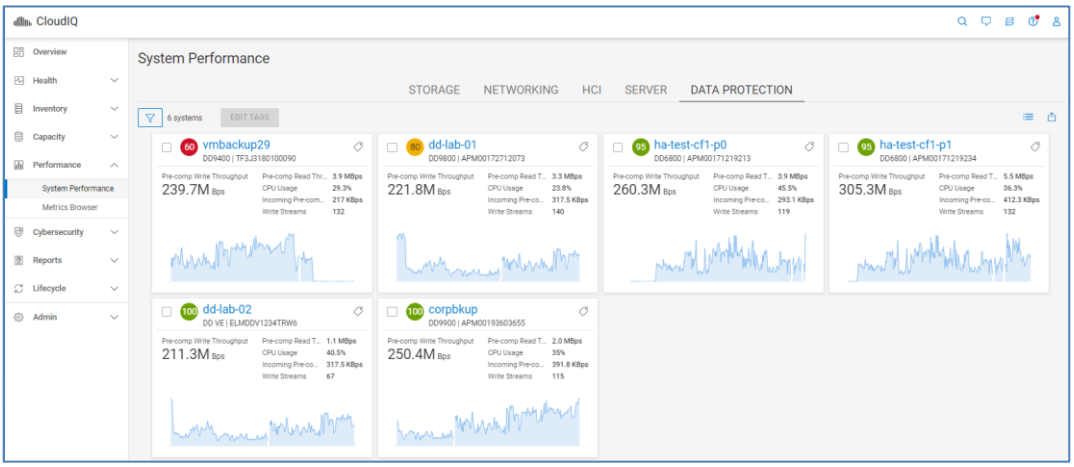
PowerEdge servers show the following performance metrics:

- CPU Usage – Percentage of CPU consumed by the server
- Memory Usage – Percentage of RAM the server uses based on what is allocated
- System Board IO
- SYS Usage
- Inlet Temp – Temperature reading in Celsius



PowerProtect DD systems show the 24-hour averages for the following metrics:

- Pre-compressed Write throughput
- Pre-compressed Read throughput
- CPU Usage
- Incoming Pre-compressed Replication
- Write Streams



Metrics Browser

The Metrics Browser is replaced by the Report Browser. Existing reports will automatically be migrated to the Reports section of CloudIQ. See the Custom tags and reports section for details about reporting.

Cybersecurity

Introduction

Cybersecurity is a feature within CloudIQ that adds the ability to monitor Dell resources for security risks. CloudIQ compares configurations and setups to a set of security-related evaluation criteria, notifying users of any deviations from the configured plan. Cybersecurity is supported for PowerMax, PowerStore, and PowerEdge systems and will continue to expand coverage to other Dell systems.

Note: In order to gain access to Cybersecurity, users must be given either the Cybersecurity Viewer or Cybersecurity Admin role. A CloudIQ Admin user must assign these roles to users, including themselves. See User Access for additional details.

System Risk

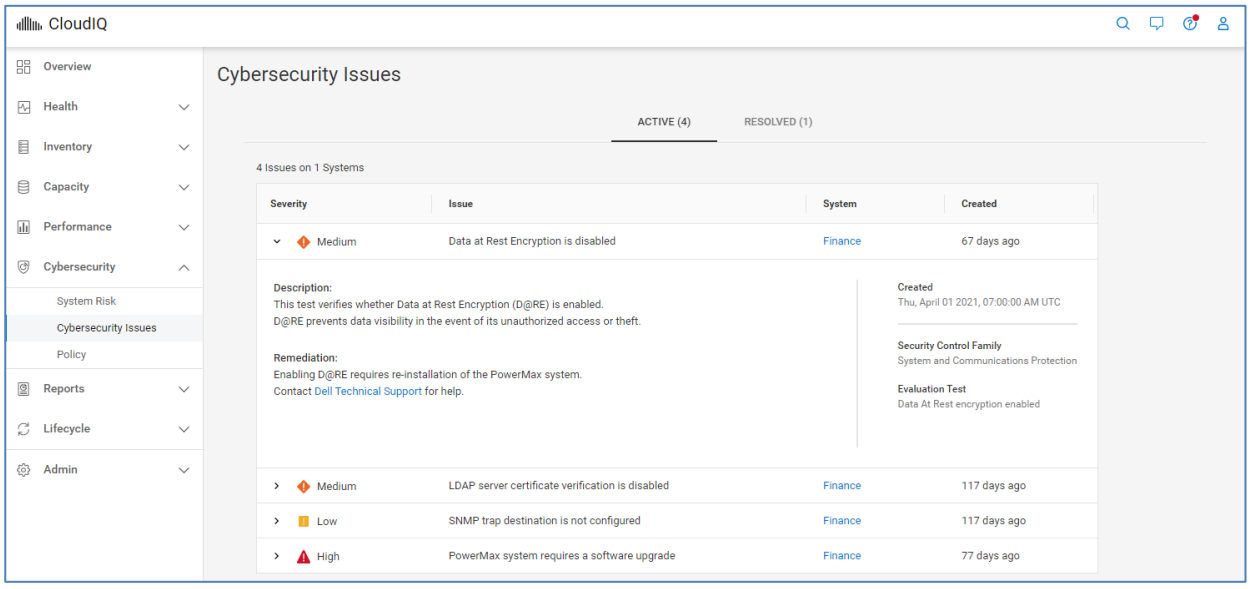
The System Risk page is the multisystem view for Cybersecurity. It displays all systems that are enabled for Cybersecurity along with the Risk Level, percentage of tests enabled in the Evaluation Plan, and summary of Issues. The Risk Level provides an overall assessment for the system based on the enabled evaluation tests, and has one of the following values:

- Normal
  - No active Cybersecurity issues.
- Low
  - One or two active Low severity Cybersecurity issues.
  - There are at least five enabled tests and the number of enabled tests is greater than 70%.
- Medium

  - One to five active non-High severity Cybersecurity issues with at least one being Medium and number of enabled tests greater than five.
  - Greater than two active Low severity Cybersecurity issues and the number of enabled tests is greater than five.
- High
  - One or more active High severity Cybersecurity issues and the number of enabled tests is greater than five.
  - More than five non-High active issues where at least one issue is Medium severity and the number of enabled tests is greater than five.
- Unknown
  - Evaluation Plan is disabled.
  - Number of enabled tests is less than or equal to five.
  - There are no active Cybersecurity issues and the number of enabled tests is less than 70%.
  - There are one or two active Low severity Cybersecurity issues and the number of enabled tests is less than 70%.

Cybersecurity Issues

The Cybersecurity Issues page provides an overall listing of Cybersecurity issues that have been identified in the environment. The Active tab lists out all active issues and provides the severity, issue name, associated system, and when it was created. Expanding the issue provides the issue description and the recommended remediation, creation timestamp, security control family, and evaluation test. The Resolved tab lists out all issues that have been corrected and the timestamp for when the issue was resolved.



Policy

The Policy page is where users enable, disable, and configure the tests in the Evaluation Plan. This can be done by creating individual evaluation plans for each system or by creating a template and applying it to multiple systems. There are two tabs in the Policy page: SYSTEMS and TEMPLATES.

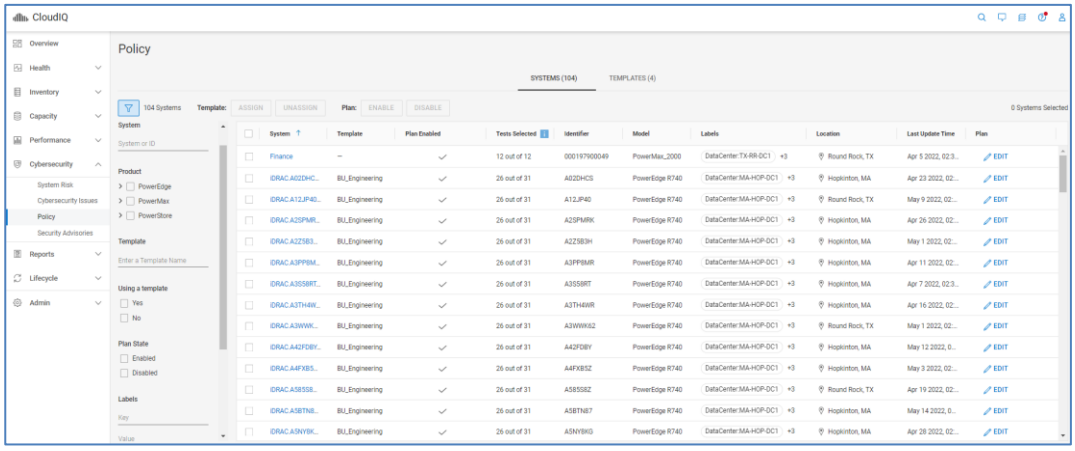
Systems

The Systems tab lists the Cybersecurity enabled systems. It also includes information such as if there is an associated template, if the evaluation plan is enabled, how many tests are selected for the plan, custom labels, and the last time the evaluation plan was updated. Cybersecurity Admins can assign or unassign templates to systems, enable or disable the evaluation plan for systems, or edit the evaluation plan for an individual system.

The filter icon allows users to filter the list of systems based on the following:

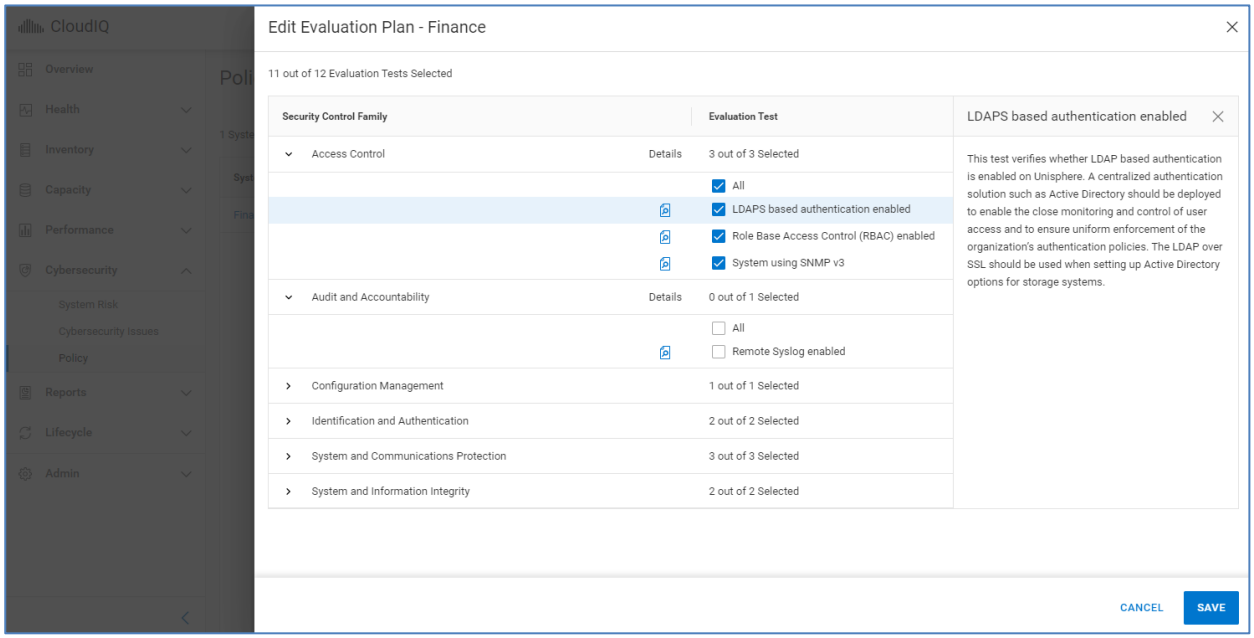
- System name or ID
- Product type
- Template name
- Systems using or not using a template
- Systems evaluation plan status
- Custom tags
- Site
- Location

By using the filter mechanism, users can produce a group of systems on which they can perform an action like assign a template or disable the evaluation plan. For example, a user can select all PowerEdge systems from product and select “No” under “Using a template” and then assign a template to all of those systems that are not currently associated to a template.

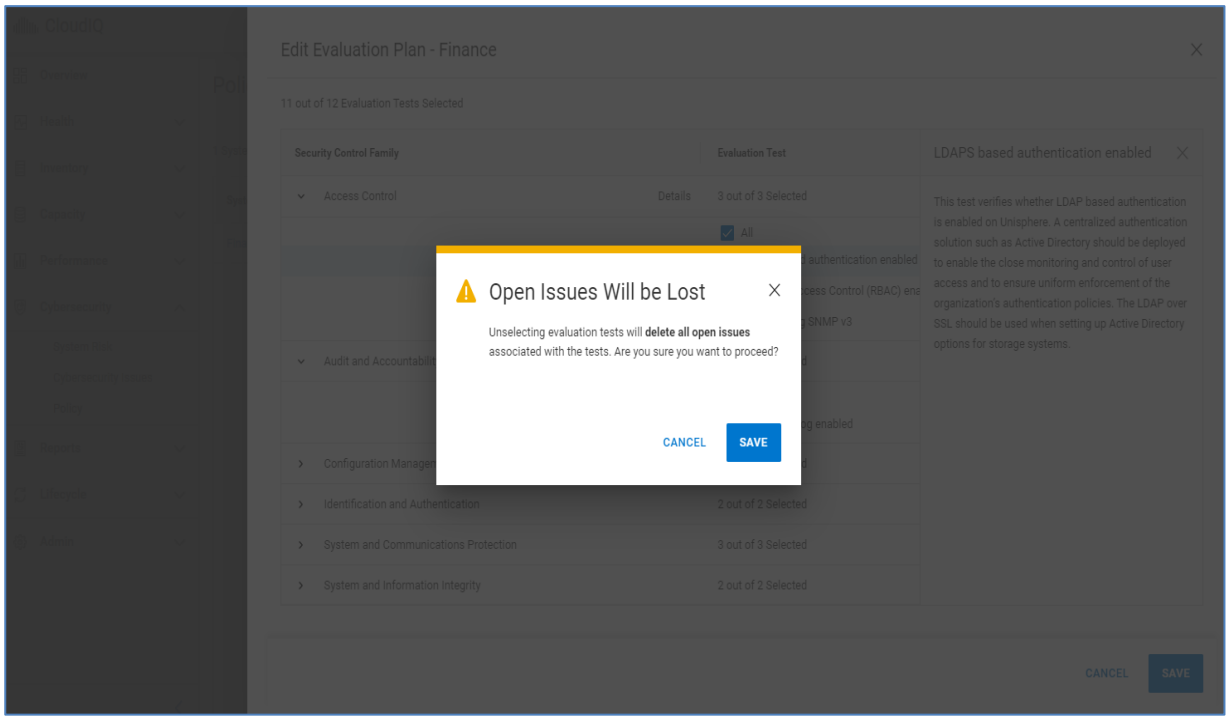


There are a few scenarios that require further explanation. If a user assigns a template to a system that already has a template, the old template is automatically unassigned. If the evaluation plan of a system is disabled, it does not affect the assigned template. The template will remain associated to the system. If the evaluation plan is edited by selecting the Edit icon in the right-side column, the template for that system is unassigned. Selecting the Edit button opens the Edit Evaluation Plan window for the system and allows the user to set the plan for that individual system. Each of the possible evaluation tests is listed and grouped by Security Control Family (based on NIST 800-53 R5). Each

test can be selected or cleared for inclusion in the Evaluation Plan. Selecting the Details icon provides a detailed description of the test.



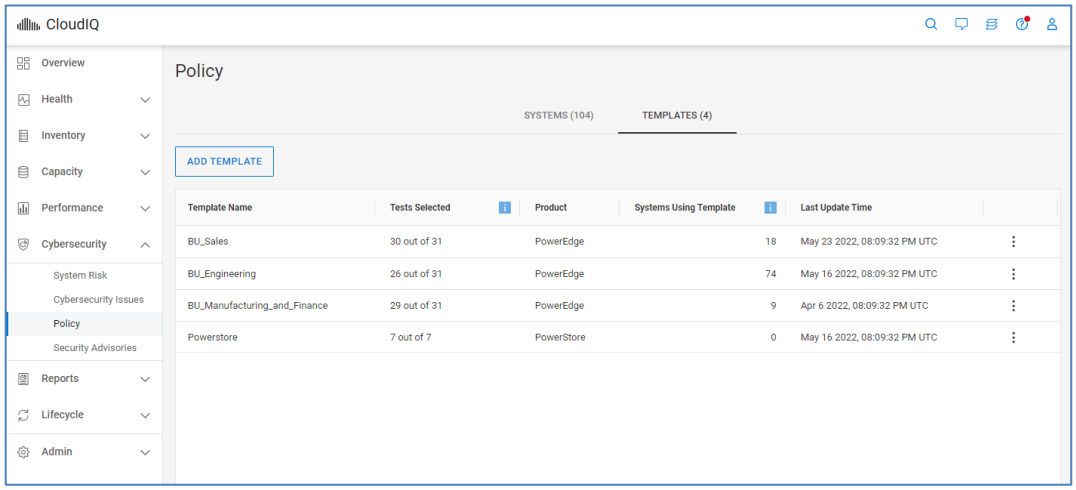
When an Evaluation Test is cleared and removed from the Evaluation Plan, any associated active issues for that test will be deleted. The following warning is provided anytime the user removes an Evaluation Test and saves the Evaluation Plan.



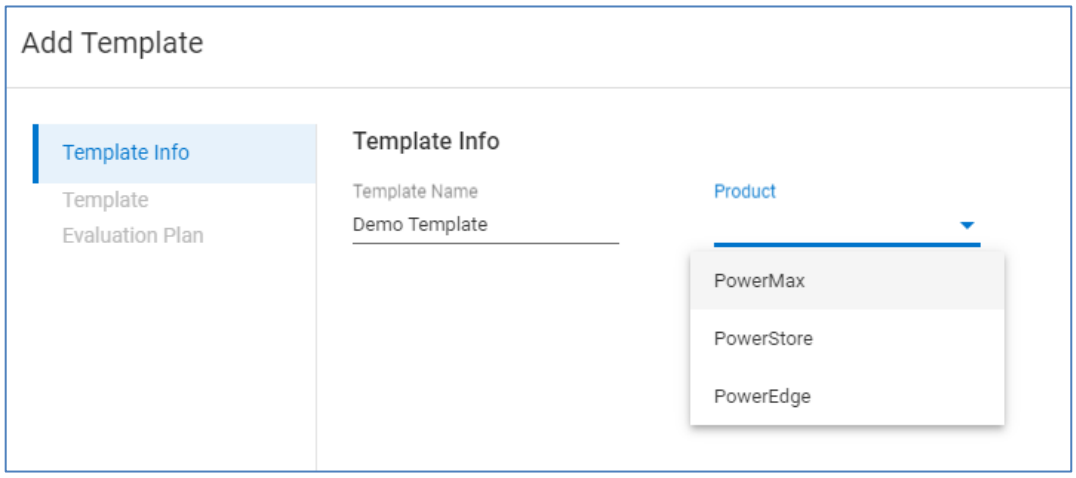
Users will be notified in the What's New section when new tests are added to the product. By default, those tests will be disabled by default.

Templates

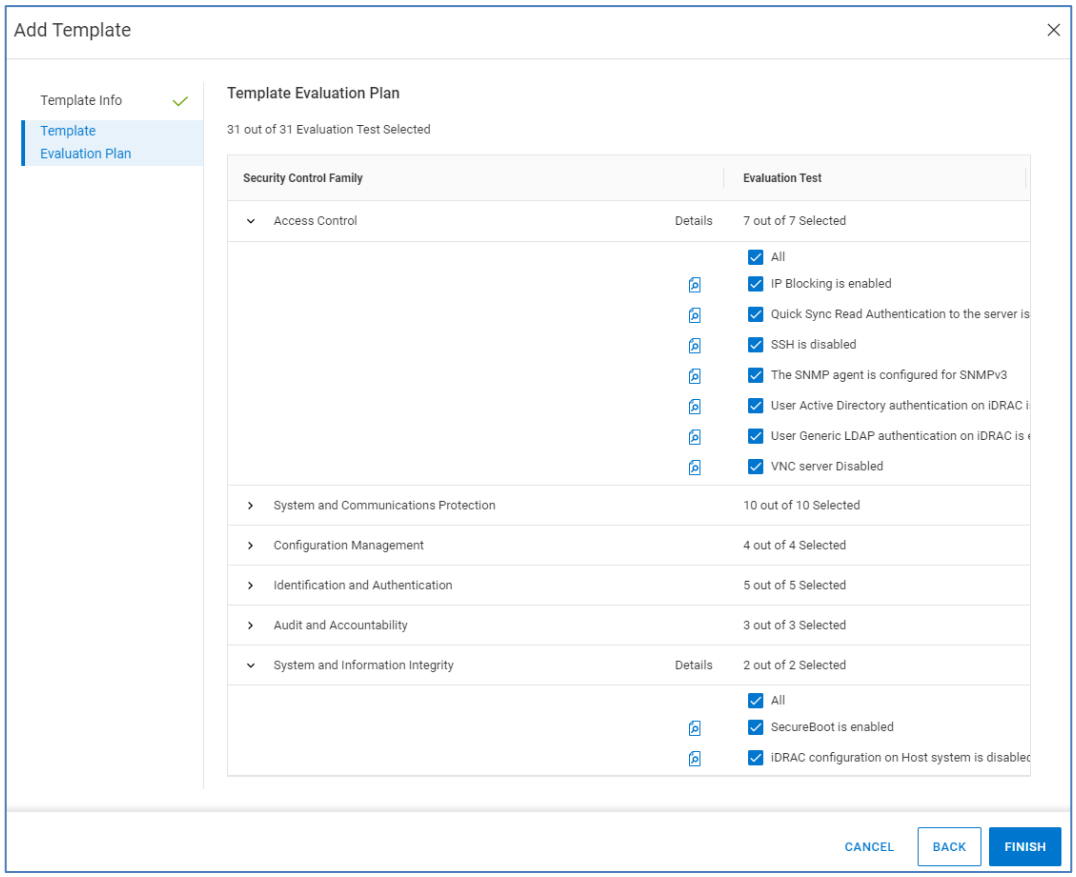
The Templates tab lists the configured templates and allows users to create new templates and view, edit, and delete existing templates. A template contains a list of configured tests which can be assigned to multiple systems of the same product technology. It allows users to efficiently set a consistent evaluation plan across many systems. A template can only be edited and deleted when there are no systems assigned to it. If a template has an assigned system, it can only be viewed or duplicated.



Selecting Add Template steps the user through the template creation wizard. The user provides a template name and then selects the product type for the template.



Then, the user selects which tests to include in the evaluation plan and then selects Finish to save the template. Then, it is available to assign to systems of that product type.



The operations that are available for a template depend on whether there are systems assigned to the template. For templates with assigned systems, the allowable operations are View and Duplicate. Templates with assigned systems cannot be edited or deleted. Templates without assigned systems have the Edit, Duplicate, and Delete operations available.

Storage System Details

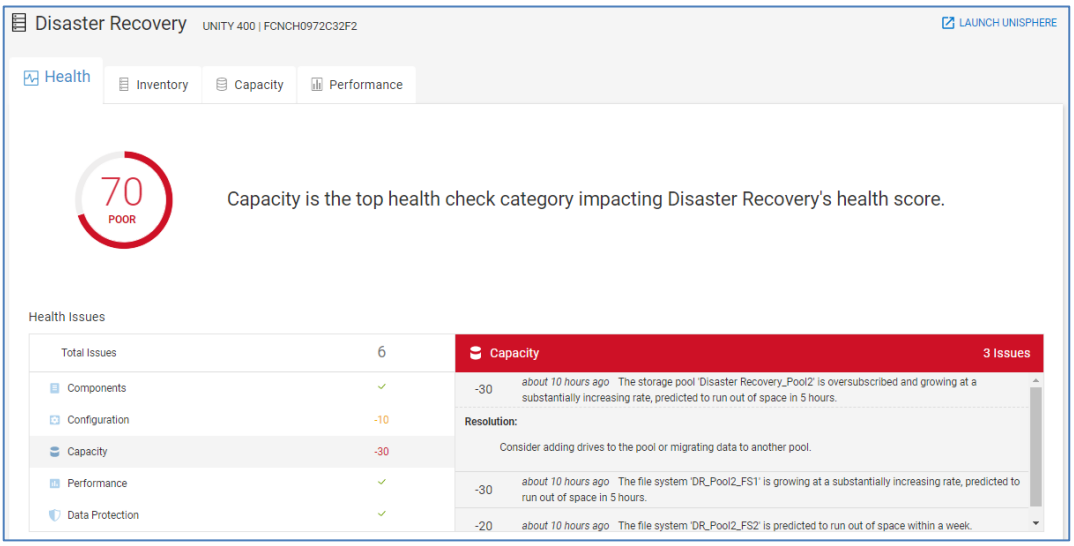
Introduction

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

Storage System Details – Health

The Health 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



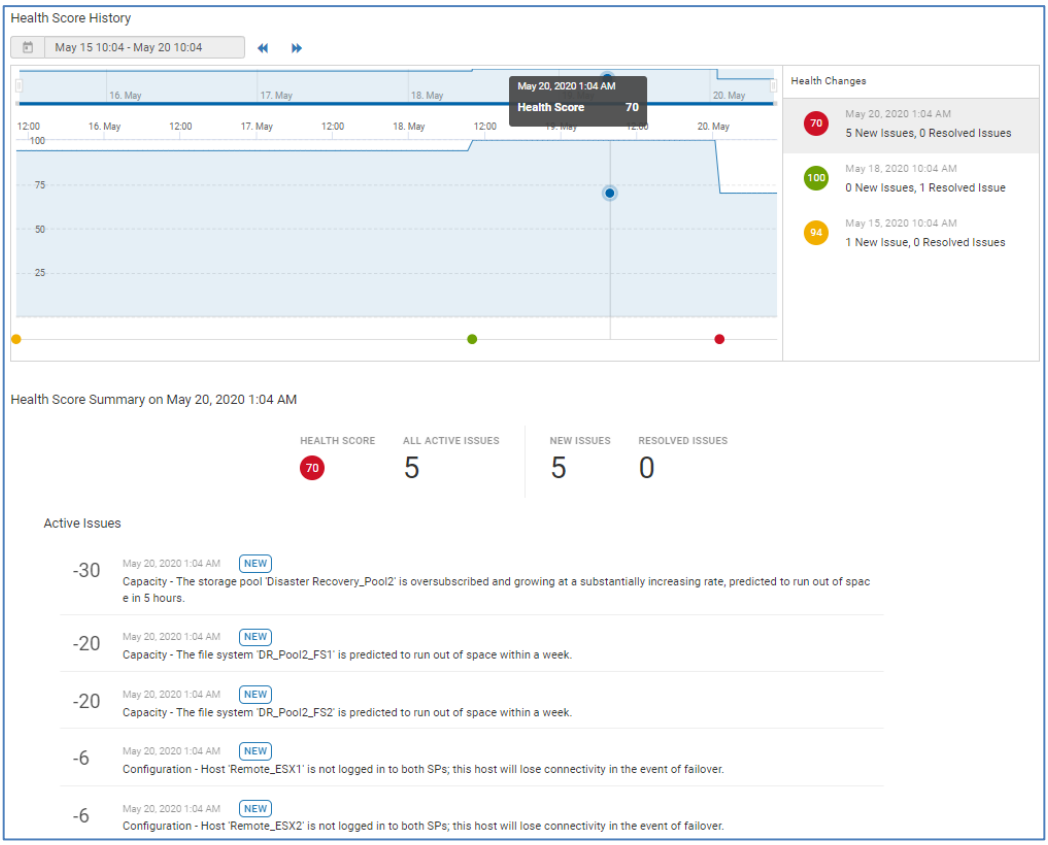
In this example there are five issues, two in the Configuration category and three in the Capacity category. Selecting the category and then selecting one of the issues will display the recommended resolution.

For issues reported against APEX Data Storage Services, CloudIQ directs the user to the DTMS Team. The DTMS team is notified of the issue, and they are responsible for maintaining the system.

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 systems.
- The Data Protection category does not apply for VxRail systems.
- Only the Components category is used for PowerEdge, Connectrix, and PowerSwitch.

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 issues over the displayed range of time.



Selecting an issue 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.

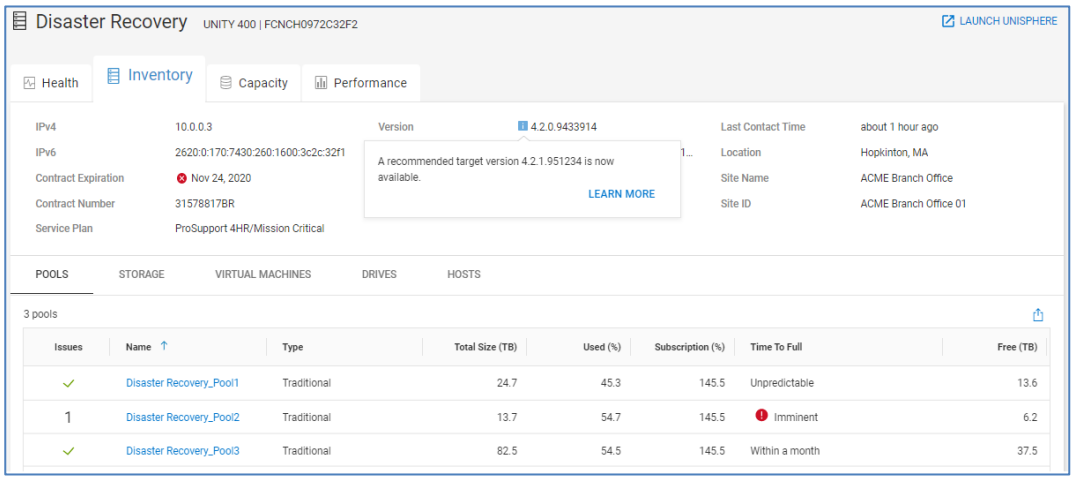
Selecting the calendar will open a drop-down, allowing users to select one of the predefined ranges or enter a custom time range. A custom view is the default. Selecting any of the dates on the right will present the list of issues for that date.

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

Storage System Details – Inventory

The Inventory tab shows the configuration data and contract information of the selected system as well as the physical and logical components of the system. For traditional storage systems, 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 the Unity XT family).

For APEX Data Storage Services, not all of this information is applicable. APEX Data Storage Services will show the Site ID, Site Location, and Last Contact Time.



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. Clicking the “Learn More” link opens 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 XT family, SC Series, PowerVault, and PowerScale/Isilon) / Storage Resource Pools (PowerMax/VMAX)
- Storage (APEX Block Storage Services, Unity XT family, PowerStore, SC Series, and PowerVault) / Volumes (XtremIO) / Storage Groups (PowerMax/VMAX)
- Virtual Machines (APEX Block Storage Services, Unity XT family, PowerStore, SC Series, XtremIO, and PowerMax/VMAX)
- Drives (Unity XT family, PowerStore, SC Series, and PowerVault)
- Hosts (APEX Block Storage Services, Unity XT family, PowerStore, and XtremIO) / Servers (SC Series) / Initiators (PowerVault)
- Consistency Groups (XtremIO)
- Service Levels (PowerMax/VMAX)
- System Health Checks (PowerMax)
- Nodes (PowerScale/Isilon)
- Node Pools (APEX File Storage Services)
- Appliances (PowerStore)
- Storage Containers (APEX Block Storage Services and PowerStore)
- Quotas (PowerScale or Isilon)

The **Pools** or **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 has a defined prediction.

The **Storage** or **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.

- PowerStore, APEX Block Storage Services: Volumes, Volume Groups, and File Systems
- Unity XT family: LUNs, File Systems, VMware vStorage 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 lists the storage groups on the system with the capacity, the associated storage resource pool, the service level, and the status of 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, ESXi Server, and ESXi 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,** or **Initiators** tab gives the details about the hosts attached to this storage system. It includes hostname, 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 **System Health Checks** tab (PowerMax) provides pass or fail information for various system checks.

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

The **Node Pools** tab provides a list of the node pools in the APEX File Storage Services along with their associated subscription.

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 or APEX Block Storage Service.

The **Quotas** tab lists each quota path, quota type, threshold size, efficiency, advisory limit, soft limit, and hard limit.

Storage System Details – Capacity

The Capacity tab shows slightly different information depending on the product type. The storage capacity details for APEX Block Storage Services, APEX File Storage Services, Unity XT family, PowerStore, SC Series, PowerVault, PowerFlex, and PowerScale/Isilon include:

- Total Capacity
- Storage Usage
- Drive Type Usage (not applicable for PowerScale or Isilon, or PowerFlex)
- Pools (not applicable for PowerStore or PowerFlex)

The **Total Capacity** graph provides a breakdown of raw storage to Used, Free, and Unconfigured Drives (Unprovisioned Capacity for PowerScale or Isilon).

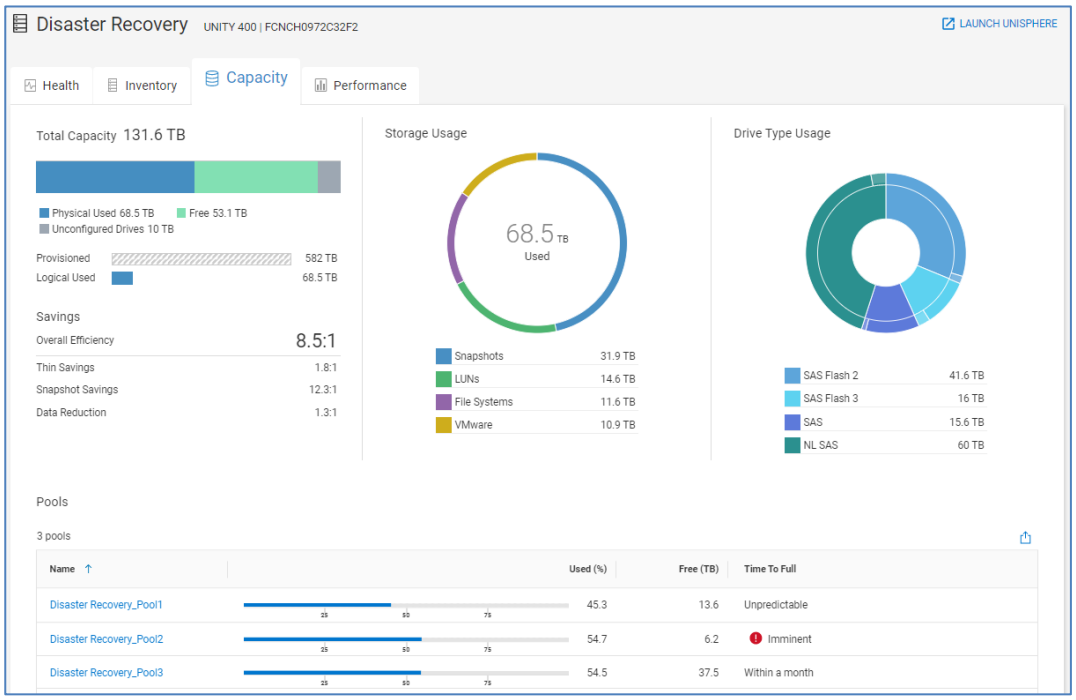
Savings includes a breakdown of the Logical and Used capacity of the total storage visible to the hosts, and the Efficiency Savings explained previously.

Storage Usage shows the consumed capacity of these categories of storage objects:

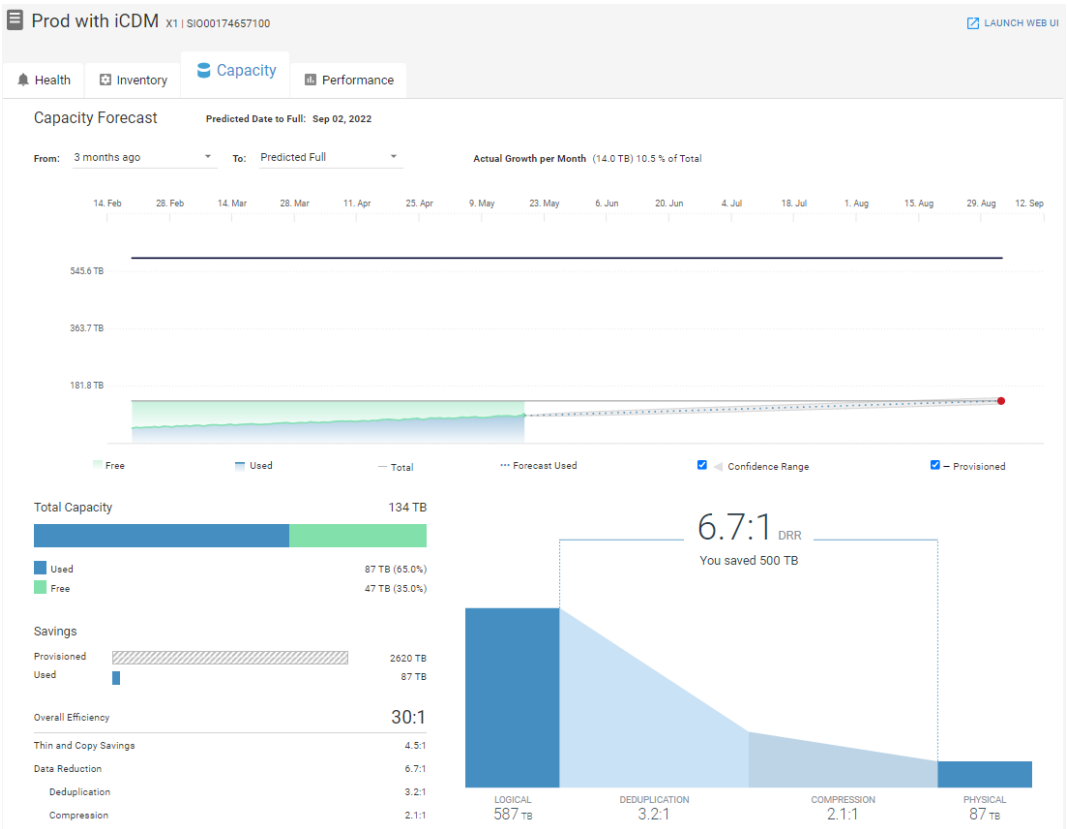
- Block (LUNs for Unity XT family)
- Volumes for PowerStore, SC Series, and PowerVault)
- File Systems (Unity XT family and PowerStore)
- Virtual Hot Spares (PowerScale/Isilon)
- User data (PowerScale/Isilon)
- VMware (VMware datastores for Unity XT family and PowerStore)
- Snapshots

Drive Type Usage (not available for PowerScale/Isilon or APEX File Storage Services) 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.

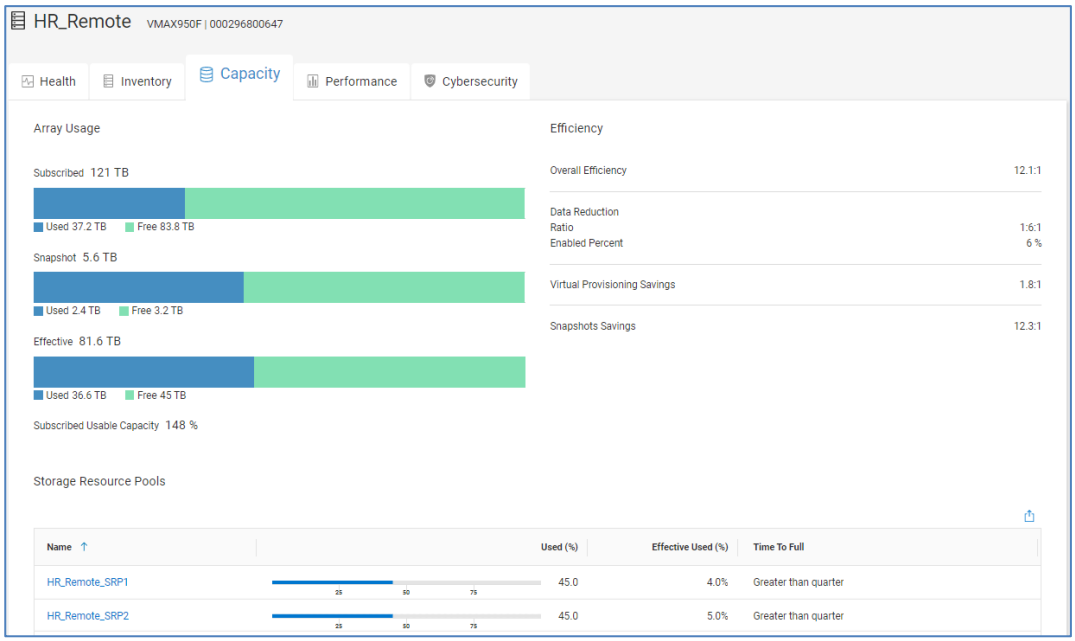
The **Pools** table lists the configured storage pools on the system. It includes the Free, Used, and Time to Full details for each pool. Selecting a pool name navigates the user to the Pool Details page.



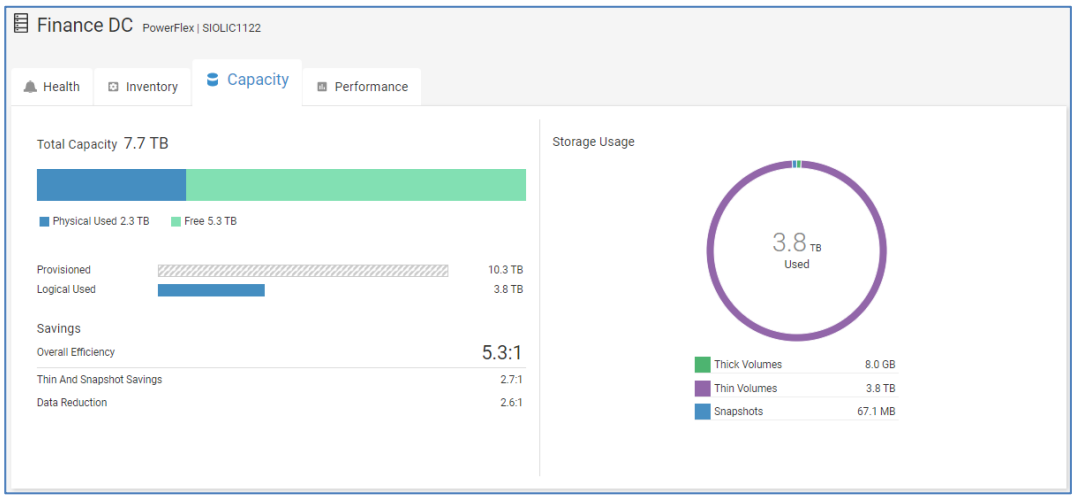
XtremIO systems include the total capacity broken down by used and free along with a detailed data reduction chart.



PowerMax or 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.



PowerFlex provides a breakdown of Total Capacity based on physical used and free. It also provides total provisioned and logical used charts and overall efficiency based on thin and snapshot savings and data reduction.



For APEX Block Storage Services, the Capacity tab displays the Effective Capacity of the subscription. The table displays the Usable, Used, and Free capacities for the Total storage as well as for the Base and On-Demand storage. The total storage available in the subscription is the sum of the Base and the On-Demand storage.

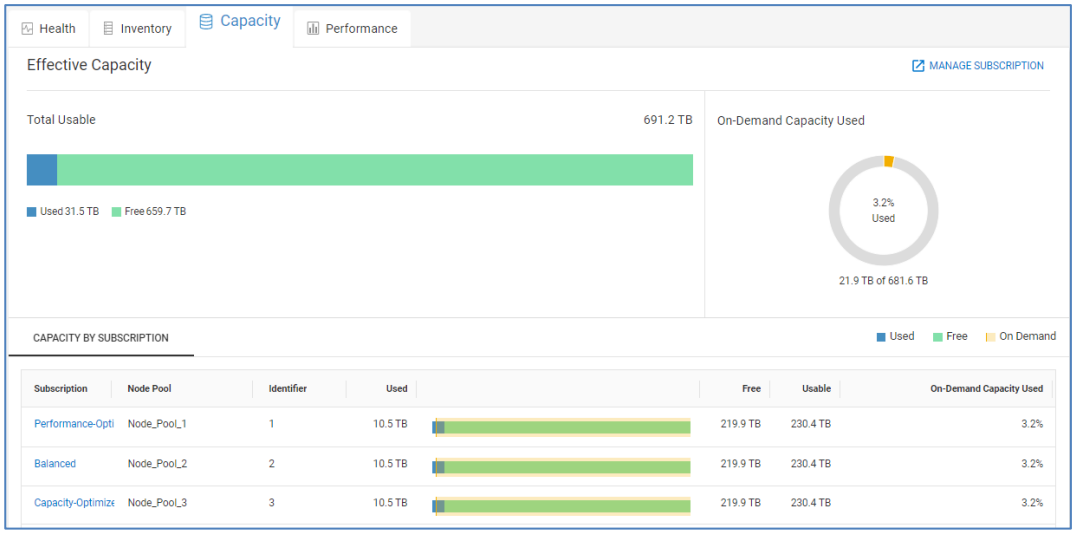
The Capacity Forecast chart provides historical and forecasting predictions for Free, Used, and Usable storage and highlights the On-Demand storage range. This brings attention to the user how often they are using storage from the On-Demand category. If

consistently using On-Demand storage, they may want to consider modifying their subscription to increase the Base capacity, which results in a lower cost per GB.

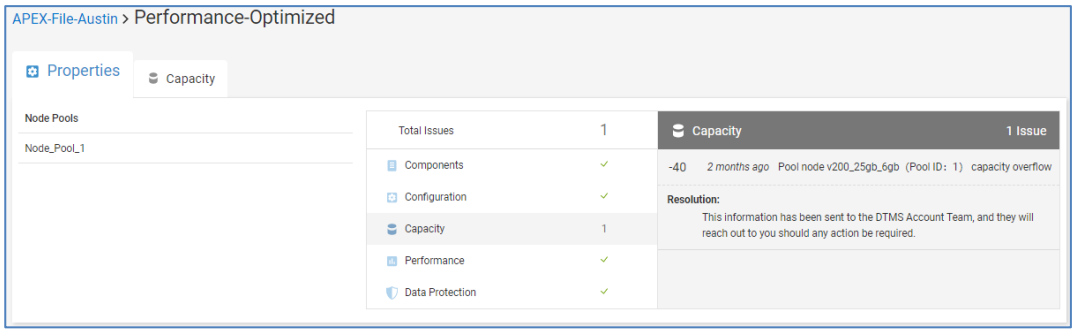
The Manage Subscriptions link directs the user to the APEX Console.

For APEX File Storage Services, the top portion of the page displays the Effective Capacity, breaking down the Total Usable capacity to Used and Free. There is a doughnut chart showing the percentage of On-Demand capacity in use.

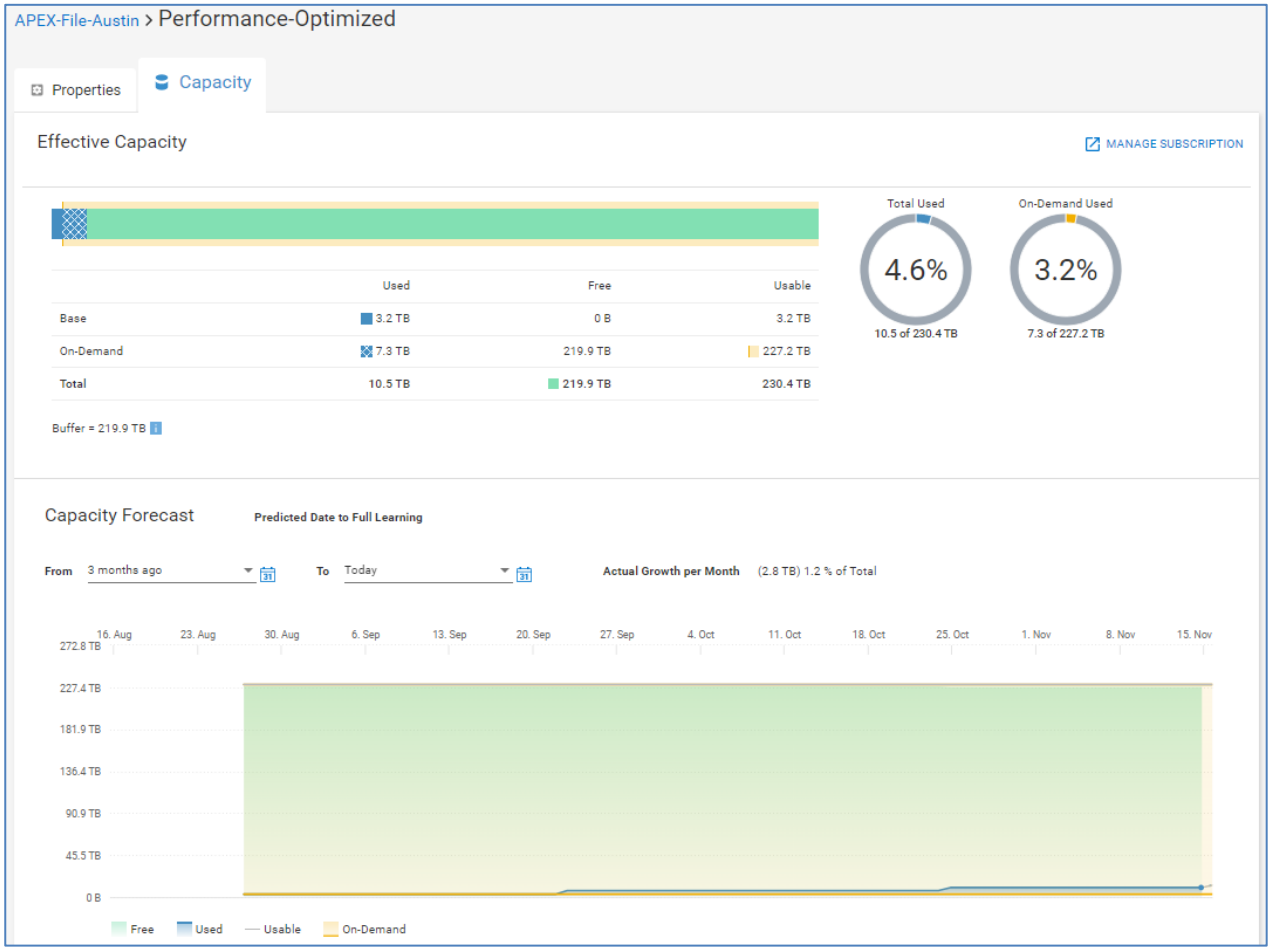
The bottom portion of the page breaks out the total capacity by subscription. The table shows the Usable, Used, and Free capacities per subscription. The percentage of On-Demand Capacity in use is also displayed.



Selecting the Subscription link opens a subscription details page with a Properties and Capacity tab. The Properties tab lists the Node Pools and the summary of any health issues.



The Capacity tab provides a breakdown of the Total, Base, and On-Demand capacities for the subscription based on Used, Free, and Usable. The bottom of the page provides a capacity forecast chart.



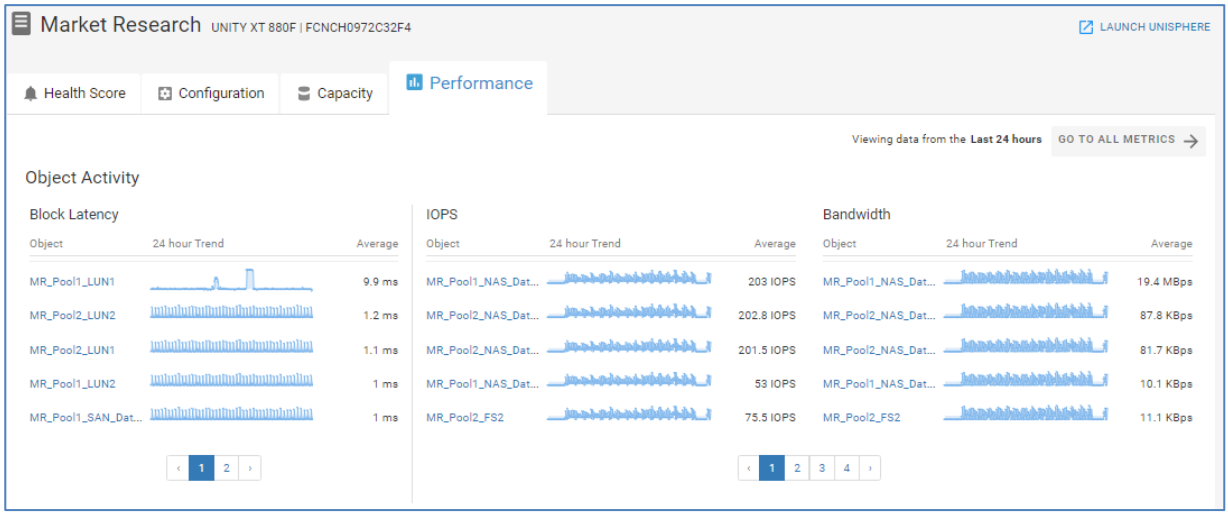
Storage System Details – Performance

The Performance tab is supported for all storage systems and APEX Data Storage Services. 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 and 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.

- Latency (PowerStore, PowerMax/VMAX, Unity XT family, PowerScale, PowerFlex, XtremIO, APEX Block, and APEX File), Volume Latency (SC Series)
- IOPS (all platforms)
- Bandwidth (all platforms)



Note:

- For PowerMax/VMAX systems, CloudIQ displays these performance metrics at the Storage Group level.
- Top Object Activity is not displayed for PowerScale/Isilon, PowerFlex, or APEX File Storage Services

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:

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

- Protocol: IOPS (PowerScale/Isilon, and APEX File Storage Services)
- Protocol: Bandwidth (PowerScale/Isilon, and APEX File Storage Services)

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. Metrics Browser provides more information about performance charts and how to create customized performance dashboards.

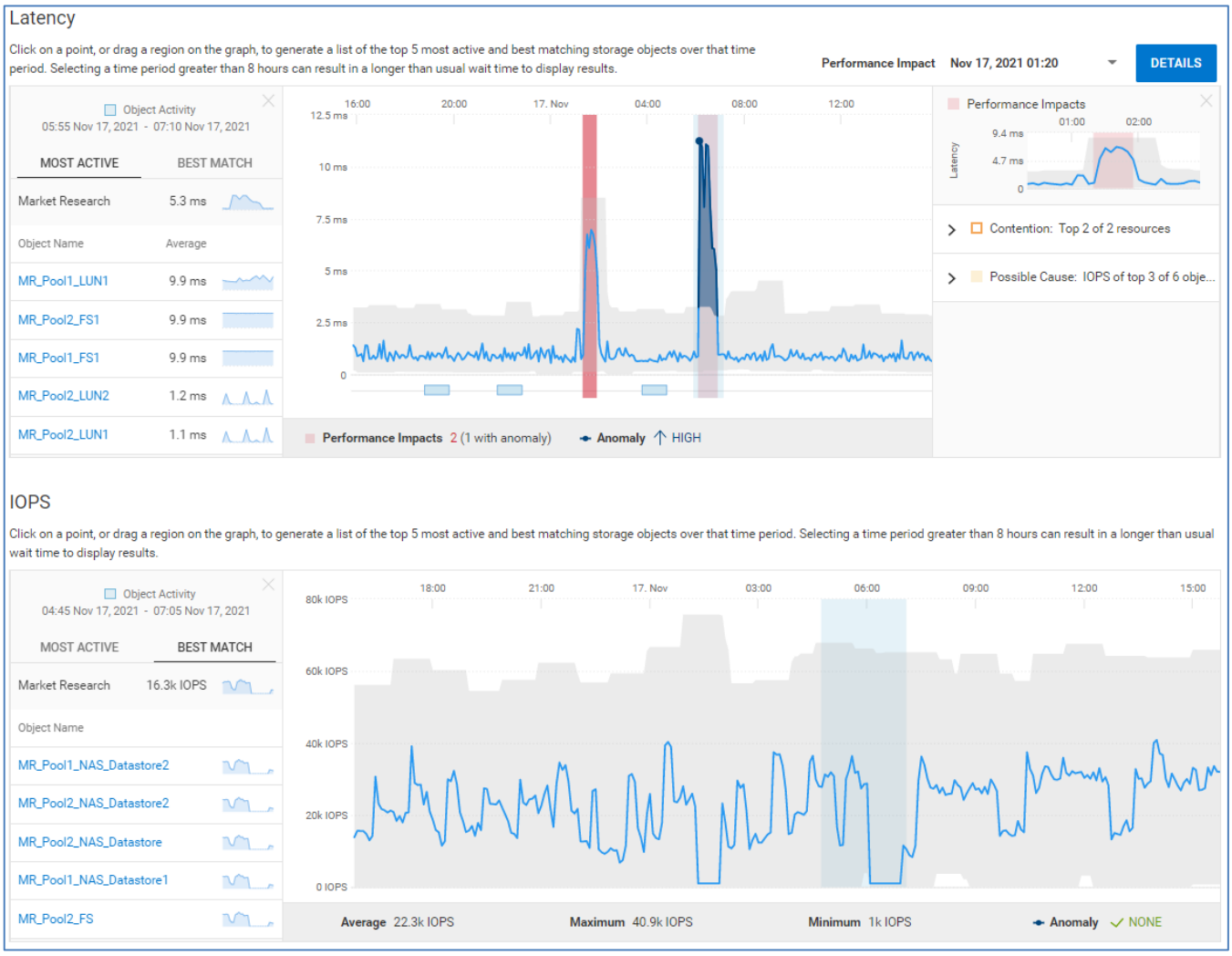
CloudIQ identifies performance anomalies on all system level performance charts for all system types except PowerScale and APEX File Storage Services. A shaded blue area identifies performance anomalies. For APEX Block Storage Services, Unity XT family, PowerStore, PowerMax, and PowerFlex systems, CloudIQ identifies areas of performance impacts on the Latency chart. A pink shaded area identifies performance impacts. Similar to the latency chart for Unity XT storage pools, the user can select the DETAILS button to see the most likely competing workloads causing the impact.

For APEX Block Data Storage Services, Unity XT family, and PowerStore systems, configuration changes are identified as rectangles along the X-axis of the charts. Selecting the configuration change rectangle opens the Storage Configuration Changes window which contains details of the changes. By identifying when configuration changes occur, CloudIQ 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 (except PowerScale, APEX File Storage Services, and PowerFlex) displays the top five most active storage objects during that time period in the left side of the chart. Objects would be LUNs for Unity XT family, Volumes for APEX Block Storage Services, PowerStore, SC Series, PowerVault and XtremIO, and 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 side of the screen. For PowerStore, Unity XT family, and APEX Block Storage Services, CloudIQ also provides the Best Match tab identifying objects whose performance characteristics most closely correlate to the selected range in the performance chart. The Best Match tab is shown in the IOPS chart below.

As with Pools performance, the user can select the Details button and see possible causes and resource contention for performance impact.

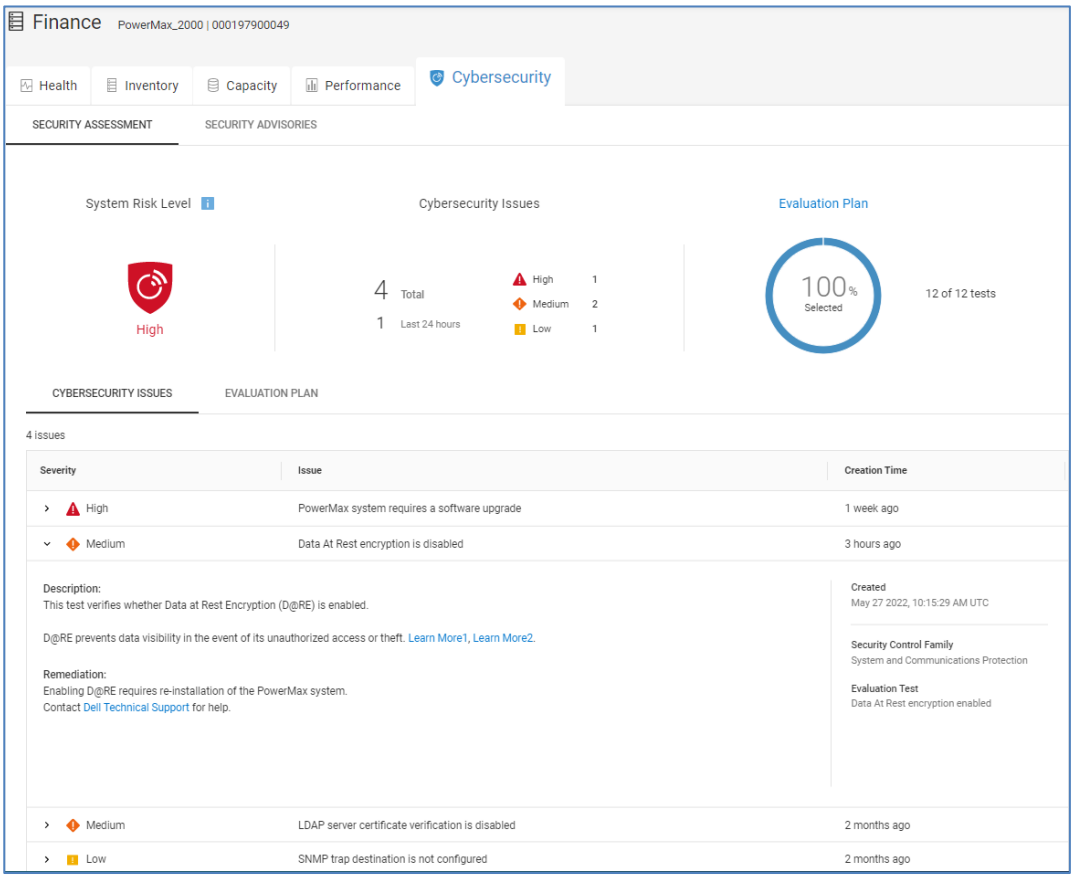
Note: Currently, resource contention is supported for Unity XT family systems only.



Storage System Details – Cybersecurity

The Cybersecurity tab is available for systems that have Cybersecurity enabled. Cybersecurity is supported for PowerMax and PowerStore systems, and will continue to expand coverage to other Dell assets. The top of the page shows information provided in the multisystem view: The System Risk Level, the summary of active issues, and the percentage of enabled tests in the Evaluation Plan. The bottom of the page has two tabs: Cybersecurity Issues and Evaluation Plan.

The Cybersecurity Issues tab lists all active issues identified on this system. Expanding each issue provides a detailed issue description and the recommended remediation. Users can also see the time the issue was created, the security control family (defined by NIST 800-53 R5), and the name of the evaluation test.

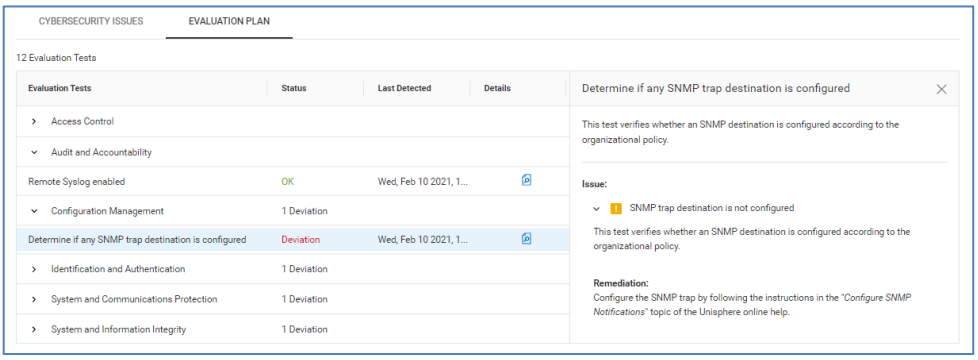


The Evaluation Plan tab lists all possible tests for this system type. The evaluation tests are grouped into Security Control Families. Each family can be expanded to show the individual tests that make up the group and one of the following statuses for each test:

- OK – Test is enabled and no issues identified.
- Deviation – Test is enabled and an active issue exists.
- Not In Plan – Test is not enabled.

When an active issue exists, the Last Detected Column shows the first time the issue was detected. When an issue does not exist, it shows the last time this data was changed (as reported by the system).

There is a details icon which shows the details of each test. In instances where there is a deviation, it will also show the recommended remediation.



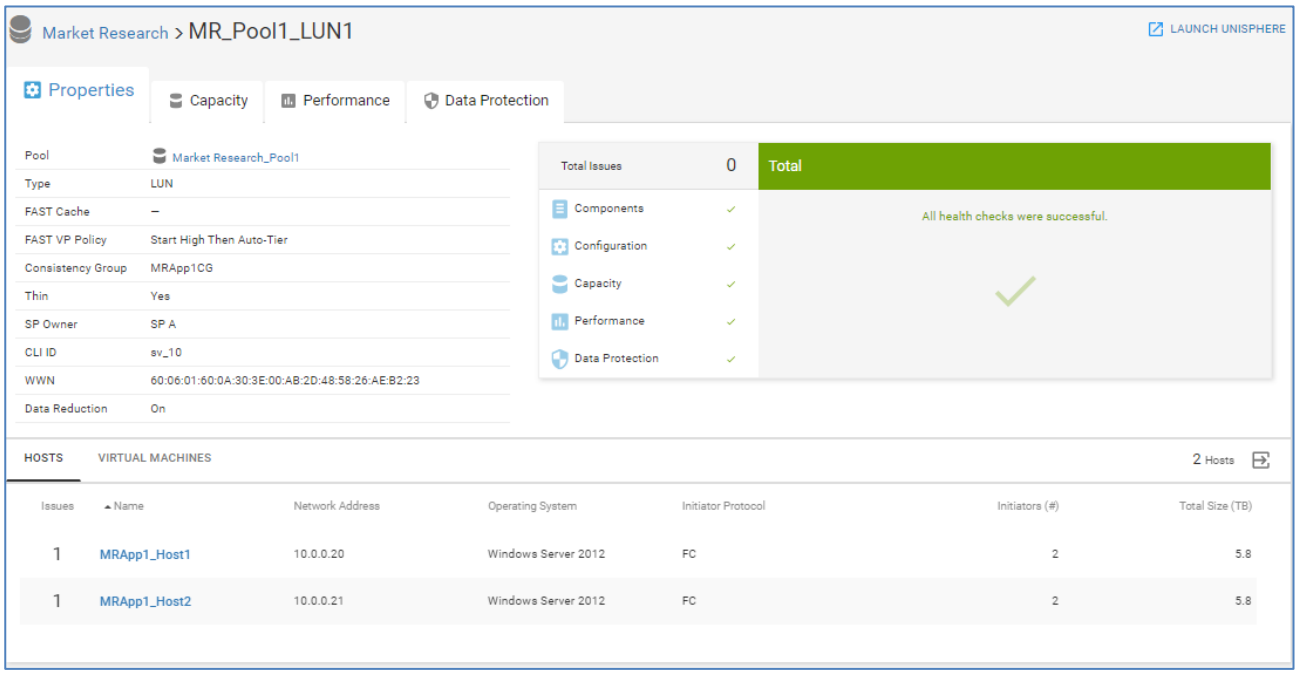
Block Object Details

Introduction

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

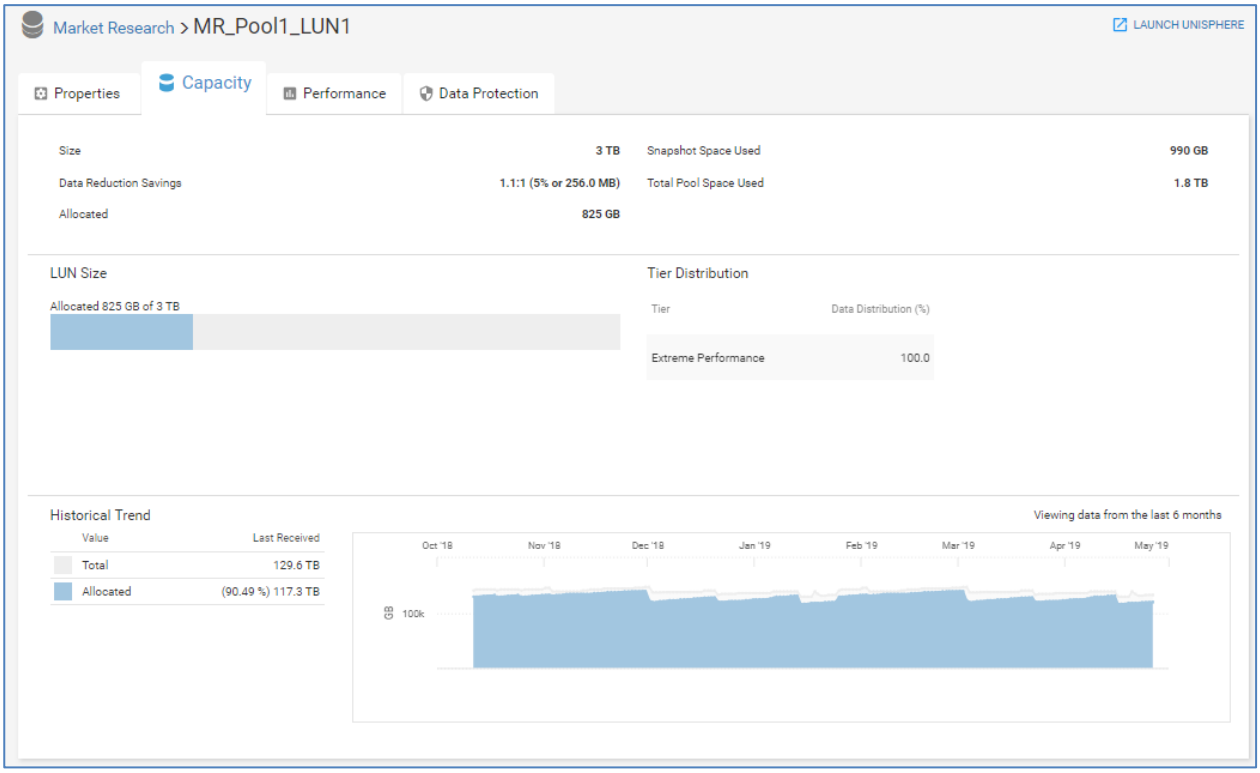
Block Object Details – Properties

The **Properties** tab for a Block object displays attributes for the object and any Health issues associated with this object. The bottom of the page varies slightly depending on storage type. It displays the Hosts (for Unity XT family 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 XT family, SC Series, and XtremIO objects. The Consistency Groups tab is available for XtremIO volumes listing consistency group information to which the volume belongs.

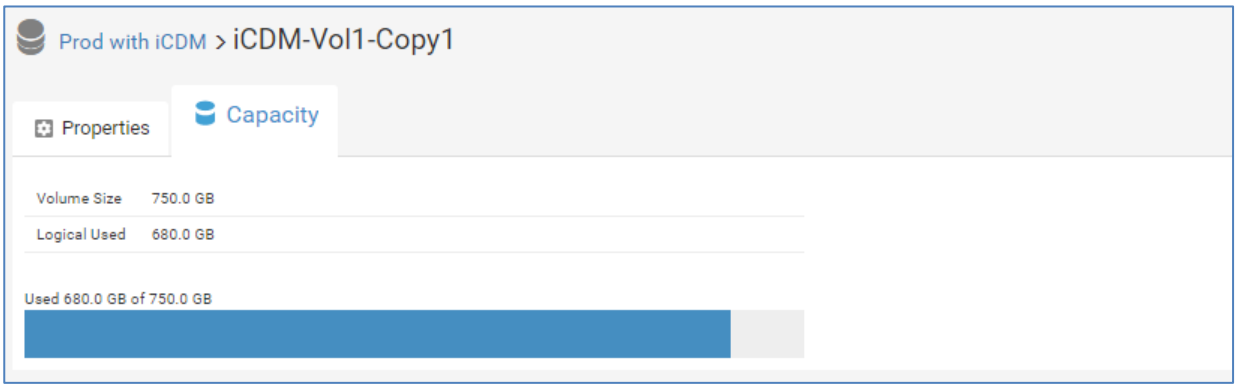


Block Object Details – Capacity

The **Capacity** tab for Unity XT family, 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.

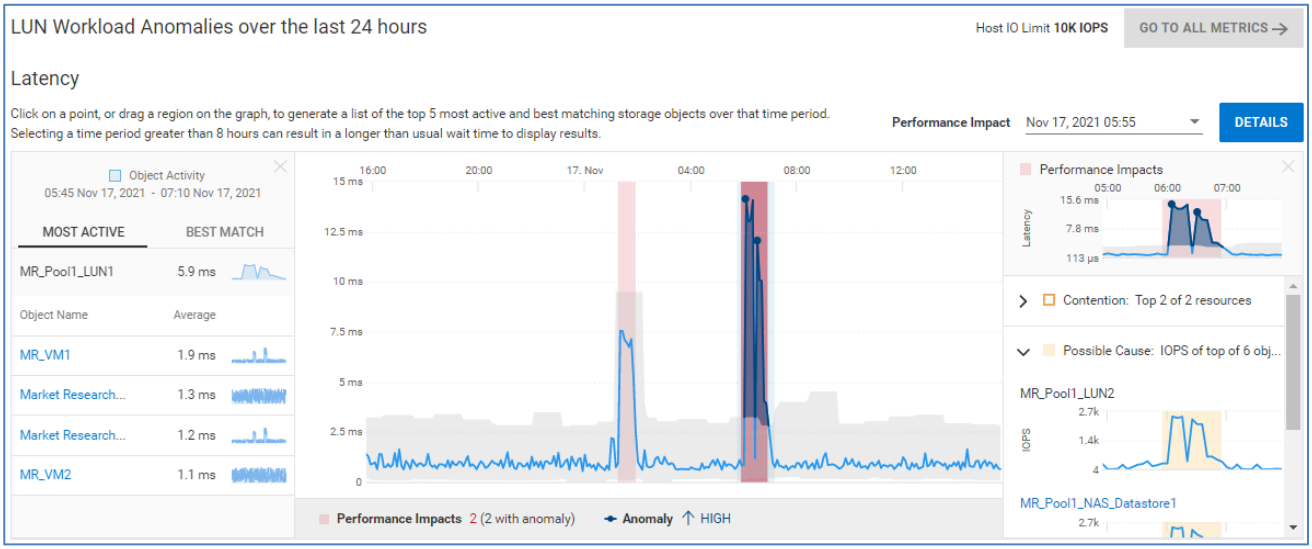

Prod with iCDM > iCDM-Vol1-Copy1
Properties
Capacity
Volume Size 750.0 GB
Logical Used 680.0 GB
Used 680.0 GB of 750.0 GB

Block Object Details – Performance

The **Performance** tab for block objects (Unity XT family, 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 XT family systems, CloudIQ also identifies performance impacts at the object level.

Highlighting an area in the performance charts for a block object identifies up to the five most active virtual machines contributing to the metric during that time period. Unity XT family systems have the additional feature of providing the virtual machines that most closely correlate to the behavior in the selected time range. This correlation is shown under the Best Match tab.

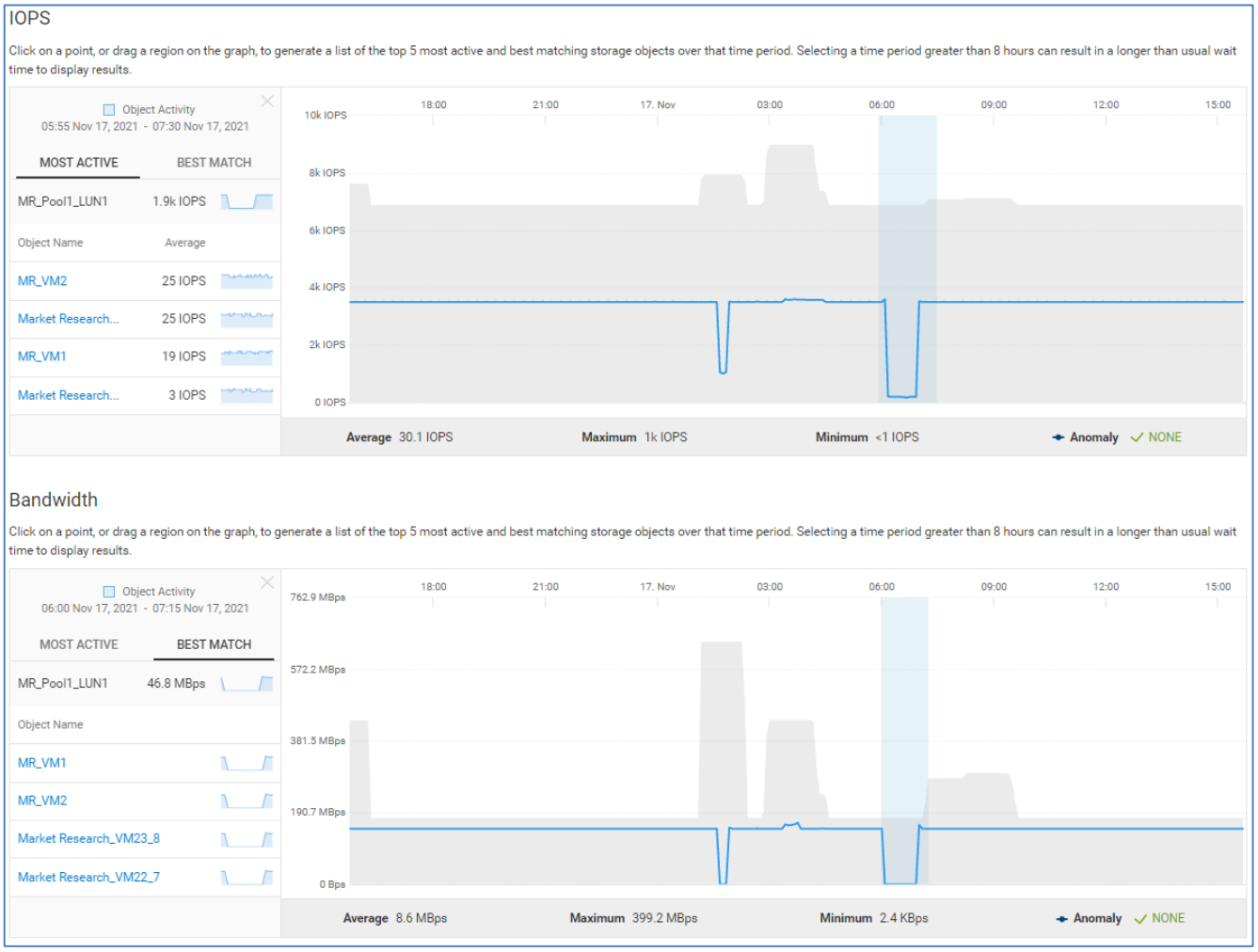
The following shows two performance impacts on a Unity XT block latency chart. The first is an impact only, the second is an impact with a performance anomaly. Selecting the Details button opens a window in the right side of the chart identifying storage objects whose IOPS are correlated with the rise in latency for the impacted LUN. These objects are the most likely candidates causing workload contention and the performance impact. CloudIQ also identifies if there is possible resource contention for Unity XT LUNs experiencing a performance impact.



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

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

In the following screenshot, a region of the IOPS chart is highlighted. The left 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 period.

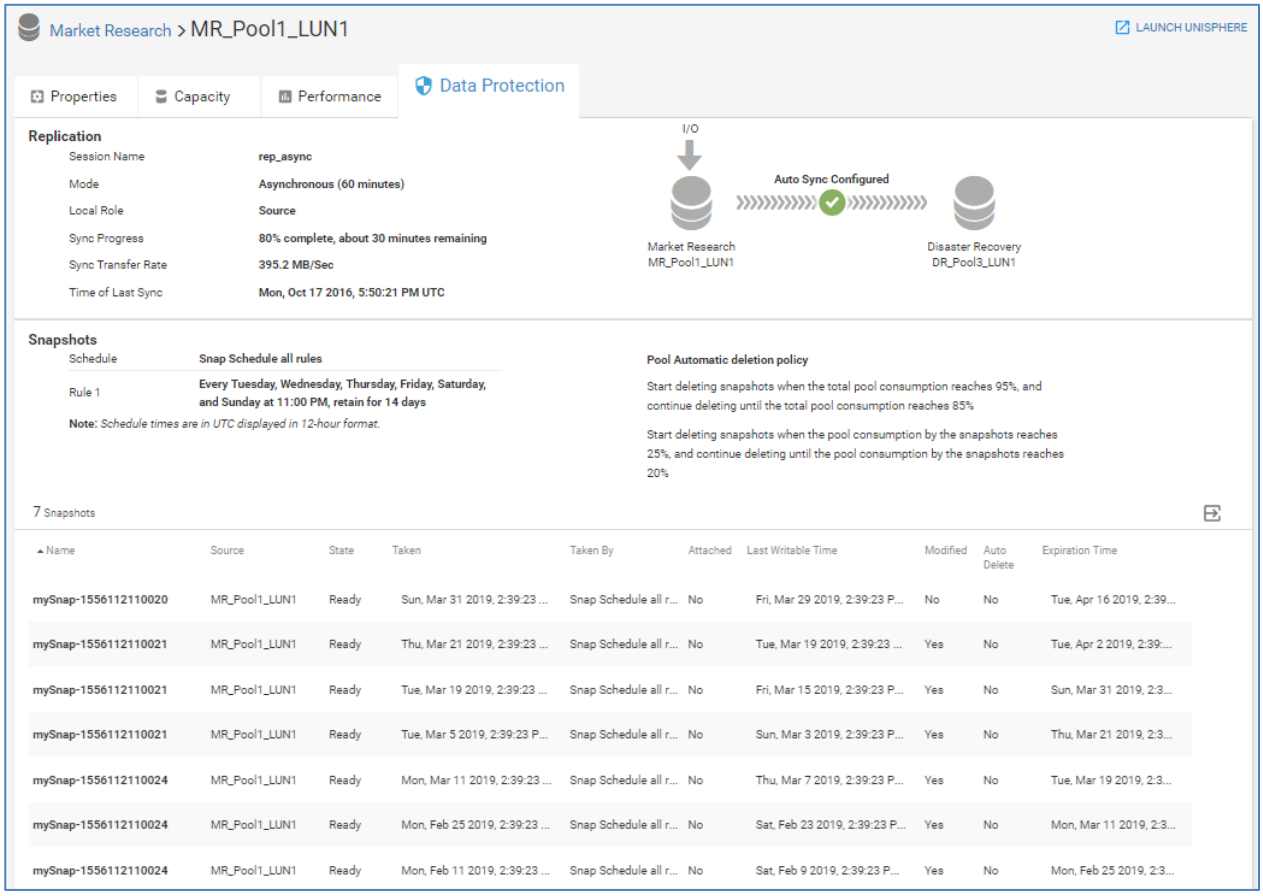


Block Object Details – Data Protection

The **Data Protection** tab for Unity XT family 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
- 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.



File Object Details

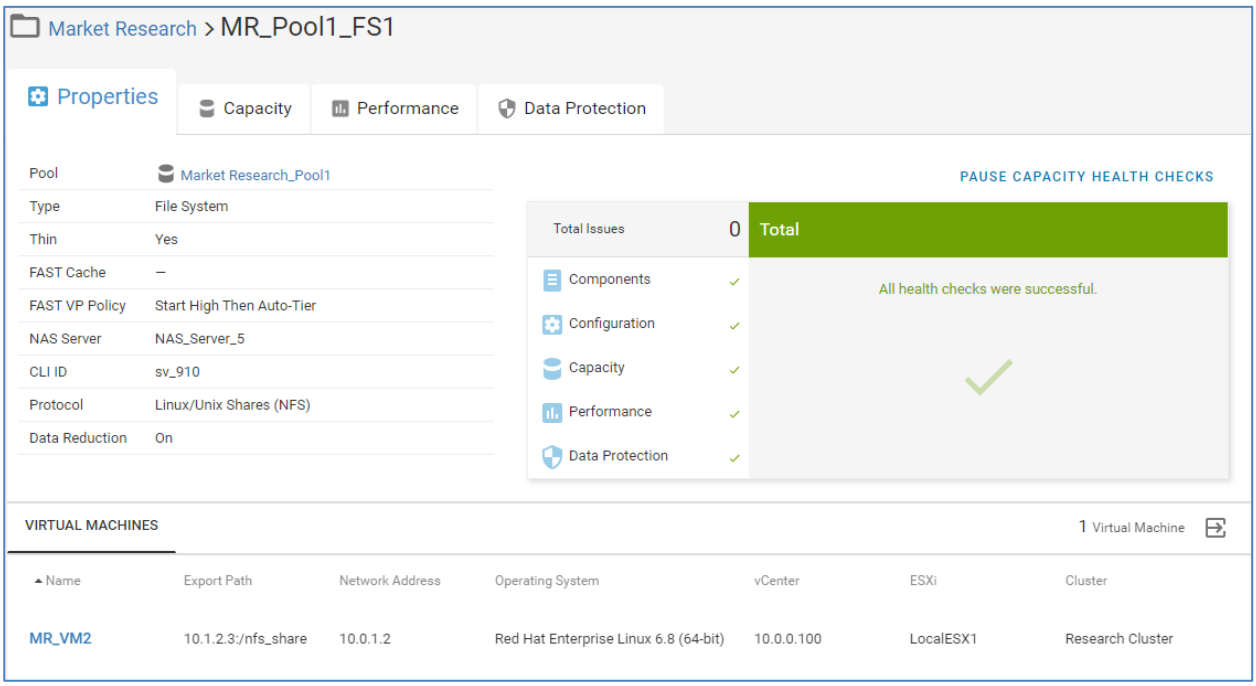
Introduction

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

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 allows users to pause the capacity health check for the file system. This can also be accomplished from the Customization menu under Admin. See CloudIQ administration for more details.

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

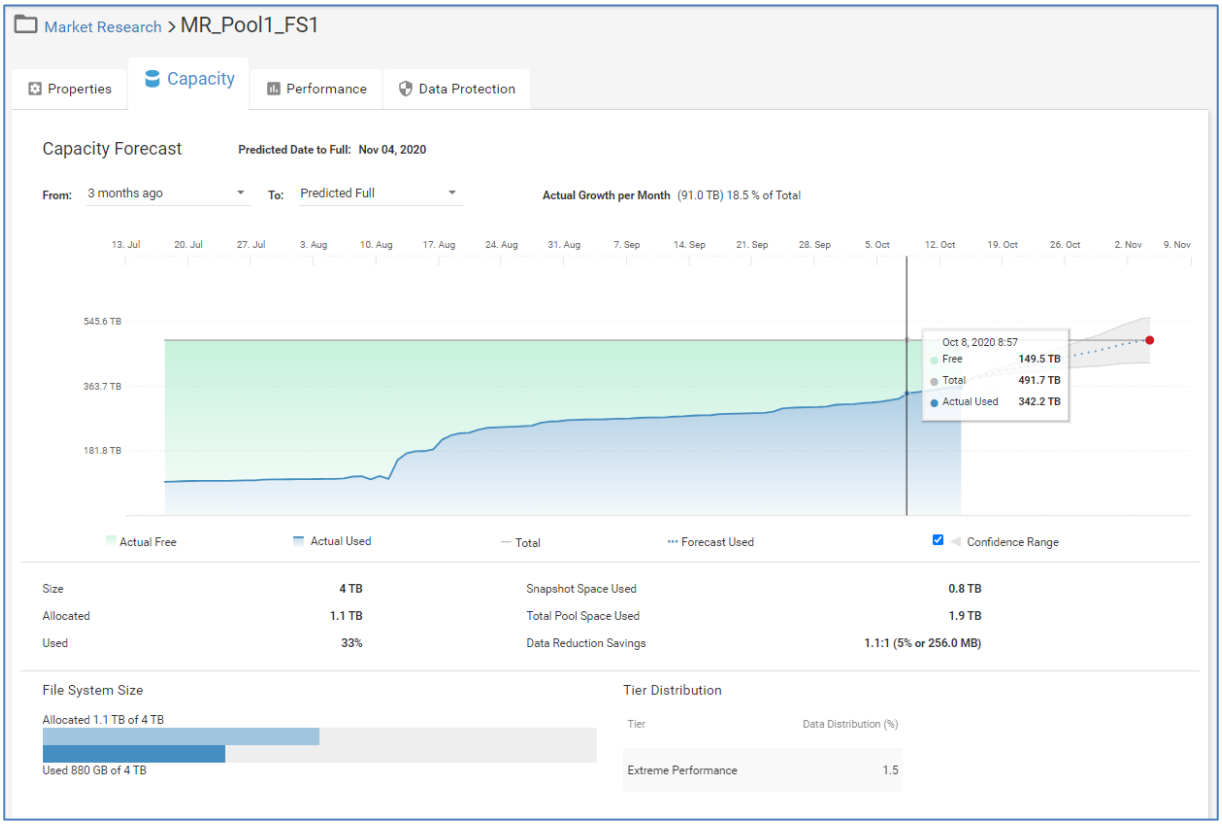


File Object Details – Capacity

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 on the actual data written to the file system.

The Capacity Forecast shows a historical trend and capacity changes since the object was created. CloudIQ 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.



File Object Details – Performance

The **Performance** tab for a file object 24-hour performance charts for the following metrics:

- Latency
- IOPS
- Bandwidth
- %Read
- IO Size
- Queue Length

Performance anomalies are supported for each of these metrics.

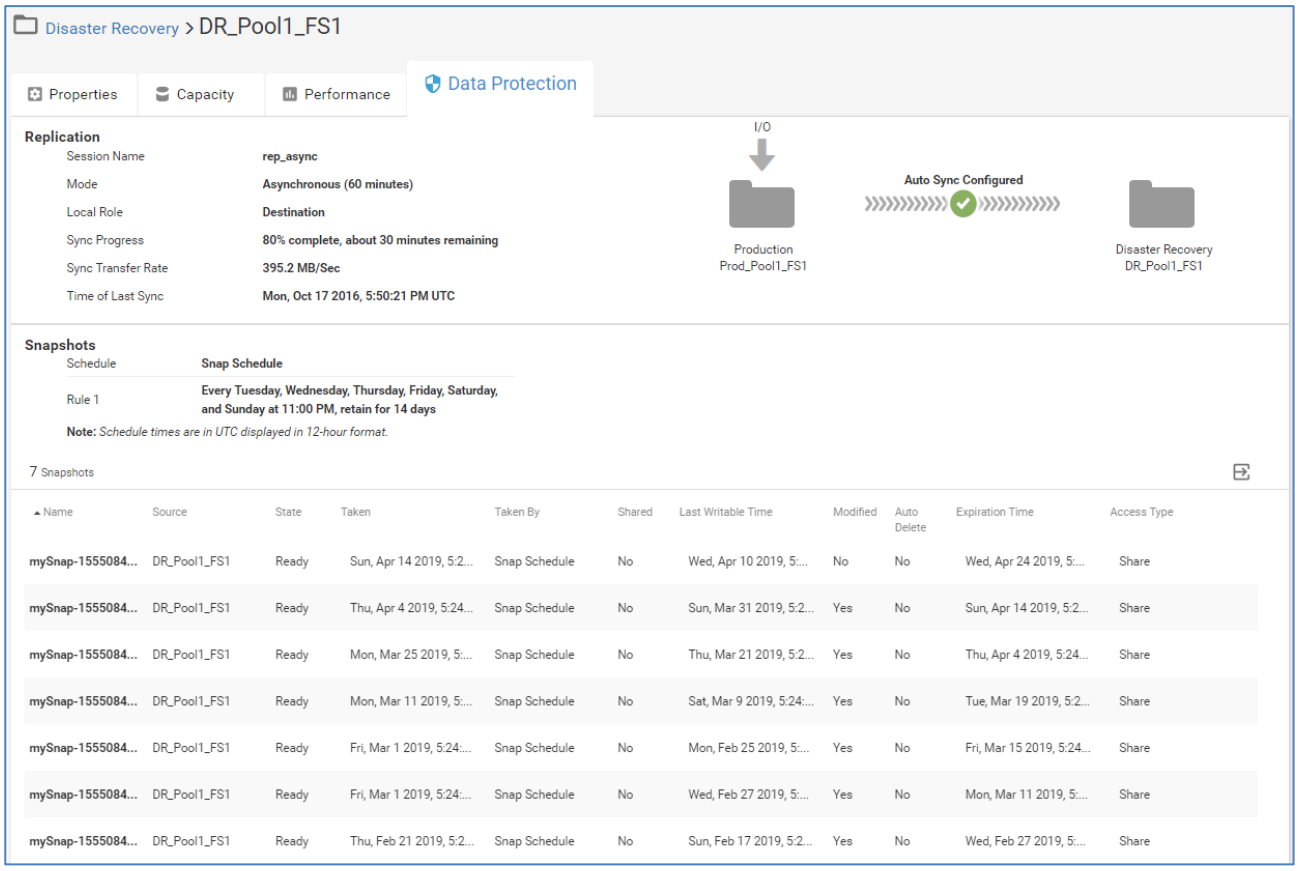
Note: Latency and Queue Length metrics are available for Unity XT v5.0 and higher.

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
- 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.



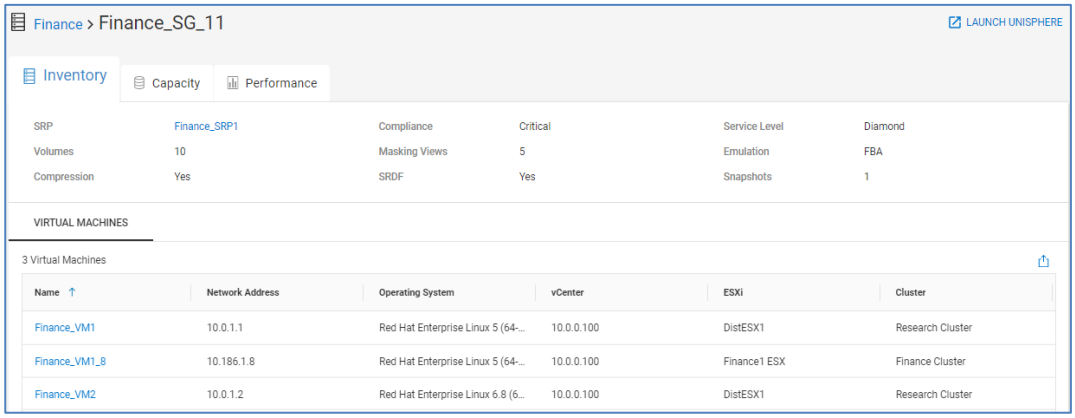
Storage Group Details (PowerMax/VMAX systems)

Introduction

Each PowerMax/VMAX system lists the storage groups with key information including the associated Storage Resource Pool, the assigned Service Level and whether 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 using global search of the storage group name.

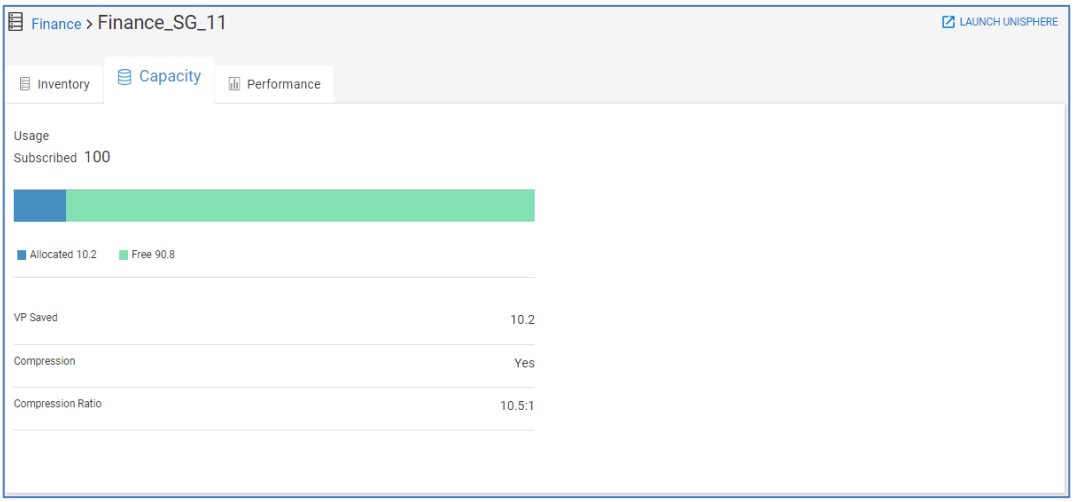
Storage Group Details – Inventory

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



Storage Group Details – Capacity

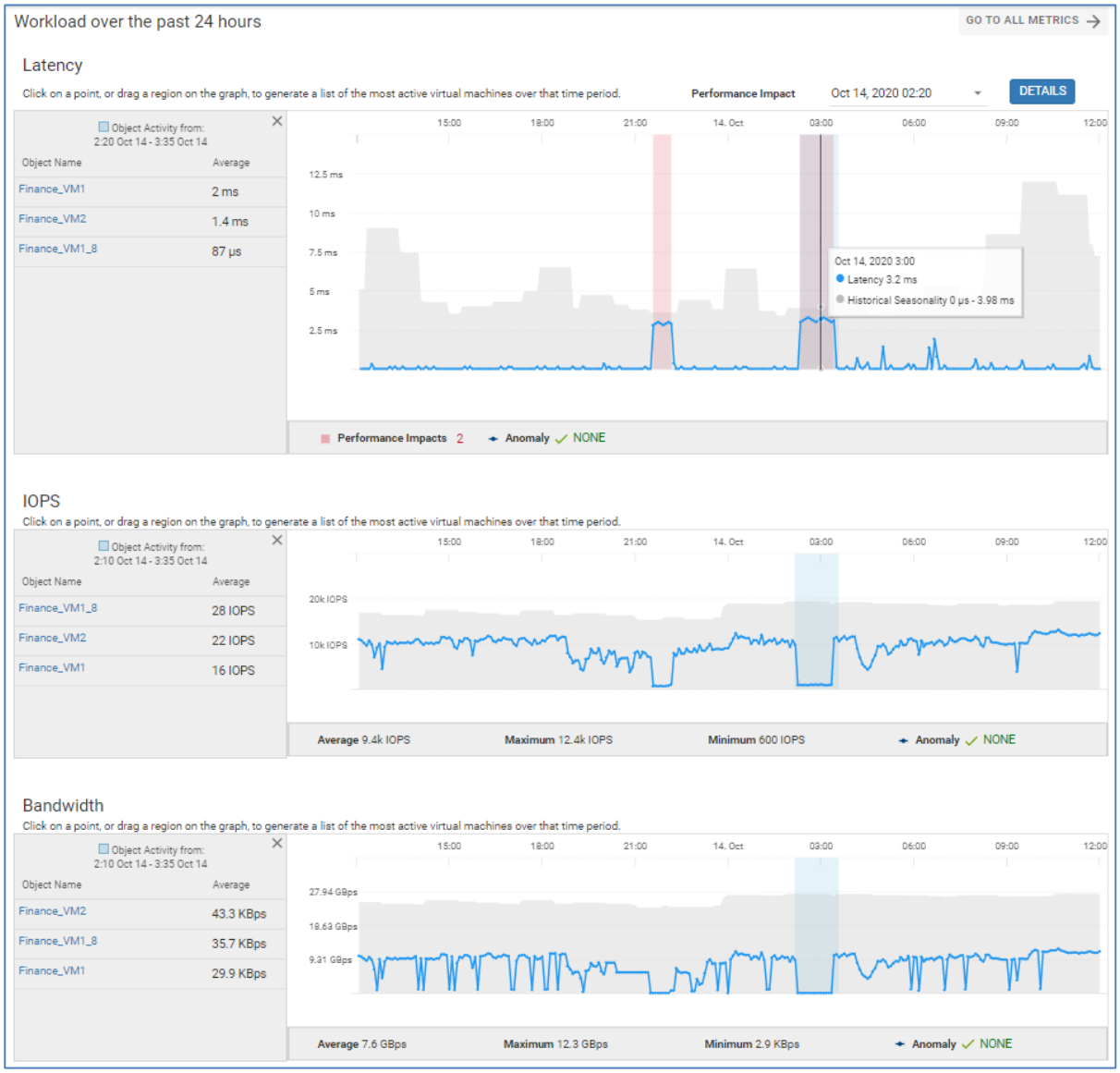
The **Capacity** tab for a Storage Group provides details for the Storage Group capacity, showing Used and Free Allocation. Also, Storage Efficiency information is provided, including virtual provisioning (VP) savings and the compression ratio.



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 side of the chart.



Connectrix and PowerSwitch Details

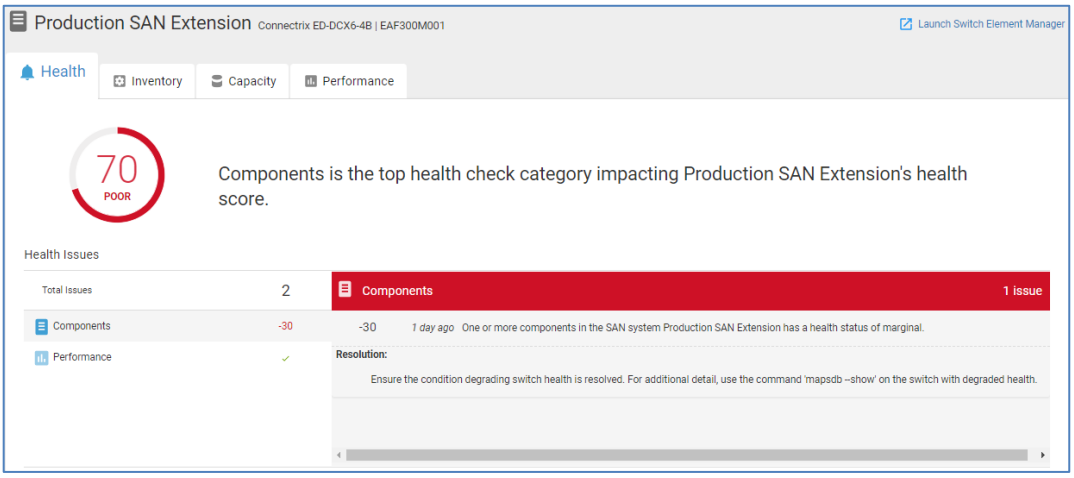
Introduction

CloudIQ can monitor both Connectrix and PowerSwitch networking devices. For Connectrix, CloudIQ uses a local collector that communicates to the switches using a read-only privilege and the collector sends the data back to CloudIQ through the Secure Remote Services Gateway. PowerSwitch sends data to CloudIQ through a direct connection to SupportAssist.

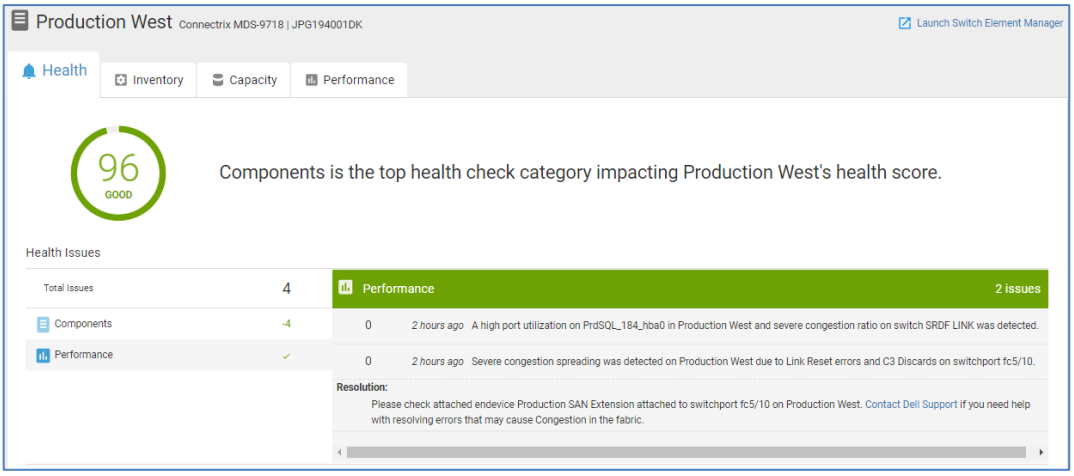
Selecting the switch hyperlink in the overview page or any of the multisystem views opens the System Details page for that switch. The following sections discuss each tab of the Switch System Details page in greater depth.

Switch System Details – Health

The Health tab shows the details for a selected switch driving the health score number. 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. The bottom of the page shows the Health Score History chart for both Connectrix and PowerSwitch devices.

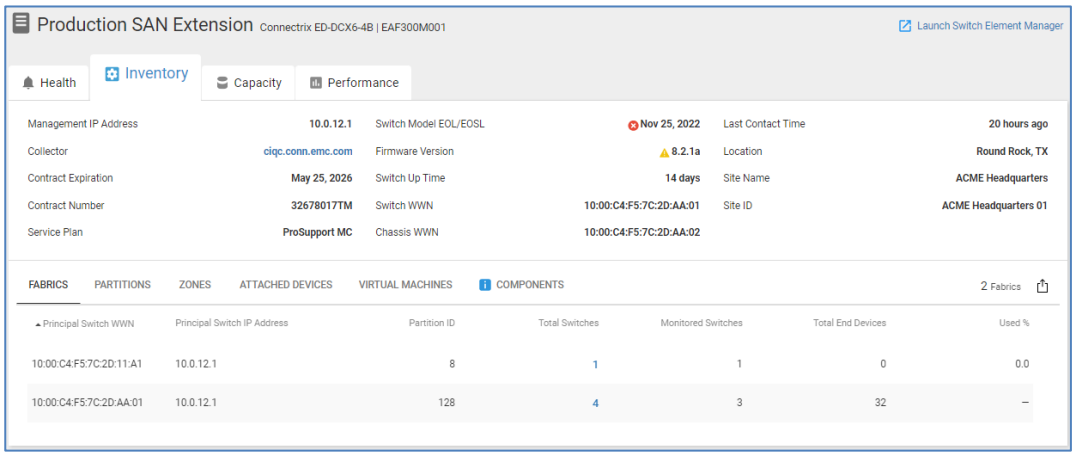


A relatively new feature in CloudIQ is the ability to detect congestion spreading on Connectrix switches. The detection evaluates various conditions including congested ports, port errors, and port utilization on the local switch or connected switches. Health score deductions for these scenarios are under investigation, and this condition does not affect the health score of the switch.

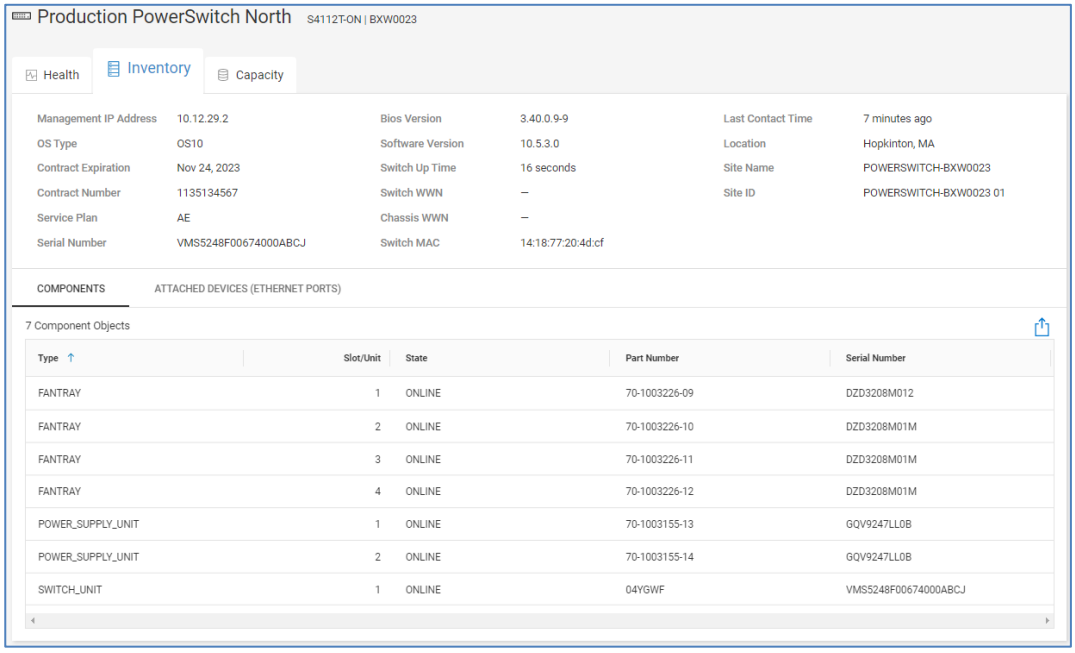


Switch System Details – Inventory

The Inventory tab differs slightly between Connectrix and PowerSwitch. For Connectrix, it 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. It also highlights if a model had reached End of Life (EOL) or End of Service Life (EOSL) and identifies if recommended firmware updates are available. The bottom half of the window contains the following tabs: Fabrics, Partitions, Zones, Attached Devices, Virtual Machines, and Components.



The top half of the Inventory tab for PowerSwitch includes the service tag, serial number, model, operating-system type, location, site, BIOS or software versions, management IP address, and contract information. The bottom half of the page has the Components and Attached Devices (Ethernet Ports) tabs.

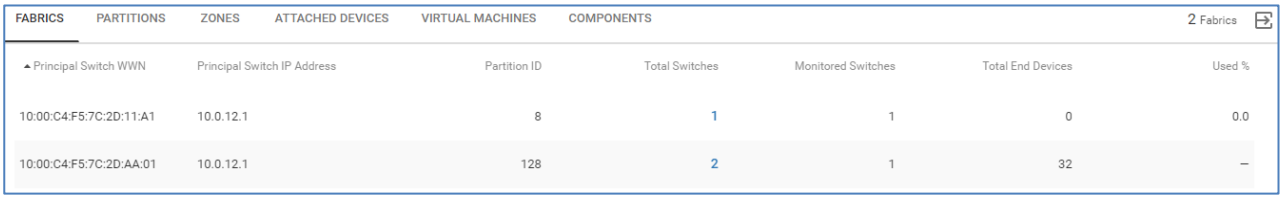


Fabrics

The Fabrics tab (Connectrix only) 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.

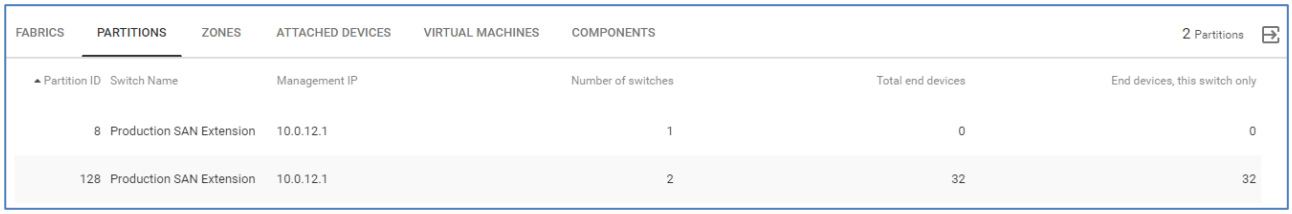
- Total Switches – Total number of switches participating in the fabric that this VF or VSAN or switch is a member of. This number is a hyperlink which, when selected, displays a window listing all switches in the fabric.
- Total End Devices – Total number of N_Ports participating in the fabric that this VF or VSAN or switch is a member of.
- Monitored Switches – Total number of switches participating in the fabric that are also monitored by CloudIQ.
- Used % – Percentage of ports in this fabric that are in use.



Partitions

The Partitions tab (Connectrix only) 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.

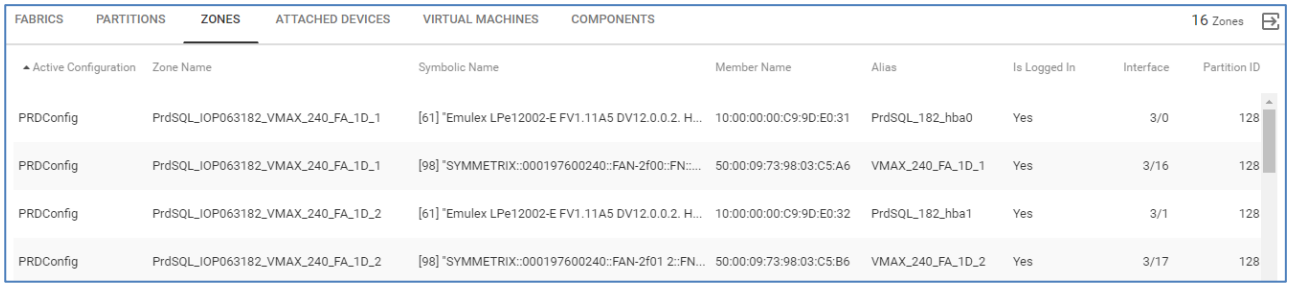


Zones

The Zones tab (Connectrix only) 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 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.



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

Attached Devices (Connectrix)

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 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.

Attached Devices (Ethernet Ports) (PowerSwitch)

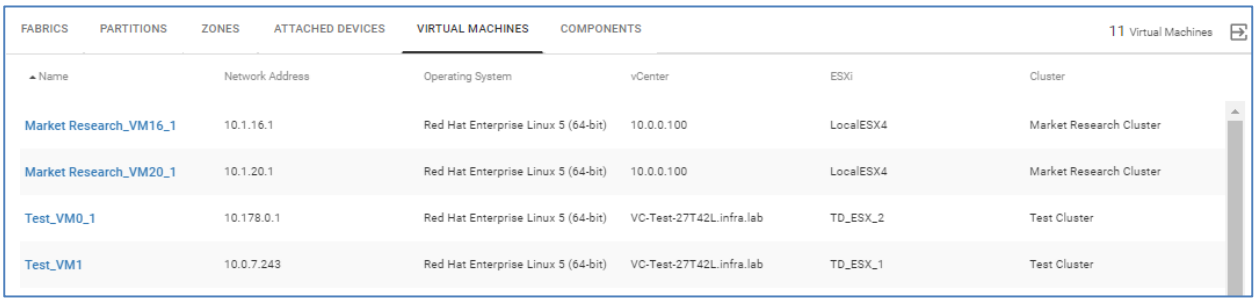
The Attached Devices tab for PowerSwitch lists each of the devices attached to the Ethernet ports of the switch.

- Local Port ID – The Port ID of the switch.
- Remote Hostname – Hostname of the attached device.
- Remote Port ID – Port ID of the attached device.
- Remote Chassis ID – Chassis ID of the attached device.
- Remote Management IPv4 – Management IPv4 address of the attached device.
- Remote Management IPv6 – Management IPv6 address of the attached device.

Virtual Machines

The Virtual Machines tab (Connectrix only) shows virtual machines residing on ESXi servers that are connected to the switch.

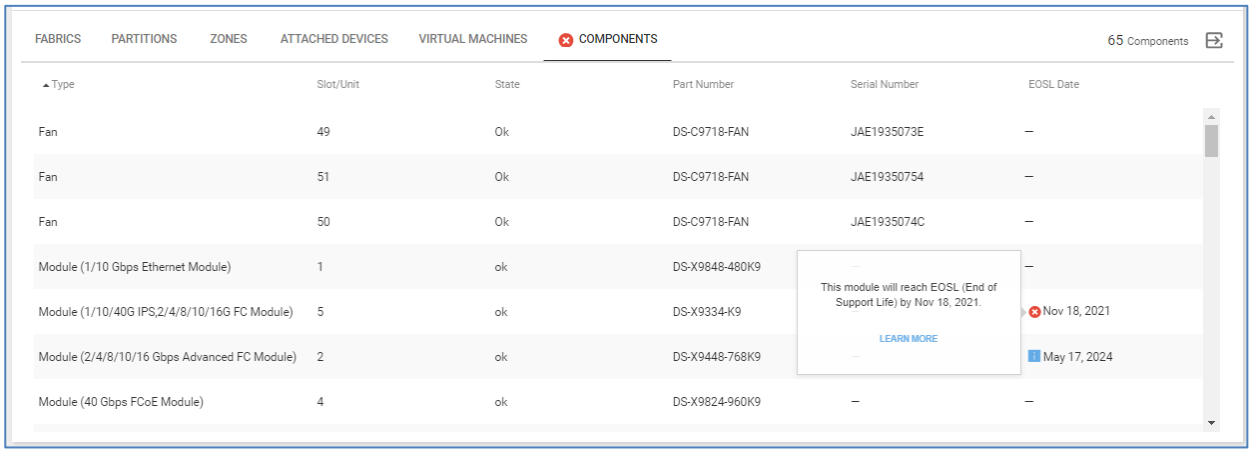
- Name – Name of the virtual machine.
- Network Address – IP address of the virtual machine.
- Operating System – Operating system installed on the virtual machine.
- vCenter – Hostname of vCenter managing the virtual machine.
- ESXi – Hostname of ESXi server hosting the virtual machine.
- Cluster –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



Components

The Components tab lists out the system hardware for both Connectrix and PowerSwitch.

- 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.
- EOSL Date (Connectrix only) – Identifies components with upcoming End of Life (EOL) and End of Support Life (EOSL) dates.



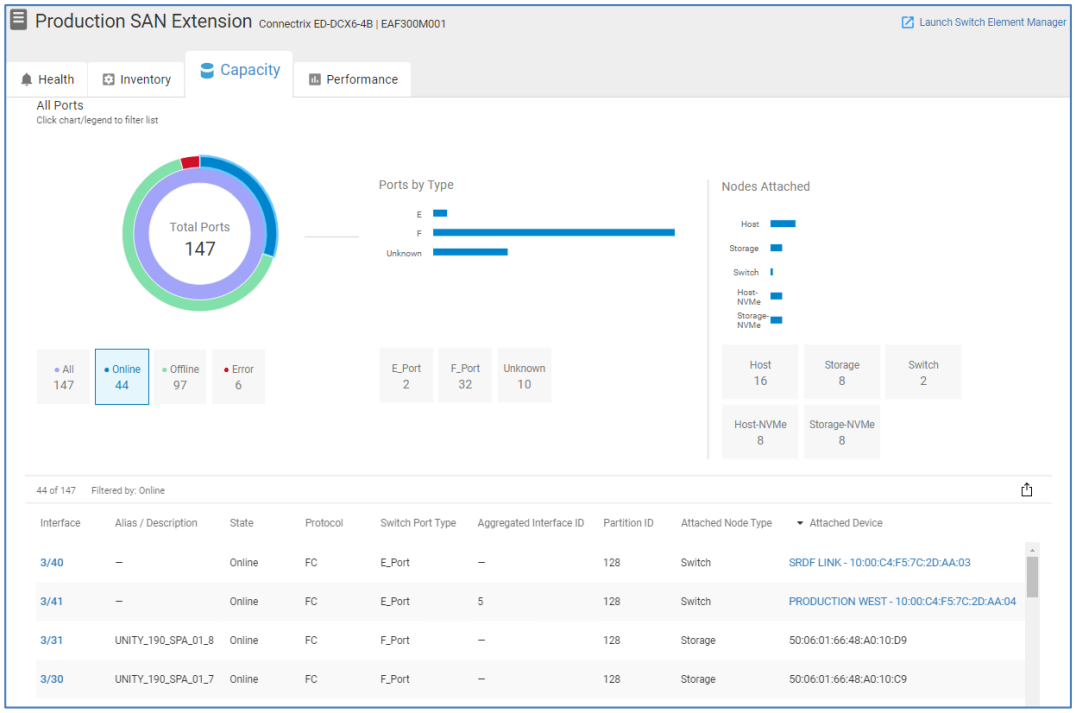
Switch System Details – Capacity

The Capacity tab for a switch provides port usage details for both Connectrix and PowerSwitch. The upper left portion of the view shows a breakdown of the ports on the switch broken down by Online, Offline, and Error status. The Ports by Type bar charts show a filtered list of ports broken down by port type. For Connectrix, the Nodes Attached bar charts show a breakdown of attached nodes by Host Ports, Storage Ports, 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. The following columns are displayed at the bottom of the page:

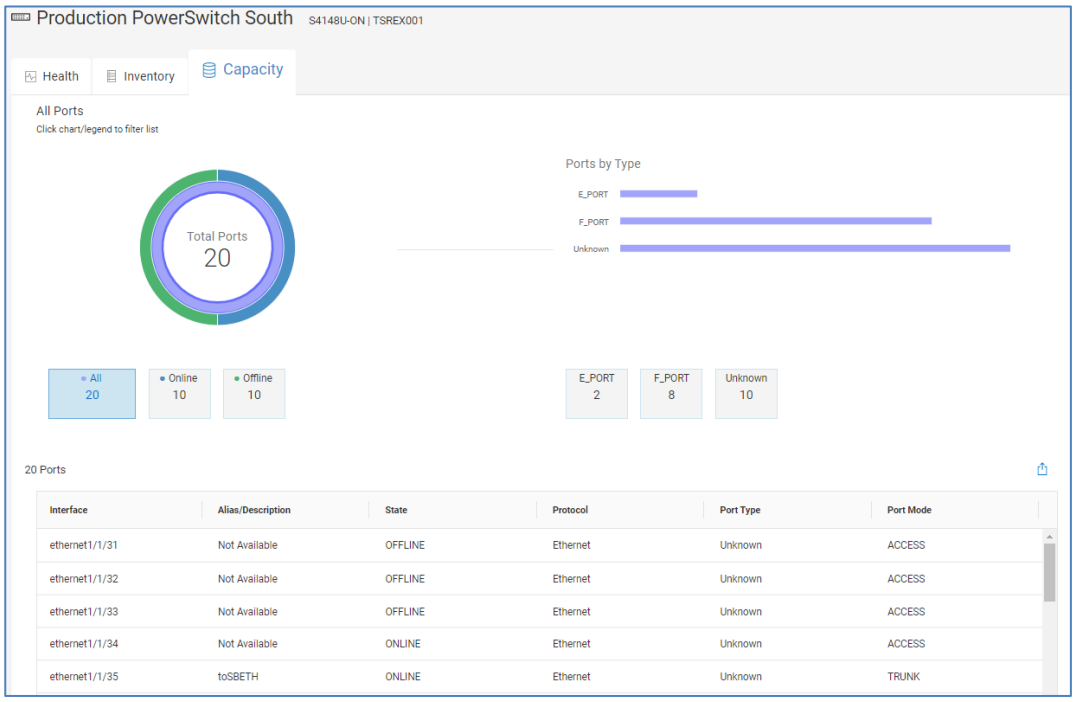
- Interface – Location of the port, shown as slot/port number. For Connectrix, it is also a hyperlink which directs user to port performance charts.
- Alias/Description – Switch port alias, if defined.

- State – Status of the switch port.
- Protocol – Protocol configured for the switch port.
- Switch Port Type – Logical configuration of the switch port. Possible values include F_PORT, N_PORT, E_PORT, Unknown, or Disabled for FC ports. Set to Unknown for Ethernet ports.
- Port Mode (PowerSwitch only) – Logical configuration of the interface, such as Access or Trunk.
- Aggregated Interface ID (Connectrix only) – Value of trunk or port channel if the physical port is being aggregated.
- Partition ID (Connectrix only)
  - 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 (Connectrix only) – Describes the device attached to the switch port.
- Attached Device (Connectrix only) – Worldwide name of the attached device.

Capacity tab for Connectrix:



Capacity tab for PowerSwitch:

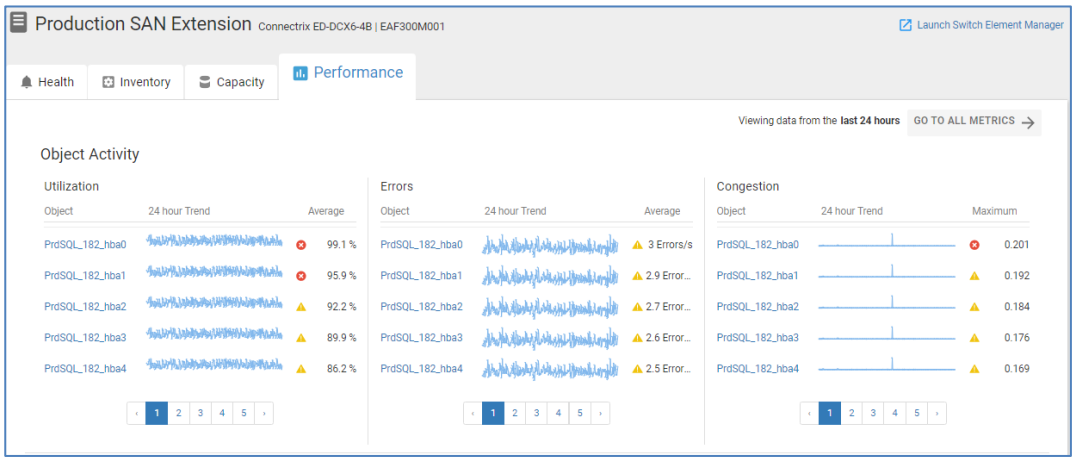


Switch System Details – Performance

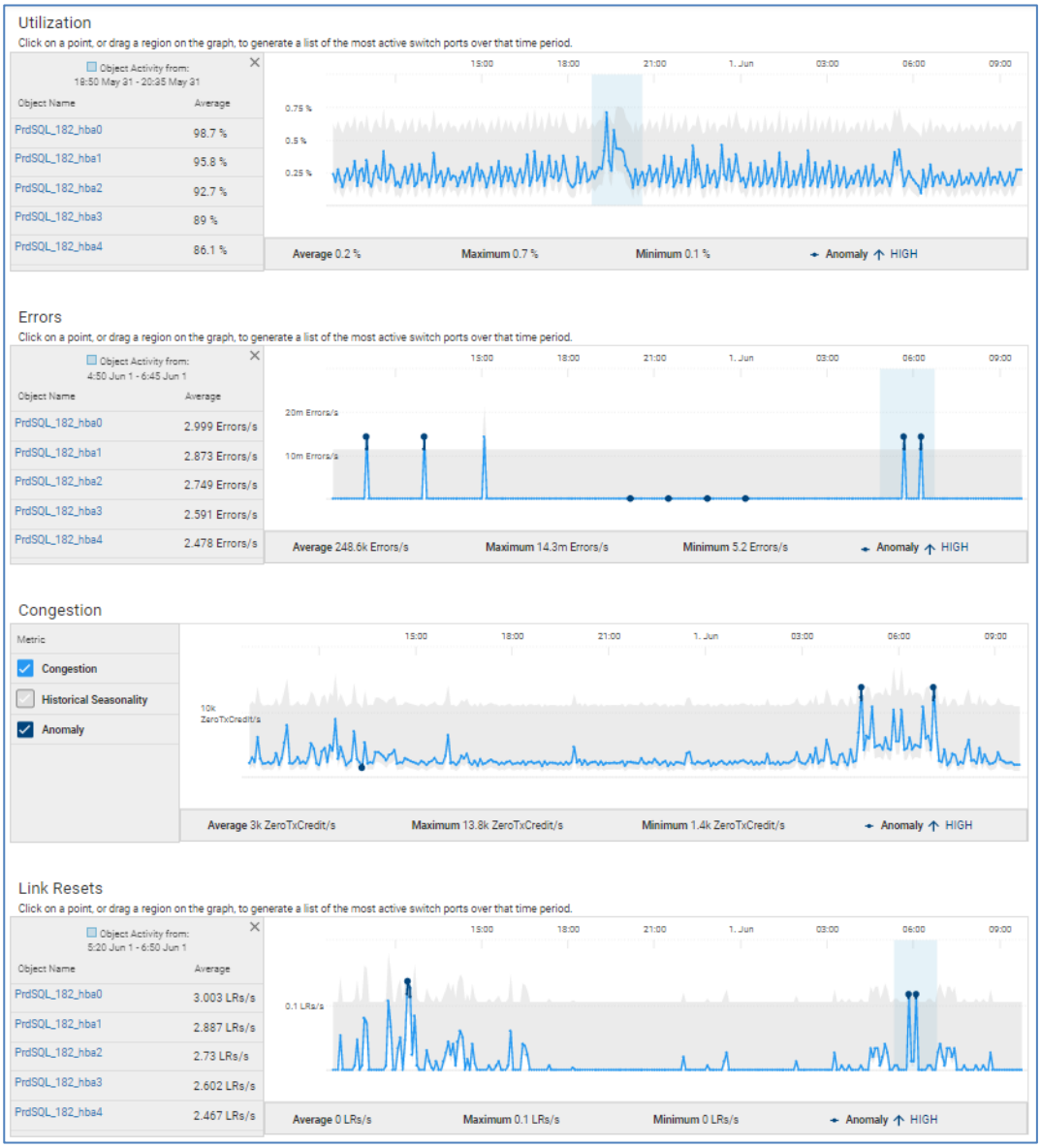
The top section of the Performance tab for Connectrix switches is Object Activity, and it displays the top ports contributing to Utilization, Errors, and Congestion sorted by their 24-hour average. Showing the top objects first allows the user to quickly identify ports using the most resources and experiencing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

The user can scroll down to see 24-hour charts for the following Connectrix 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.



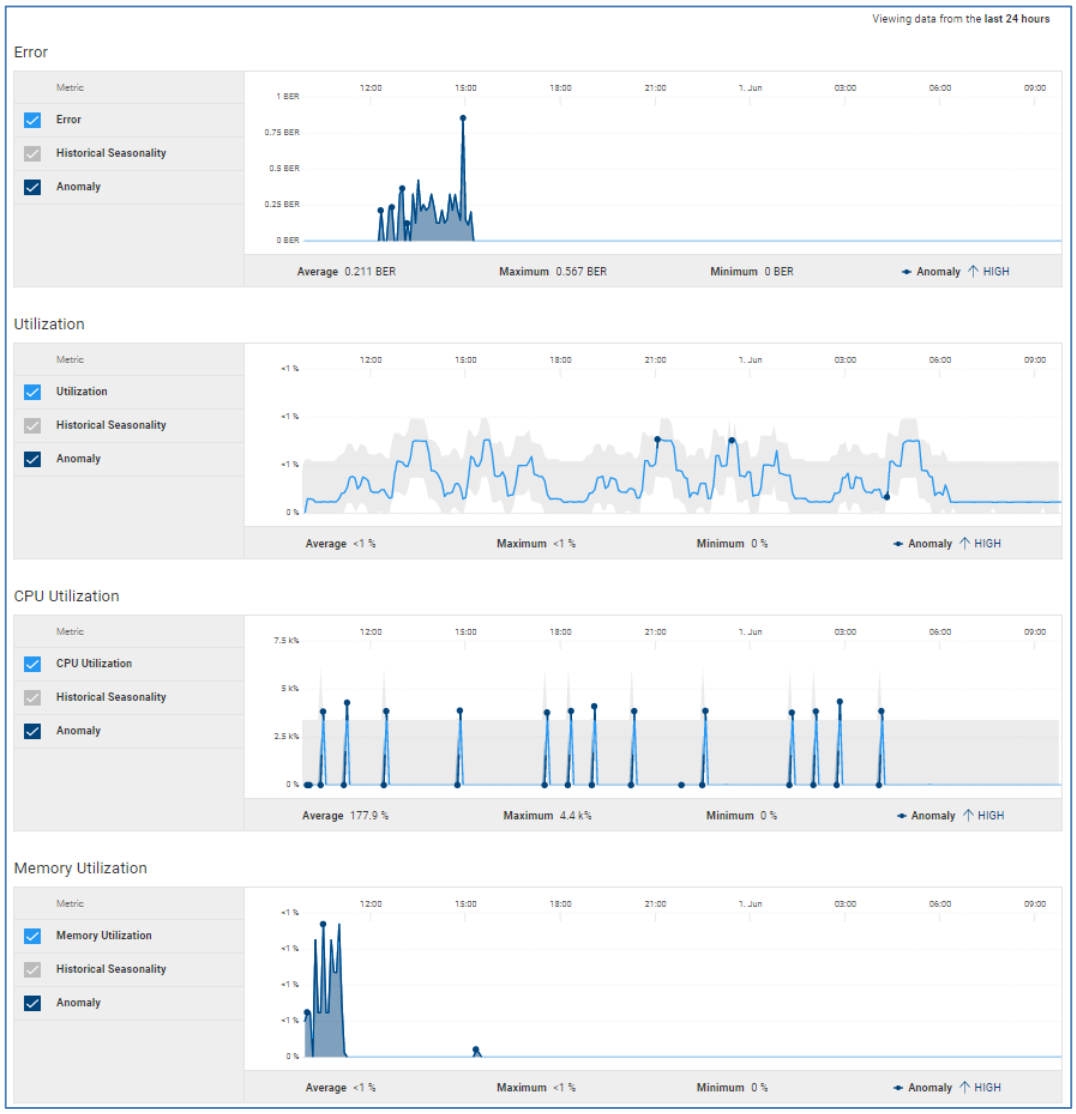
Highlighting an area in any of these performance charts shows the top five port contributors to that performance metric during that time period in the left side of the chart. The ports listed in the left side of each chart are hyperlinks that direct the user to port-level performance charts. Performance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



PowerSwitch devices show 24-hour charts and performance anomalies for the following performance metrics:

- Error – The Bit Error Rate across all switch interfaces.
- Utilization – The percentage of transmit bandwidth being used across all switch interfaces.
- CPU Utilization – The percentage of CPU usage over the selected time period.
- Memory Utilization – The percentage of memory usage used by various processes running on the switch.

Note: Performance metrics required minimum of OS10 version 10.5.3.2. Memory utilization requires a minimum of OS10 version 10.5.4.

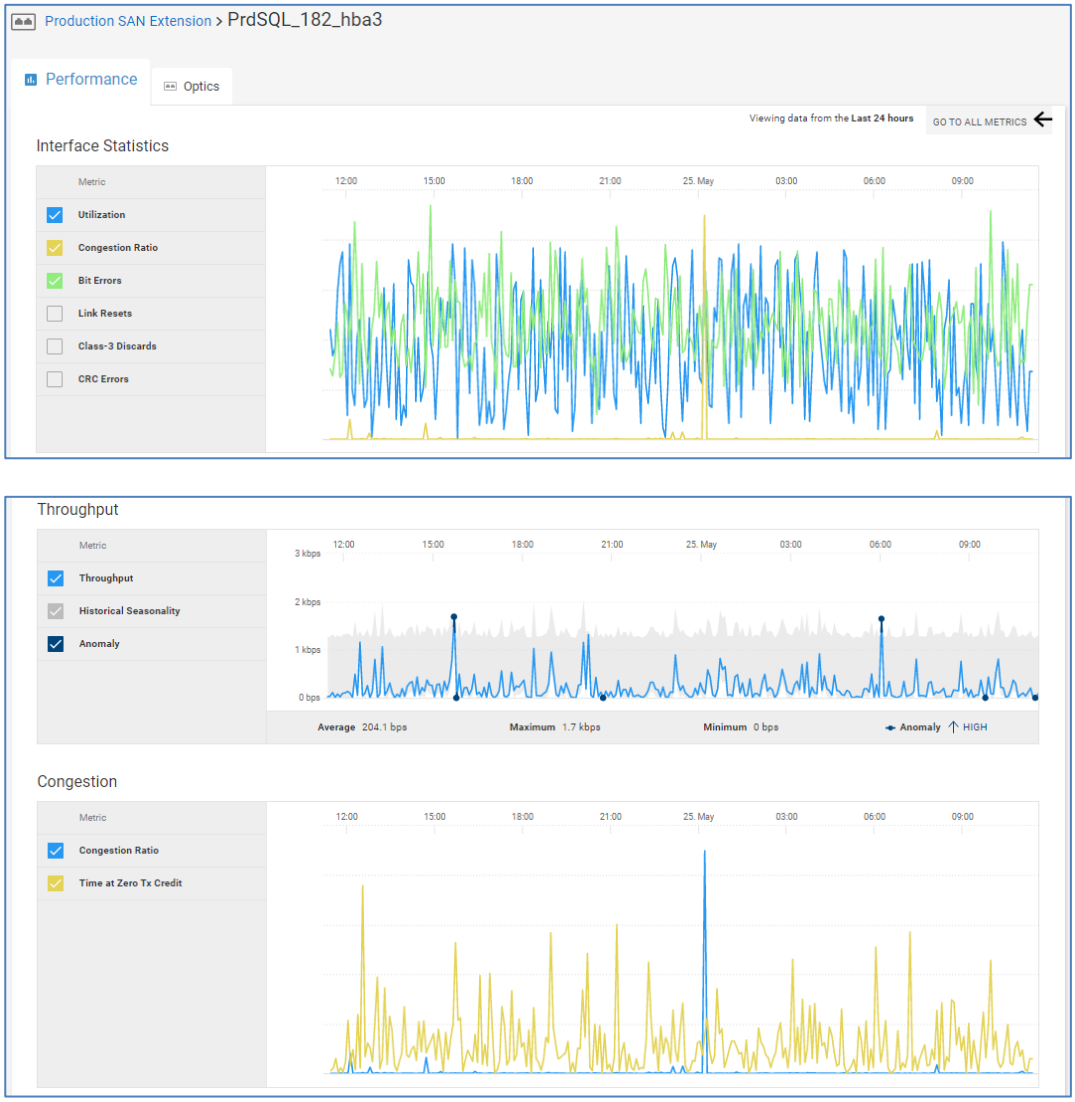


Switch Port Details – Performance

Users can access port-level performance metrics for Connectrix switches. Select the port from the Interface column in the Switch Capacity page, or select the port hyperlink in the top object activity shown in the previous section. Port-level performance metrics are shown in the following charts:

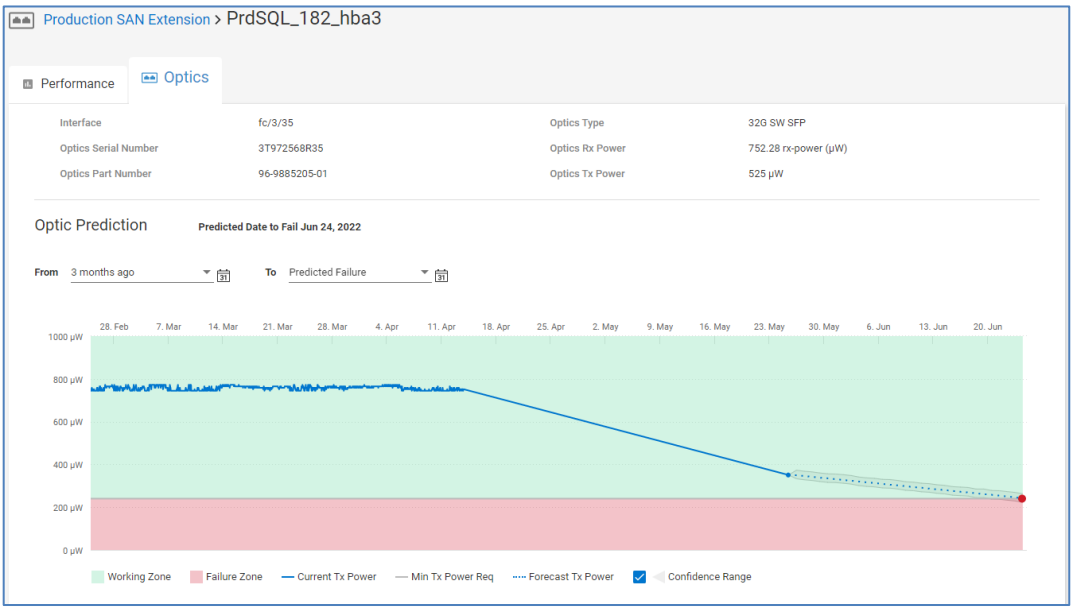
- Interface Statistics
  - Utilization
  - Congestion Ratio
  - Bit Errors
  - Link Resets
  - Class-3 Discards
  - CRC Errors
- Throughput
- Congestion

  - Congestion Ratio
  - Time at Zero Tx Credit
- Bit Errors
- Link Resets



Switch Port Details – Optics

The Optics tab for Connectrix switches provides various property information about the optic on the top of the page and graphs the historical and predicted Tx power at the bottom of the page. The chart provides the working and failure zones and the predicted time until failure, giving users the ability to plan ahead and take mitigating measures to address expected failures.



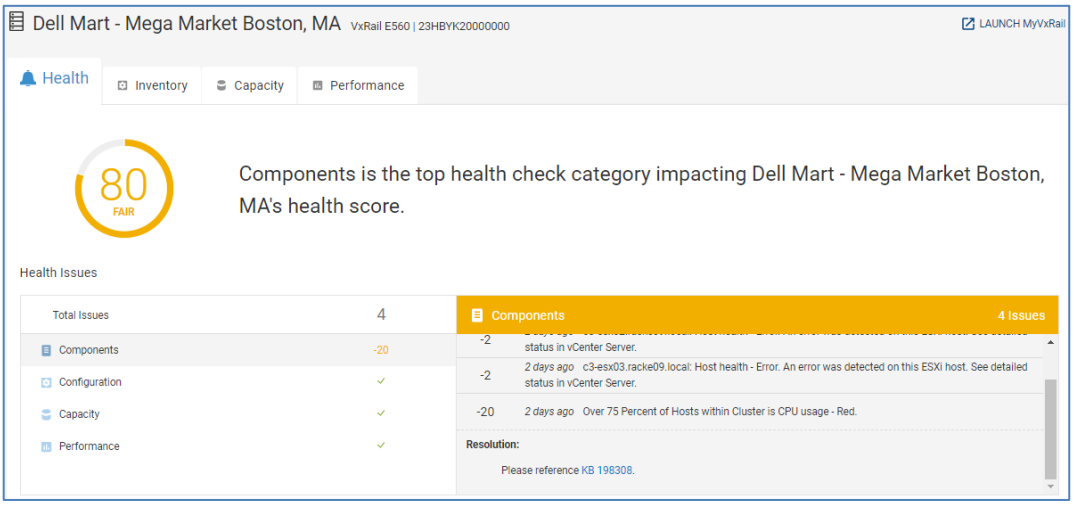
VxRail Hyperconverged Infrastructure Systems

Introduction

CloudIQ supports VxRail HCI systems. The HCI tab in the various multisystem views has been discussed earlier in this paper. This section describes the information provided in the system details view for a VxRail cluster. Each cluster has the Health, Inventory, Capacity, and Performance tabs. Each tab provides the Launch MyVxRail hyperlink to easily go to MyVxRail. The details of each tab are presented below.

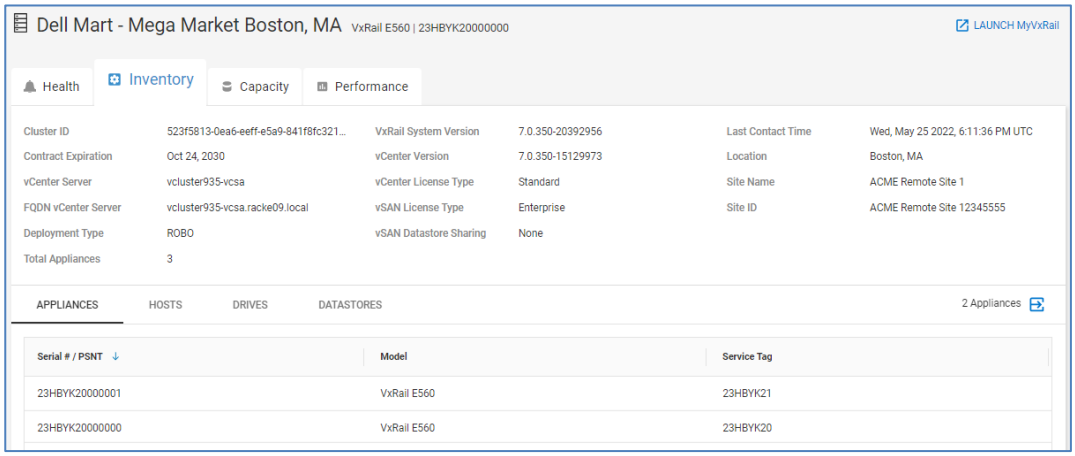
VxRail System Details – Health

The **Health** tab for VxRail clusters is similar to other systems. The Health Score is determined by monitoring issues in the following categories: Components, Configuration, Capacity, and Performance. Each issue provides a recommended remediation or link to an applicable knowledge base article. Health Score history is also supported for VxRail.



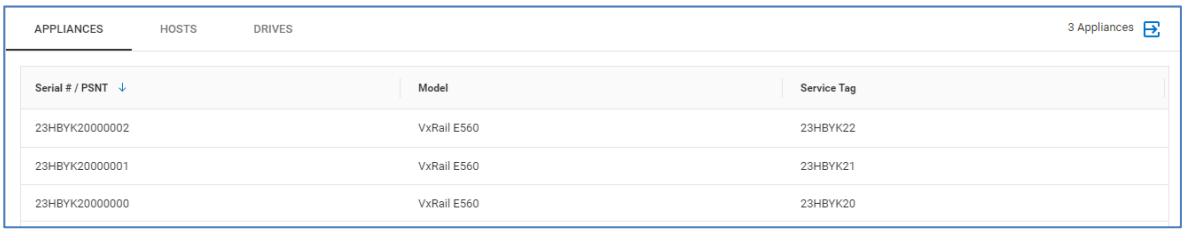
VxRail System Details – Inventory

The **Inventory** tab provides various cluster attributes at the top half of the screen, including the serial number, cluster ID, location, site, version, various vCenter information, and contract information. The bottom half of the window contains the following tabs: Appliances, Hosts, and Drives.



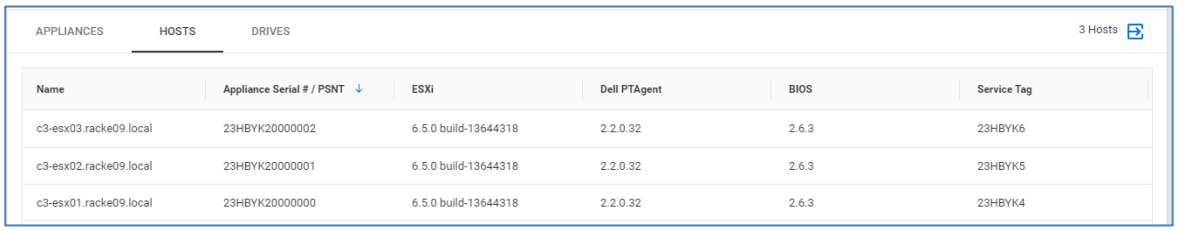
Appliances

The **Appliances** tab lists the appliances that make up the cluster and their models and service tags.



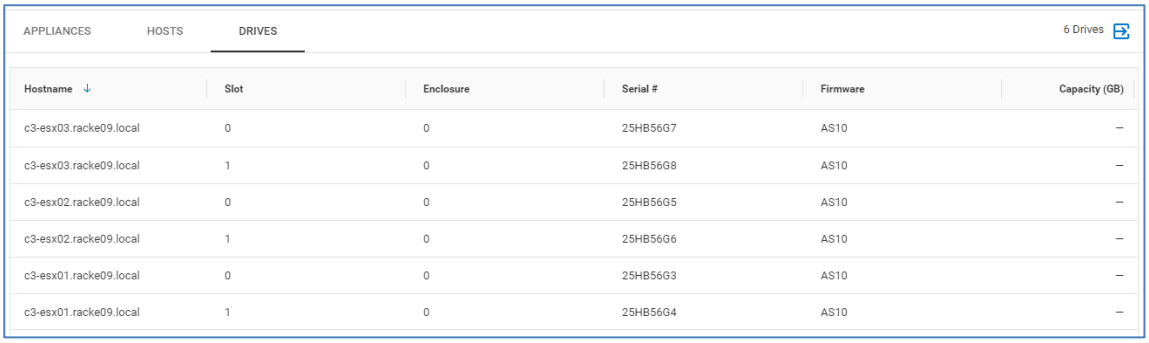
Hosts

The **Hosts** tab lists the ESXi servers that are in the VxRail cluster along with their serial number, ESXi version, BIOS, and service tag.



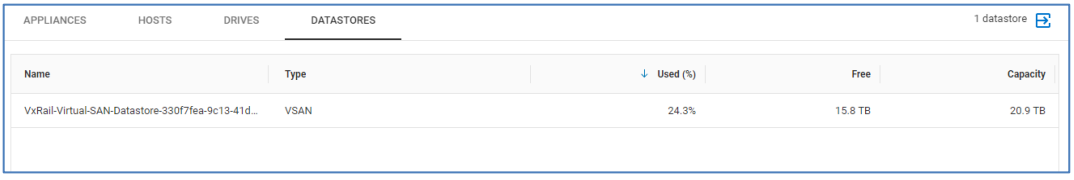
Drives

The **Drives** tab provides a listing of the hard drives in the cluster. This tab includes the ESXi host, slot and enclosure, serial number, and firmware. Capacity shows a dash as it is not yet supported for HCI systems.



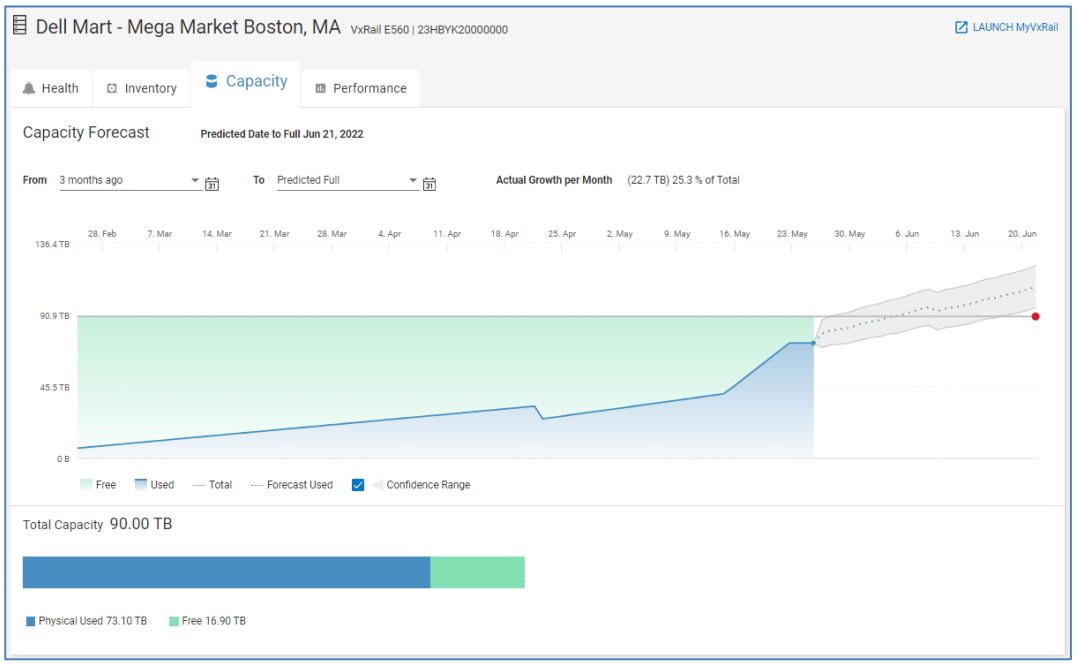
Datastores

The **Datastores** tab provides capacity utilization information for each of the datastores on the cluster.



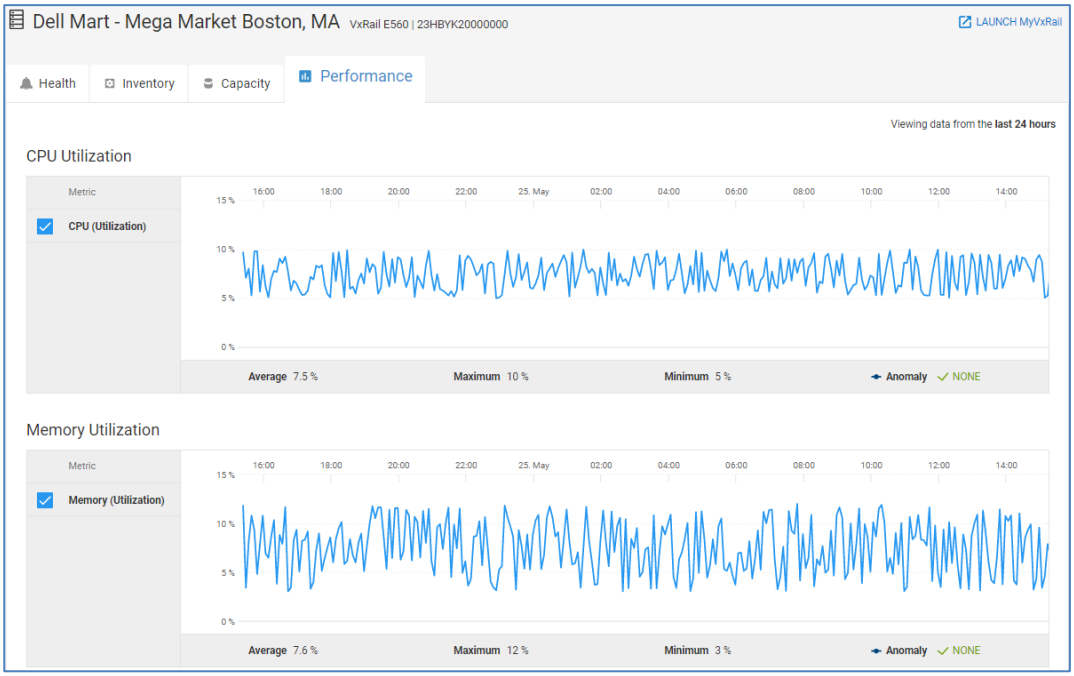
VxRail System Details – Capacity

The **Capacity** tab provides a capacity forecast chart on the top of the page. As with other systems, the chart displays the predicted full date along with a confidence range. The time range of the chart can be changed using the “From” and “To” drop-down menus. The bottom of the page displays a simple horizontal bar chart showing the breakdown of Total, Used, and Free capacity on the cluster.


Dell Mart - Mega Market Boston, MA
VxRail E560 | 23HBYK20000000
LAUNCH MyVxRail
Health
Inventory
Capacity
Performance
Capacity Forecast
Predicted Date to Full Jun 21, 2022
From
3 months ago
To
Predicted Full
Actual Growth per Month
(22.7 TB) 25.3 % of Total
28. Feb
7. Mar
14. Mar
21. Mar
28. Mar
4. Apr
11. Apr
18. Apr
25. Apr
2. May
9. May
16. May
23. May
30. May
6. Jun
13. Jun
20. Jun
136.4 TB
90.9 TB
45.5 TB
0 B
Free
Used
Total
Forecast Used
Confidence Range
Total Capacity 90.00 TB
Physical Used 73.10 TB
Free 16.90 TB

VxRail System Details – Performance

The **Performance** tab provides 24-hour charts of CPU and Memory on the system.



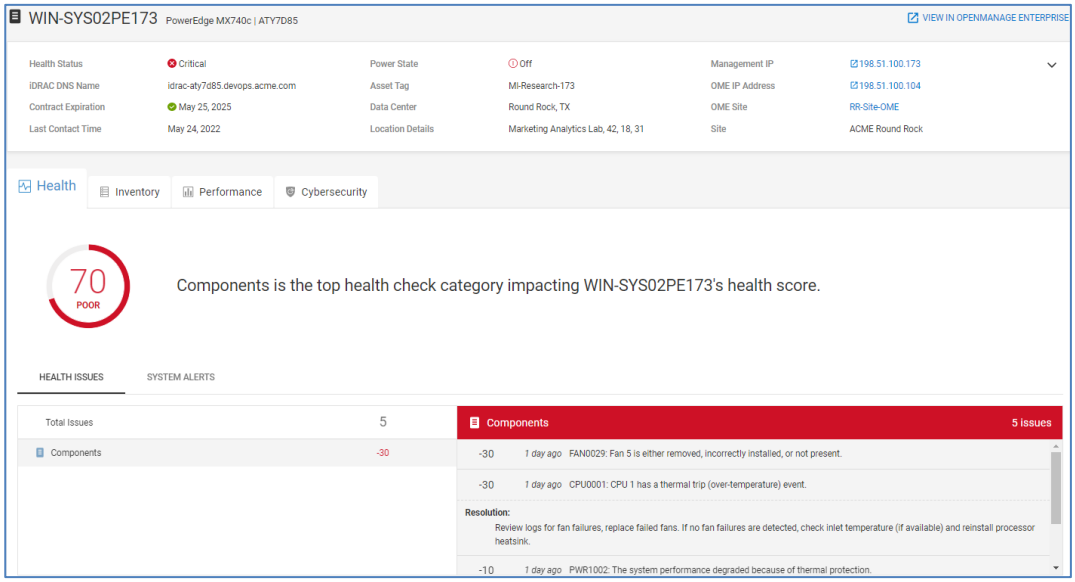
Servers

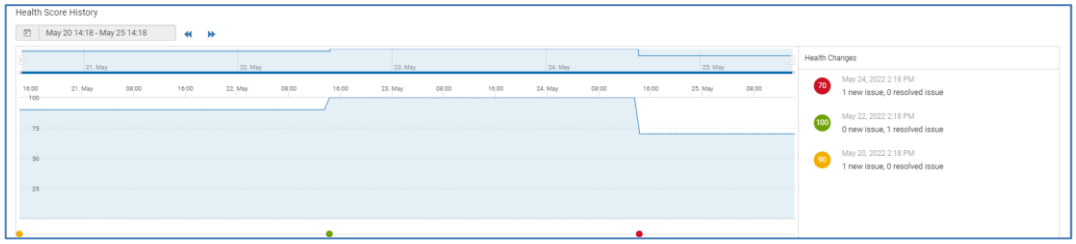
Introduction

CloudIQ supports the monitoring of PowerEdge servers through a plug-in to OpenManage Enterprise. The multisystem views for servers have been discussed earlier in this paper. This section documents the available information in the system details page for a PowerEdge server. Each server has the Health Score, Inventory, and Performance tab. Each tab provides a link to view the server in OpenManage Enterprise. The details of each tab are presented in the following sections.

PowerEdge System Details – Health

CloudIQ provides the Proactive Health Score for each server monitored by CloudIQ. Only the Components category is used to calculate the health score for servers. As with other systems, each health issue identified in CloudIQ has a corresponding recommended remediation. The Health Score History is tracked at the bottom of the page to help identify recurring issues.

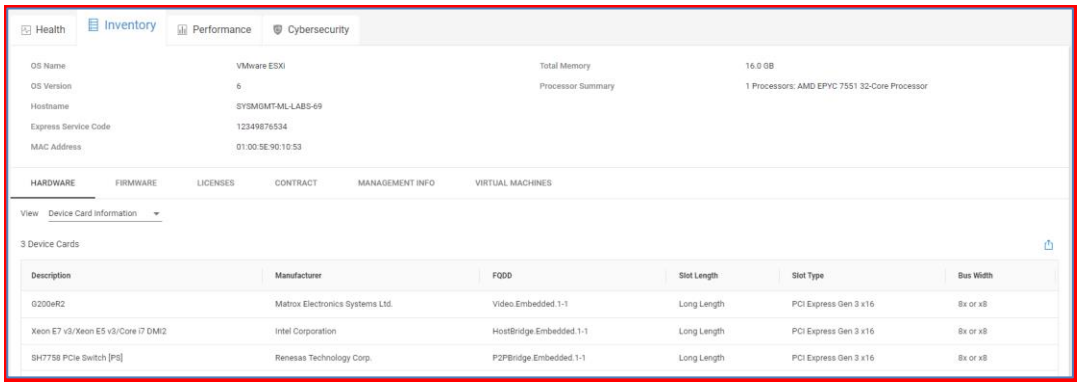




PowerEdge System Details – Inventory

The **Inventory** page provides configuration, firmware, contract, and license information for the server. The top half of Inventory provides various attributes about the server including operating system name and version, memory and CPU information, and Chassis information.

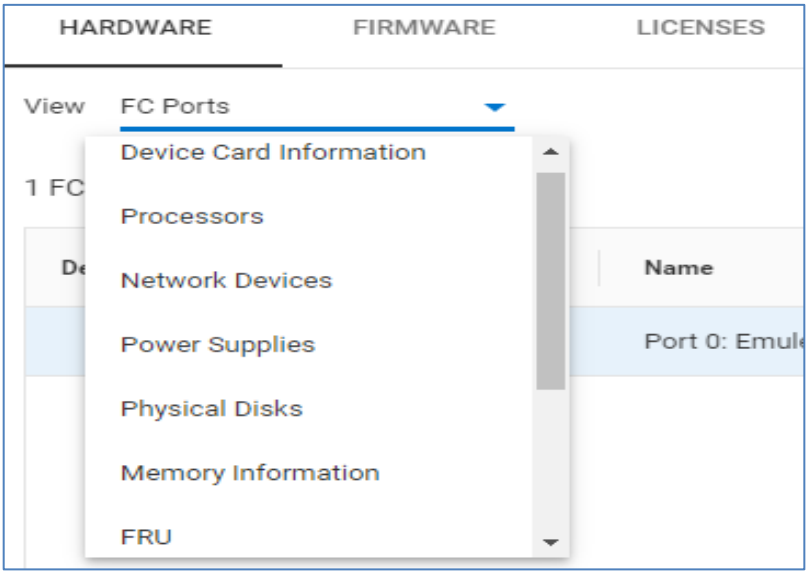
The bottom of the page has the following tabs: Hardware, Firmware, Licenses, Contract, and Management Info. A Virtual Machines tab is available and populated for servers running ESXi. Virtual machine information requires discovery of vCenter using the CloudIQ Collector. See Appendix A: Enabling CloudIQ at the system for additional details.



Hardware

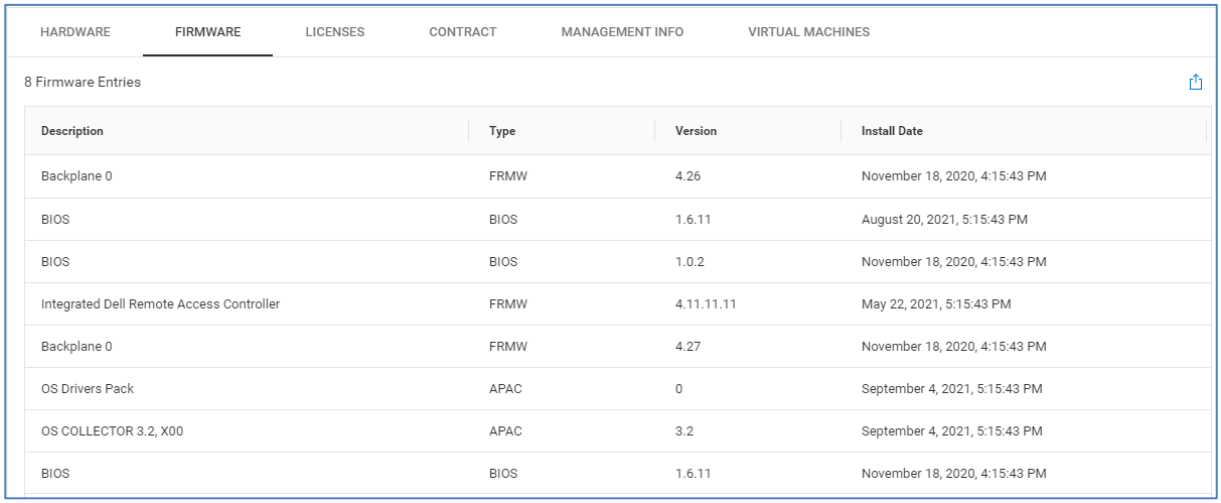
The **Hardware** tab has an additional drop-down menu to view information for the following components:

- Device Card Information
- Processors
- Network Devices
- Power Supplies
- Physical Disks
- Memory Information
- FRU
- Virtual Flash
- Storage Enclosures
- Storage Controllers
- FC Ports



Firmware

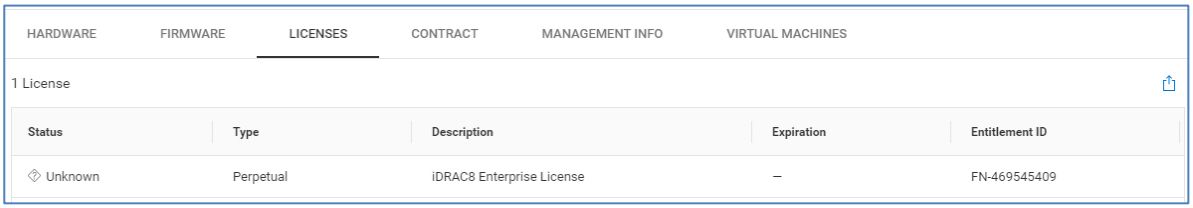
The **Firmware** tab lists out BIOS and Firmware versions and the installation date.



Description	Type	Version	Install Date
Backplane 0	FRMW	4.26	November 18, 2020, 4:15:43 PM
BIOS	BIOS	1.6.11	August 20, 2021, 5:15:43 PM
BIOS	BIOS	1.0.2	November 18, 2020, 4:15:43 PM
Integrated Dell Remote Access Controller	FRMW	4.11.11.11	May 22, 2021, 5:15:43 PM
Backplane 0	FRMW	4.27	November 18, 2020, 4:15:43 PM
OS Drivers Pack	APAC	0	September 4, 2021, 5:15:43 PM
OS COLLECTOR 3.2, X00	APAC	3.2	September 4, 2021, 5:15:43 PM
BIOS	BIOS	1.6.11	November 18, 2020, 4:15:43 PM

Licenses

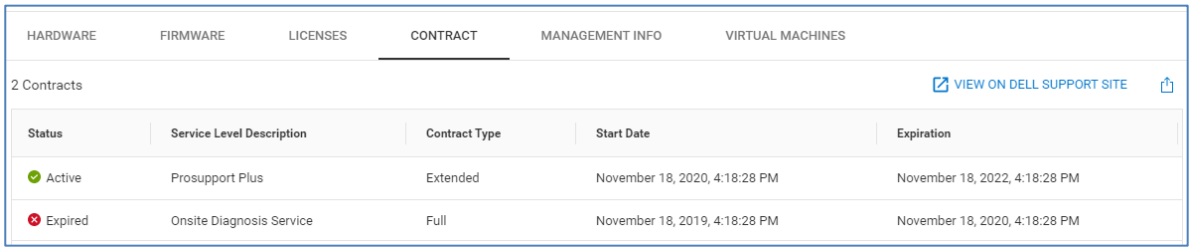
The **Licenses** tab shows various information about the license including the status, the license type (perpetual or evaluation), a description, license expiration (for evaluation licenses), and the Entitlement ID.



Status	Type	Description	Expiration	Entitlement ID
Unknown	Perpetual	iDRAC8 Enterprise License	–	FN-469545409

Contract

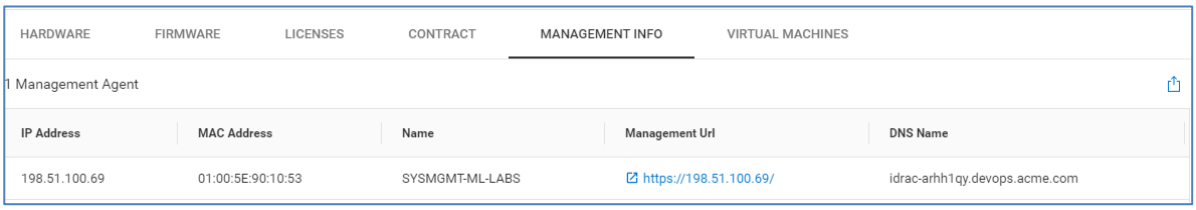
The **Contract** tab shows support contract information. This includes Status, a description, the contract type, and start and end dates.



Status	Service Level Description	Contract Type	Start Date	Expiration
Active	Prosupport Plus	Extended	November 18, 2020, 4:18:28 PM	November 18, 2022, 4:18:28 PM
Expired	Onsite Diagnosis Service	Full	November 18, 2019, 4:18:28 PM	November 18, 2020, 4:18:28 PM

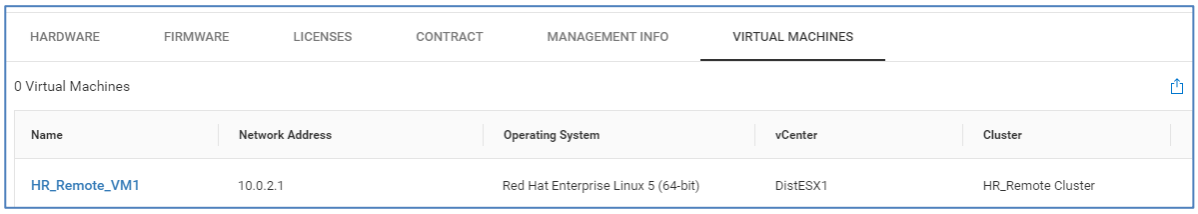
Management Info

The **Management Info** tab provides the IP Address, MAC Address, Name, and DNS Name of the iDRAC. There is also a hyperlink to launch the iDRAC management URL so that users can quickly go to the iDRAC and perform any necessary remote management tasks.



Virtual Machines

The **Virtual Machines** tab is visible for servers running ESXi and lists out various information about each VM including name, IP address, operating system, vCenter name, and ESXi Cluster.

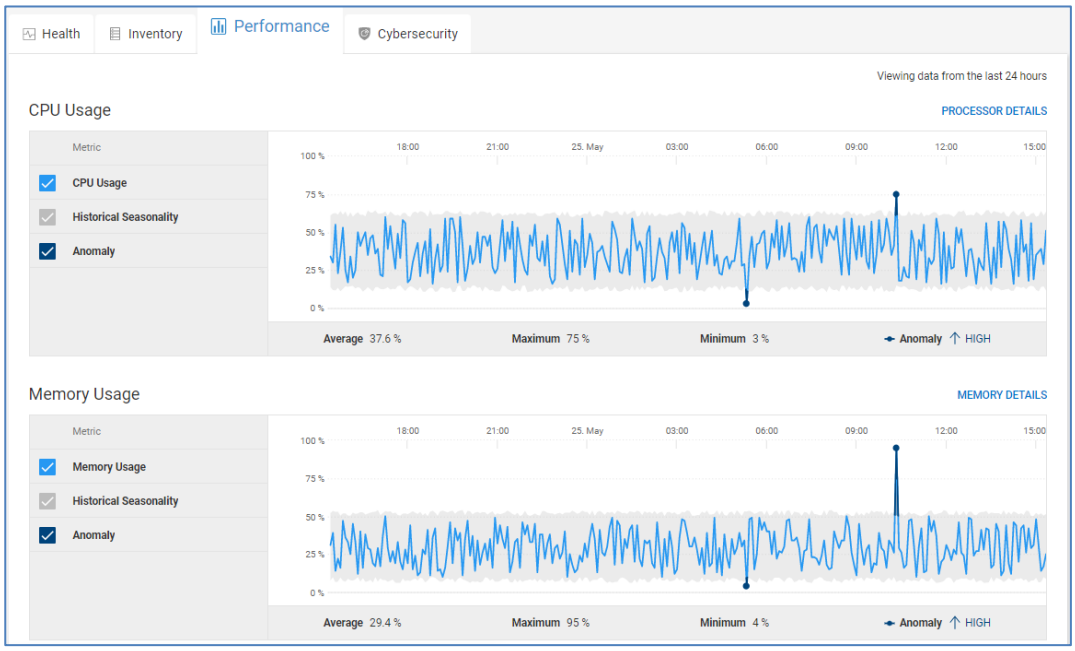


PowerEdge System Details – Performance

The **Performance** tab provides 24-hour charts for key performance metrics including:

- CPU Usage
- Memory Usage
- SYS Usage
- System Board IO Usage
- CPU Temperature
- System Inlet Temperature
- System Net Airflow
- Power Consumption

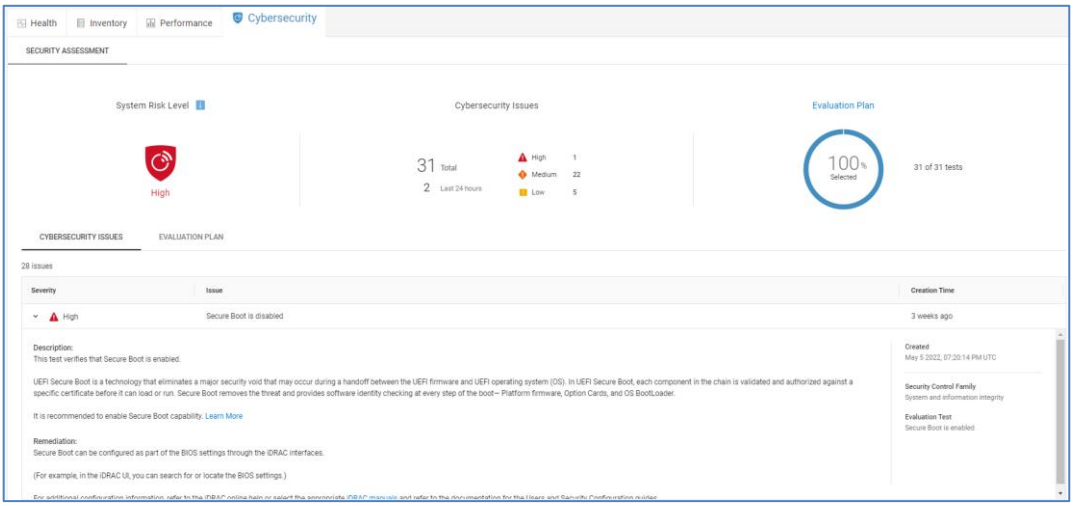
Each chart provides the average, minimum and maximum values of the metric during the time period. Performance anomalies are highlighted in the charts as dark blue shaded areas. An example of the CPU and Memory Usage chart is shown below.



Note: Available metrics vary based on license type, hardware, and firmware levels. See the CloudIQ section of the OpenManage Portfolio Software Licensing Guide for additional details.

Cybersecurity

The **Cybersecurity** tab is available for PowerEdge systems that have cybersecurity collections enabled in OpenManage Enterprise. It provides the risk level of the system, a summary of the cybersecurity issues and severities, and a chart showing the percentage of enabled tests in the evaluation plan. There are two tabs at the bottom of the screen: Cybersecurity Issues and Evaluation Plan. The Cybersecurity Issues tab lists the active issues along with the recommended remediation and the time the issue was identified.

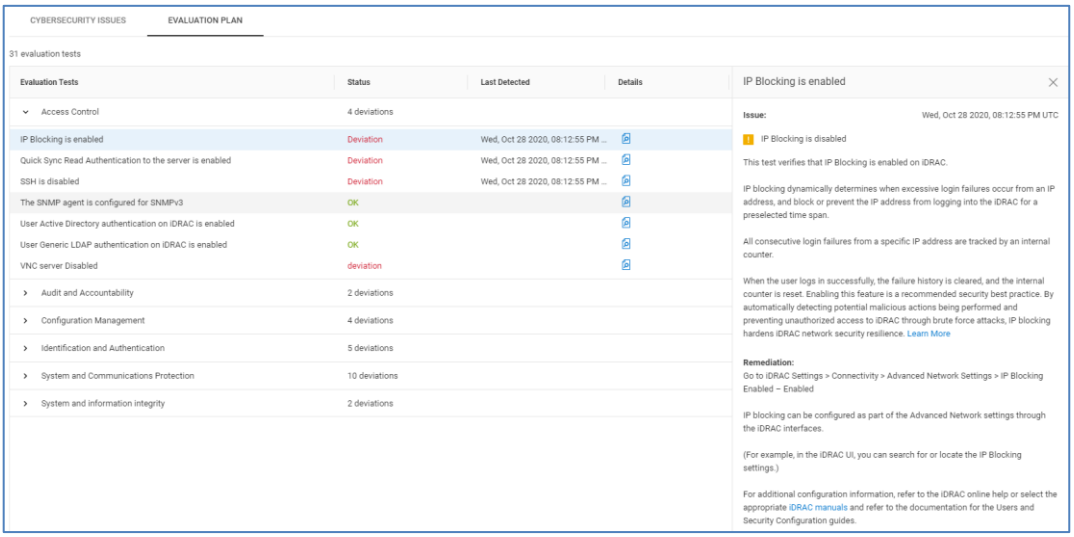


The Evaluation Plan tab lists the possible tests and the status of each test:

- Not in Plan: The test is not enabled.
- Deviation: The test is enabled, and there is an active issue.

- OK: The test is enabled, and there are no active issues.

The Details icon shows the test description, and in instances where there is an active deviation, it shows the recommended remediation.



Data protection

Introduction

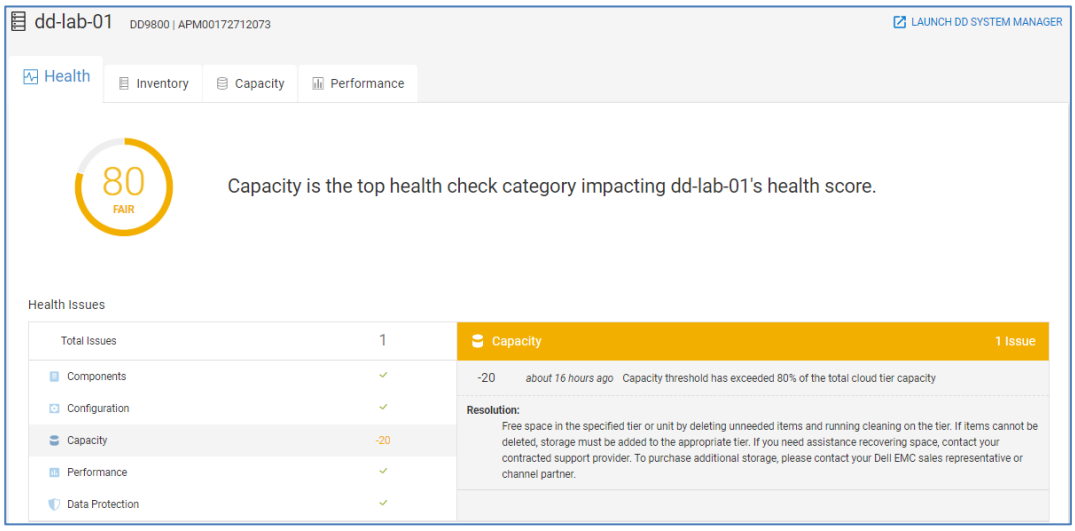
CloudIQ has added the ability to monitor PowerProtect DD backup storage systems and PowerProtect Data Manager. This section describes the current use cases for each.

PowerProtect DD

There are four tabs available on the system details page for PowerProtect DD: Health, Inventory, Capacity, and Performance. The “Launch DD System Manager” hyperlink is available on each tab to allow users to quickly go to the element manager in circumstances where additional detailed information is needed. The details available in each tab are presented below.

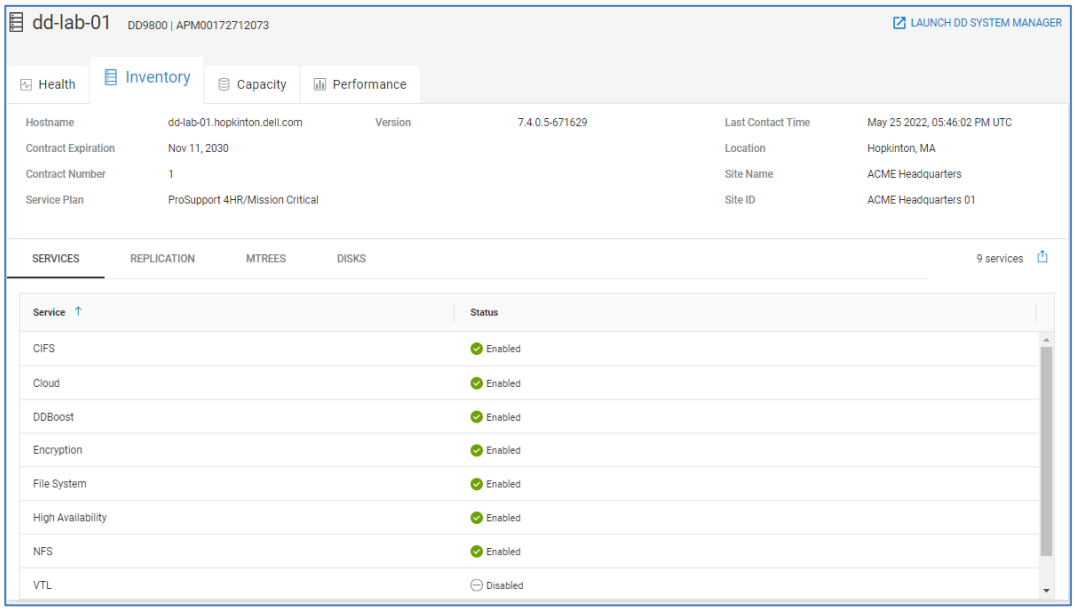
PowerProtect DD System Details – Health

All five categories are supported for determining the health score of each DD system. As with all other systems, each issue has a recommended resolution and the health score history is available at the bottom of the page.



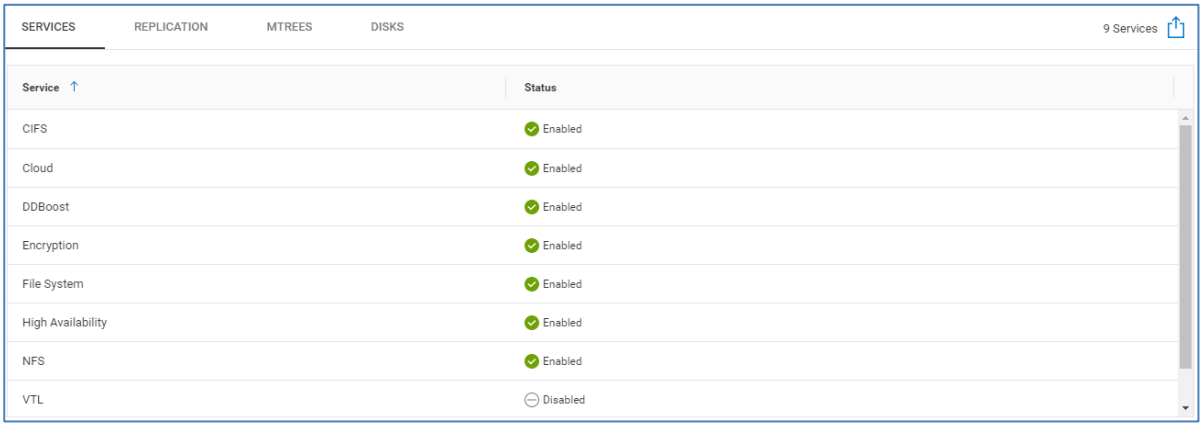
PowerProtect DD System Details – Inventory

The top portion of the **Inventory** tab provides various attributes including the serial number, model, site, location, version, and contract information. The bottom of the page contains the following tabs: Services, Replication, MTrees, and Disks. Each tab is discussed below.



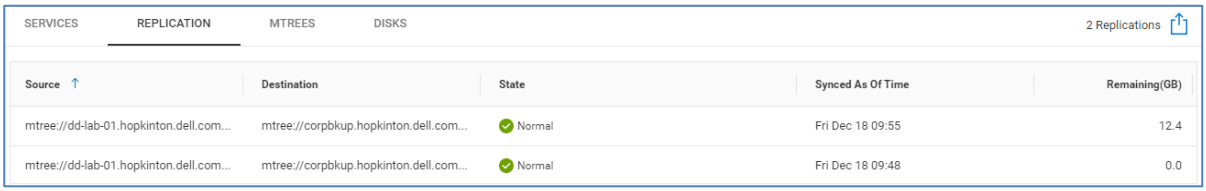
Services

The **Services** tab provides a listing of the various services running on the system along with their status.



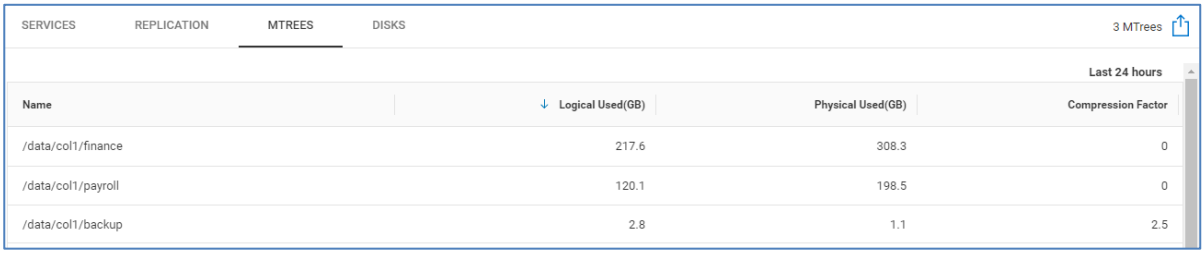
Replication

The **Replication** tab provides a listing and status of the replication sessions on the system. This information includes the source and destination, the state, the time of the last sync, and amount of remaining data to replicate from the source to the destination.



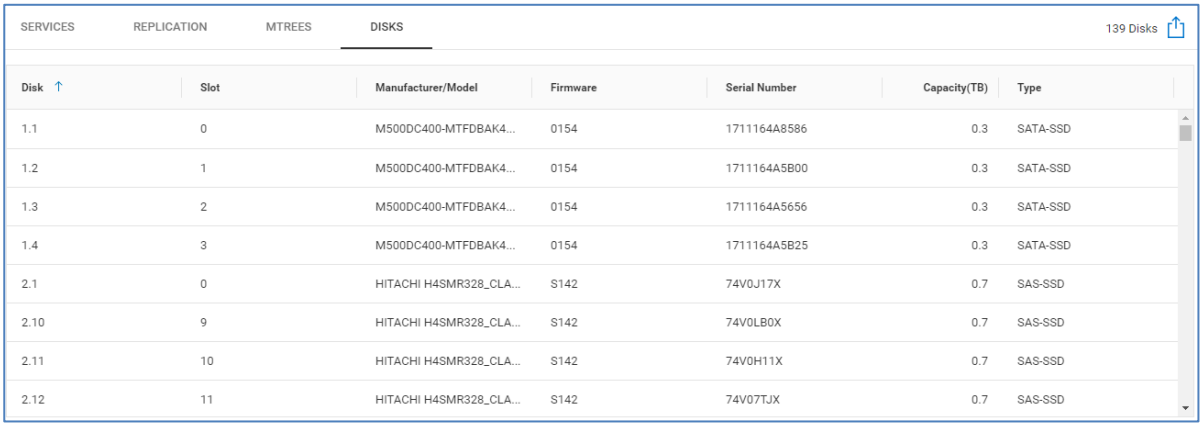
MTrees

The **MTrees** tab lists each of the configured MTrees, Storage Units, Virtual Tape Library (VTL) Pools, and so on, with the logical used, physical used, and compression factor for the last 24 hours.



Disks

The final tab is the **Disks** tab. Each disk is listed with its slot, model, firmware, serial number, capacity, and type.

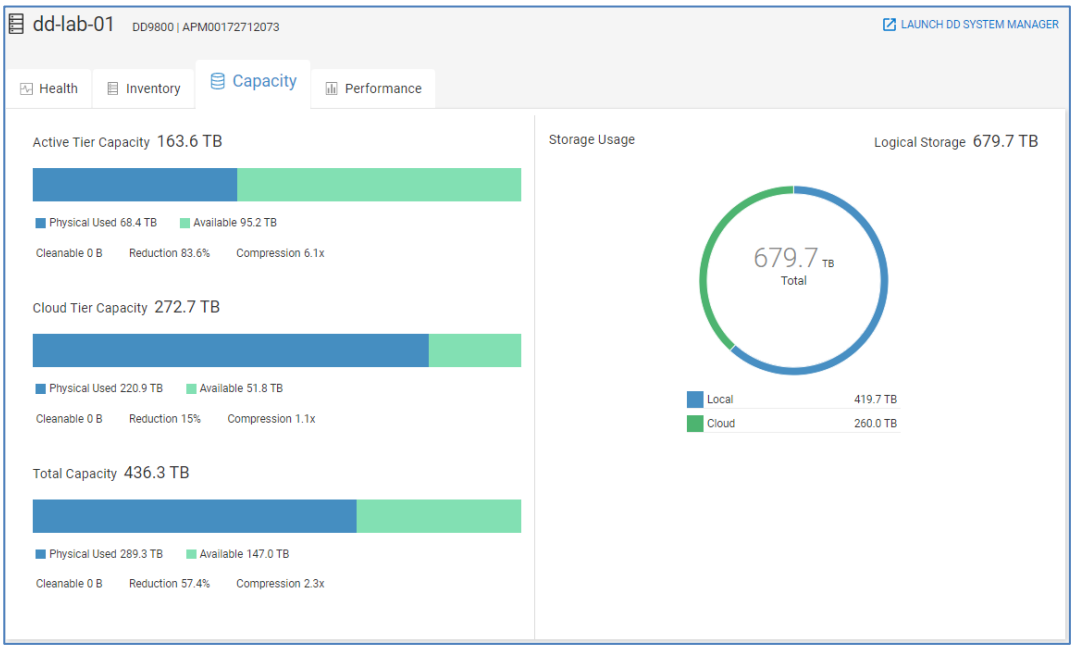


Disk	Slot	Manufacturer/Model	Firmware	Serial Number	Capacity(TB)	Type
1.1	0	M500DC400-MTFDBAK4...	0154	1711164A8586	0.3	SATA-SSD
1.2	1	M500DC400-MTFDBAK4...	0154	1711164A5B00	0.3	SATA-SSD
1.3	2	M500DC400-MTFDBAK4...	0154	1711164A5656	0.3	SATA-SSD
1.4	3	M500DC400-MTFDBAK4...	0154	1711164A5B25	0.3	SATA-SSD
2.1	0	HITACHI H4SMR328_CLA...	S142	74V0J17X	0.7	SAS-SSD
2.10	9	HITACHI H4SMR328_CLA...	S142	74V0LB0X	0.7	SAS-SSD
2.11	10	HITACHI H4SMR328_CLA...	S142	74V0H11X	0.7	SAS-SSD
2.12	11	HITACHI H4SMR328_CLA...	S142	74V07TJX	0.7	SAS-SSD

PowerProtect DD System Details – Capacity

The **Capacity** tab breaks down the physical and logical capacity on the DD system. The left side of the page displays horizontal bar charts for Active Tier and Cloud Tier Capacity. A third chart shows the total of active and cloud tier capacity. Each chart provides the total, used and free capacity. The amount of cleanable storage is also displayed as well as the reduction percentage and compression factor.

The right half of the page provides a doughnut chart of total logical storage broken down between local and cloud. This page allows users to gain insight into the capacity utilization on the system and savings due to reduction and compression.

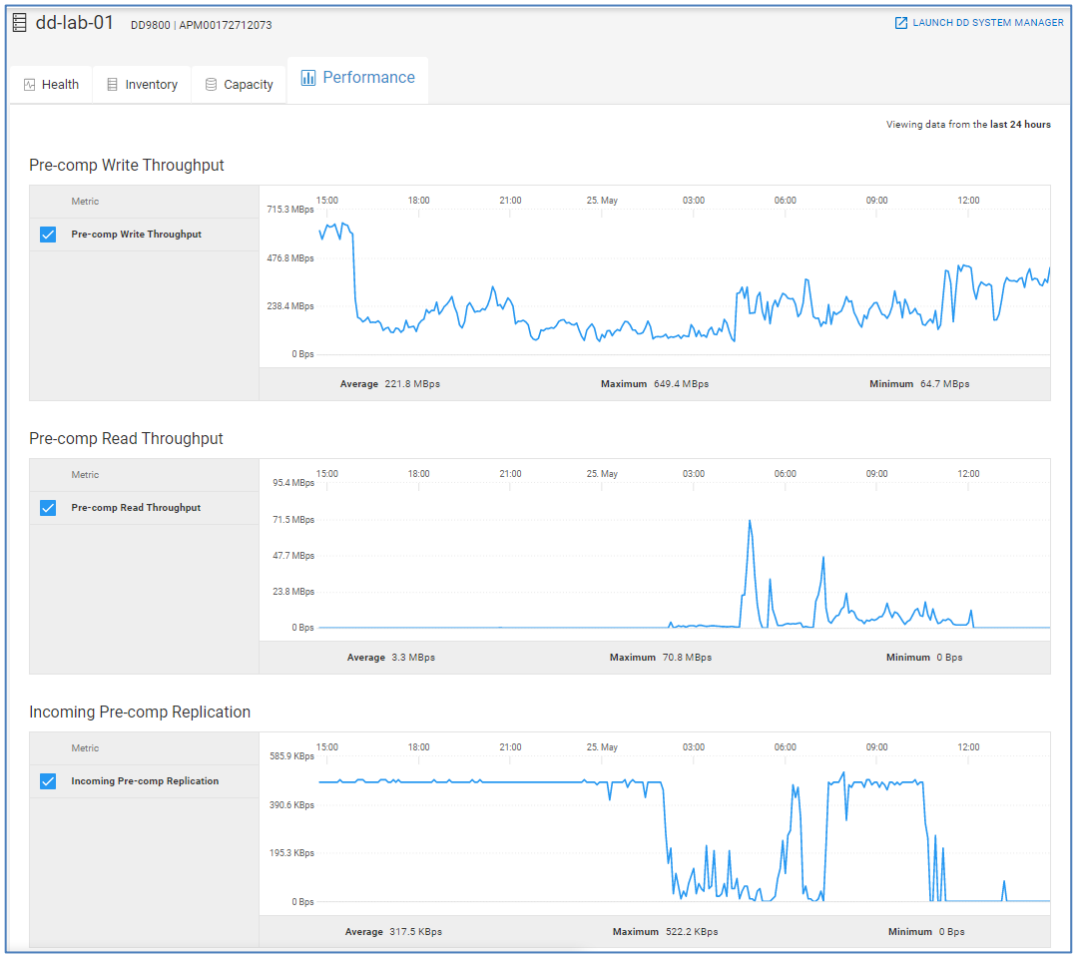


PowerProtect DD System Details – Performance

The Performance tab provides 24-hour performance charts for the following metrics:

- Pre-compressed Write Throughput
- Pre-compressed Read Throughput
- Incoming Pre-compressed Replication
- Outgoing Pre-compressed Replication
- CPU Usage
- Replication Streams Count (incoming and outgoing)
- Streams Count (reads and writes)

An example of the first few charts is shown below.



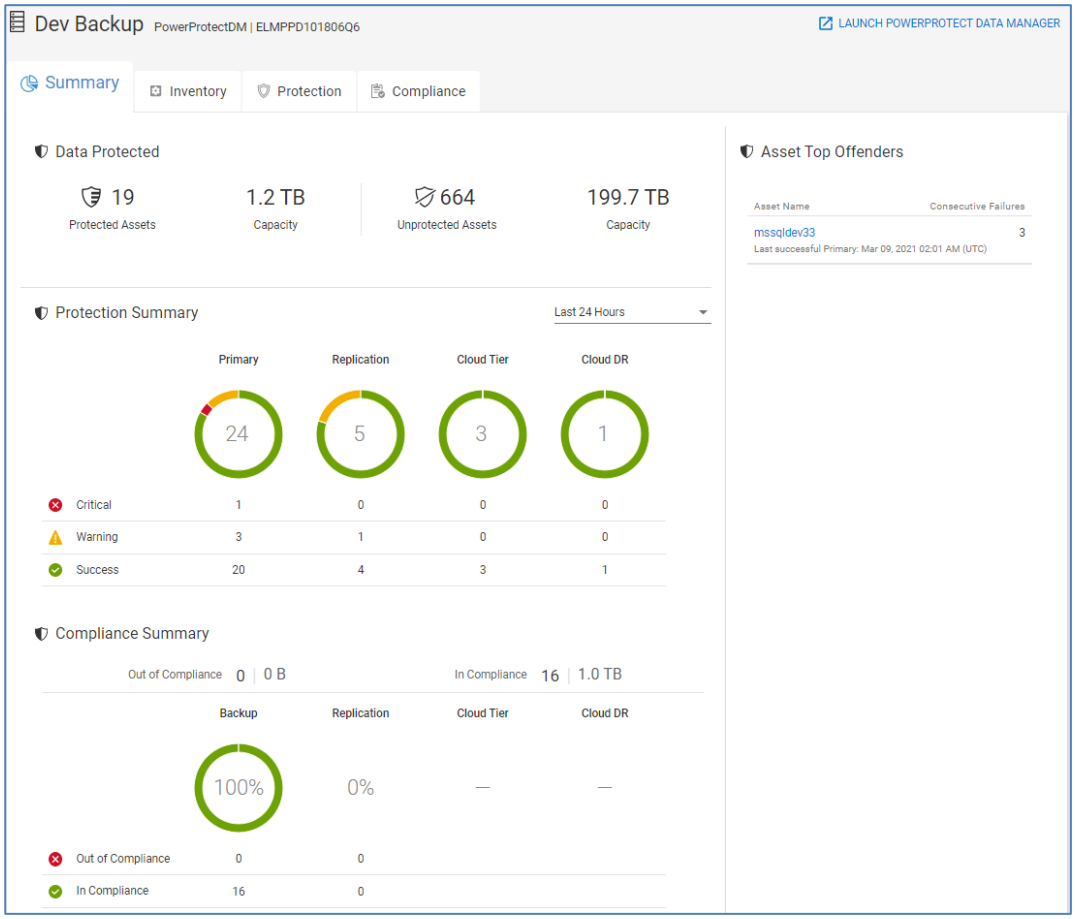
PowerProtect Data Manager

In addition to PowerProtect DD, CloudIQ can monitor instances of PowerProtect Data Manager. This allows users to see reports from Data Manager directly in the CloudIQ UI. We saw earlier that instances of PowerProtect Data Manager are displayed in Data Protection tab in the multisystem view for Inventory. Selecting an individual instance of

Data Manager directs the user to the details page which has four tabs: Summary, Inventory, Protection, and Compliance. Each tab is discussed below.

PowerProtect Data Manager Details – Summary

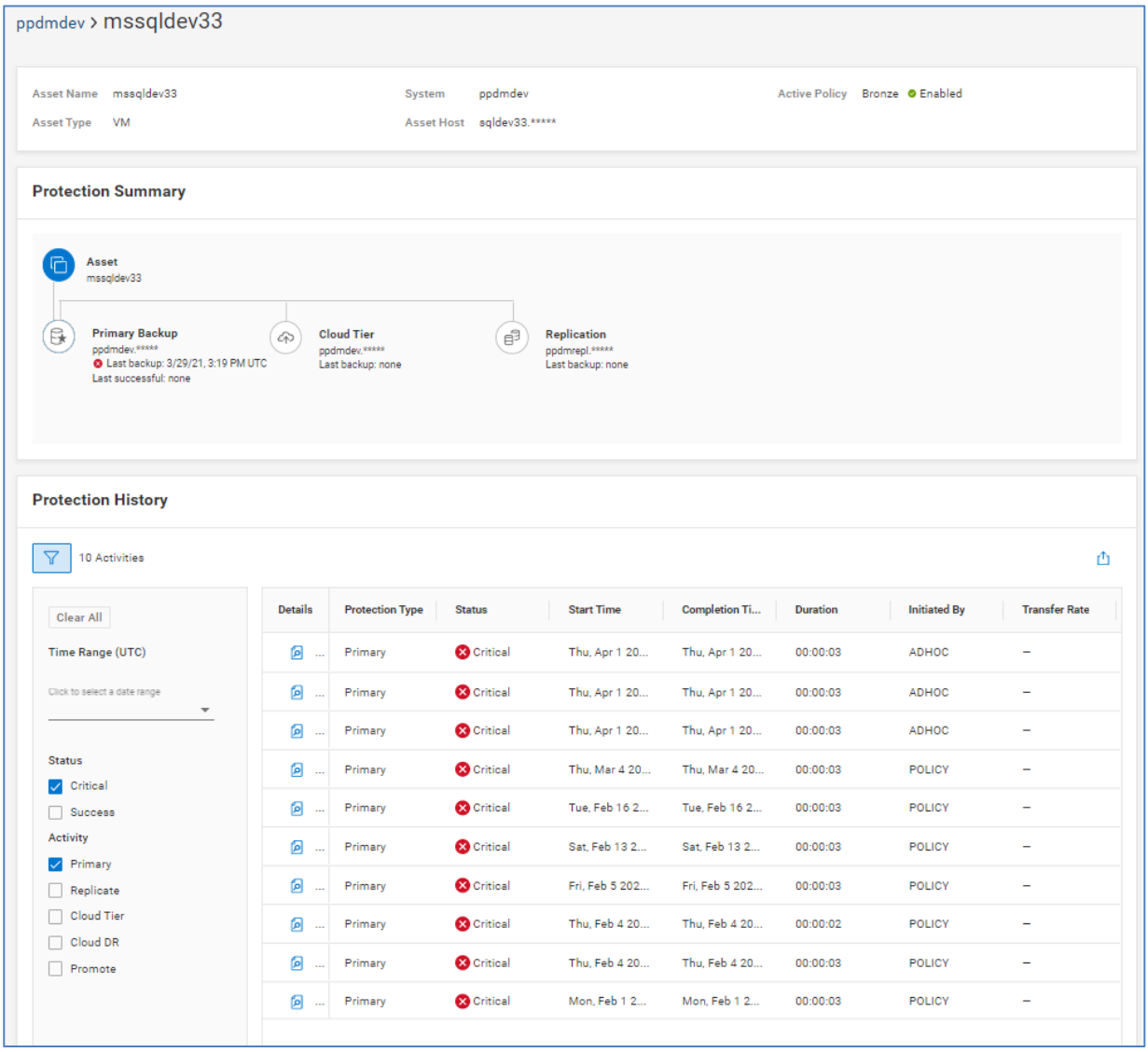
The Summary tab allows the user to quickly see status and resource information for the protection environment. The Data Protected section provides total amount of protected and unprotected assets with their capacity.



The Protection Summary section summarizes the number of assets that are protected within a specified time range. The last 24 hours is the default time range, but this can be changed to either last 3 days or last 7 days. The status is critical if all protection activities failed during the selected time range. Warning means that the asset has both failed and successful protection activities. Success means all protection activities completed successfully. The assets are grouped into one of the following four backup categories: Primary, Replication, Cloud Tier, and Cloud DR.

The Compliance Summary section displays the number and percentage of assets in each of the four backup categories that are in and out of compliance with their protection policy.

The Asset Top Offenders section lists those assets with the most consecutive failures. For those assets, a link to the asset details page is available. The asset details page shows the status of the last backup and the protection history of the asset. Users can filter the Protection History table by time range, status, or activity.

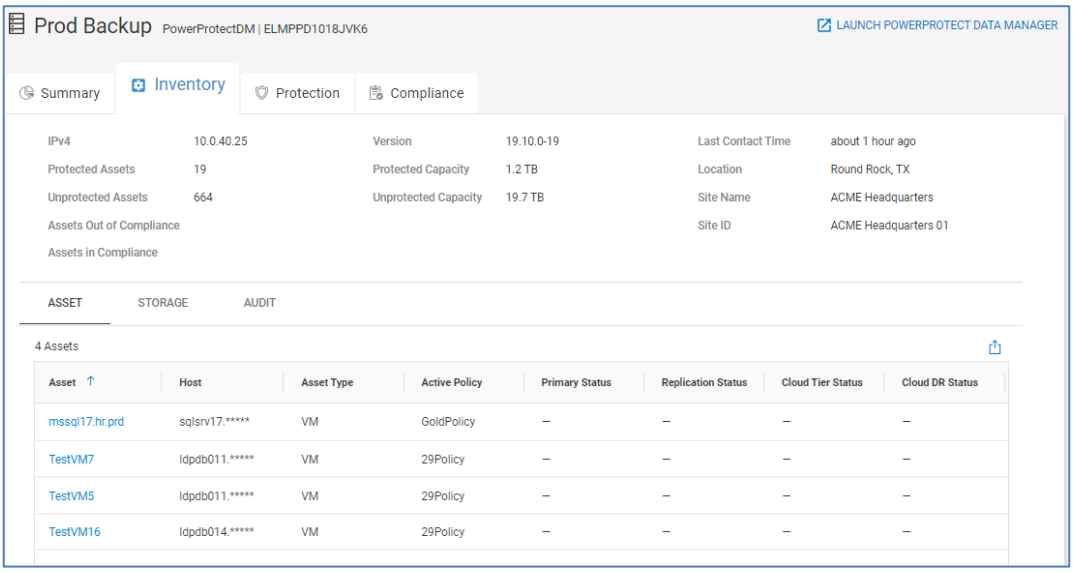

ppdmdev › mssqldev33
Asset Name mssqldev33
Asset Type VM
System ppdmdev
Asset Host sqldev33.*****
Active Policy Bronze Enabled
Protection Summary
Asset
mssqldev33
Primary Backup
ppdmdev.*****
Last backup: 3/29/21, 3:19 PM UTC
Last successful: none
Cloud Tier
ppdmdev.*****
Last backup: none
Replication
ppdmrepl.*****
Last backup: none
Protection History
10 Activities
Clear All
Time Range (UTC)
Click to select a date range
Status
Critical
Success
Activity
Primary
Replicate
Cloud Tier
Cloud DR
Promote
Details
Protection Type
Status
Start Time
Completion Ti...
Duration
Initiated By
Transfer Rate
Primary Critical Thu, Apr 1 20... Thu, Apr 1 20... 00:00:03 ADHOC –
Primary Critical Thu, Apr 1 20... Thu, Apr 1 20... 00:00:03 ADHOC –
Primary Critical Thu, Apr 1 20... Thu, Apr 1 20... 00:00:03 ADHOC –
Primary Critical Thu, Mar 4 20... Thu, Mar 4 20... 00:00:03 POLICY –
Primary Critical Tue, Feb 16 2... Tue, Feb 16 2... 00:00:03 POLICY –
Primary Critical Sat, Feb 13 2... Sat, Feb 13 2... 00:00:03 POLICY –
Primary Critical Fri, Feb 5 202... Fri, Feb 5 202... 00:00:03 POLICY –
Primary Critical Thu, Feb 4 20... Thu, Feb 4 20... 00:00:02 POLICY –
Primary Critical Thu, Feb 4 20... Thu, Feb 4 20... 00:00:03 POLICY –
Primary Critical Mon, Feb 1 2... Mon, Feb 1 2... 00:00:03 POLICY –

PowerProtect Data Manager Details – Inventory

The Inventory tab shows various configuration information at the top of the page. The bottom of the page has three tabs: Asset, Storage, and Audit.

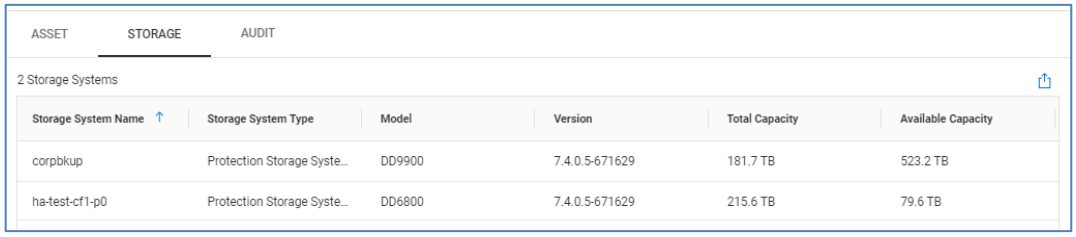
Asset

The Asset tab shows the assets discovered by PowerProtect Data Manager along with the host, asset type, active policy, and status of the most recent backup.



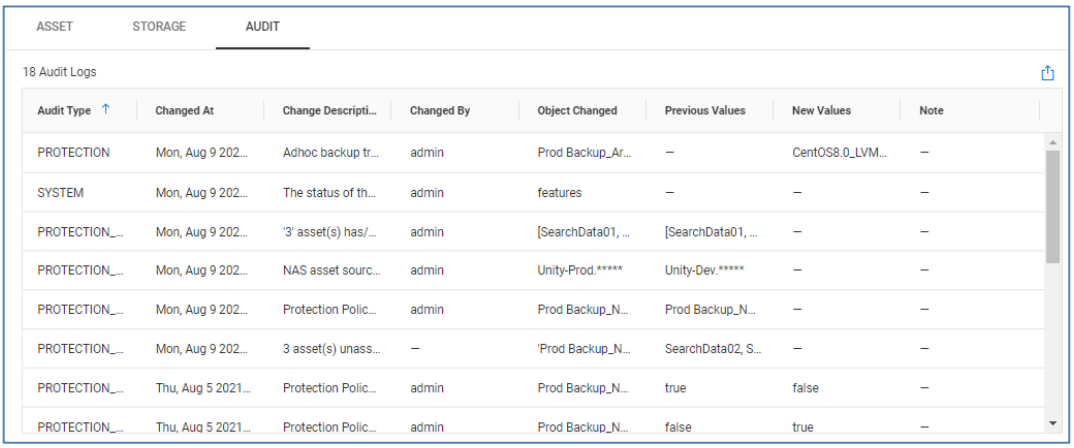
Storage

The Storage tab shows the storage systems available to PowerProtect Data Manager systems. The model and total and available capacity are listed for each system.



Audit

The Audit tab aggregates the audit information from each of the PowerProtect Data Manager systems. It provides a list of changes on the system, time of the change, the user that made the change, the changed object, and the old and new values.

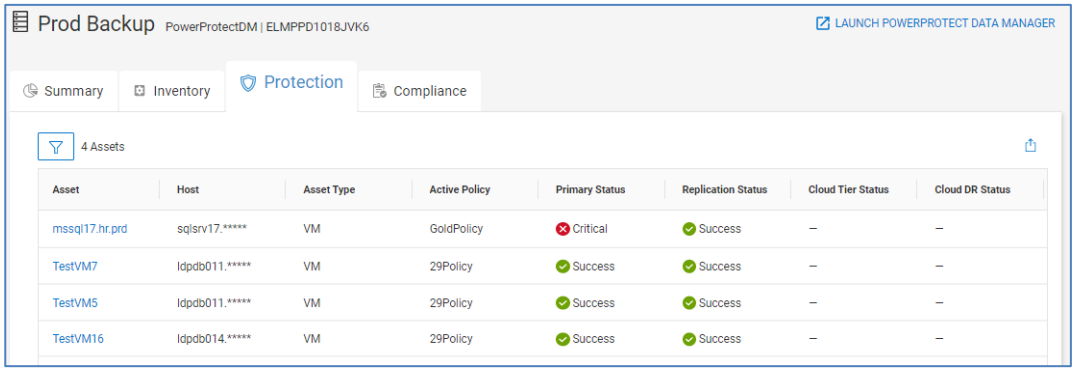


PowerProtect Data Manager Details – Protection

The Protection tab provides additional details of the protection status for each asset. This tab includes the following:

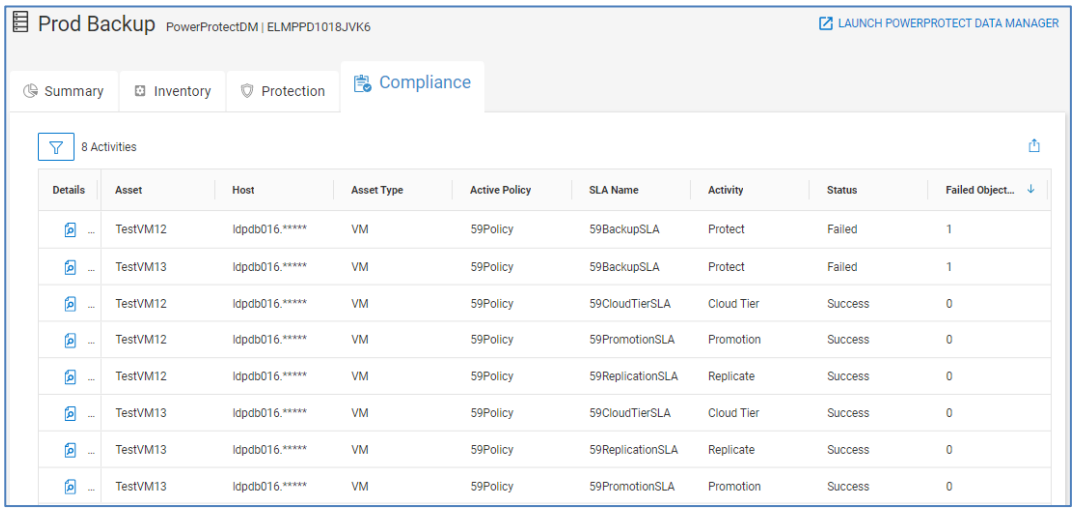
- Asset name and the host on which it is running
- Asset type (VM, Database, File System, VMAX Storage Group, or Kubernetes)
- Name of the active protection policy
- Status of each protection activity for the asset

A dash indicates that protection activity is not configured for the asset.



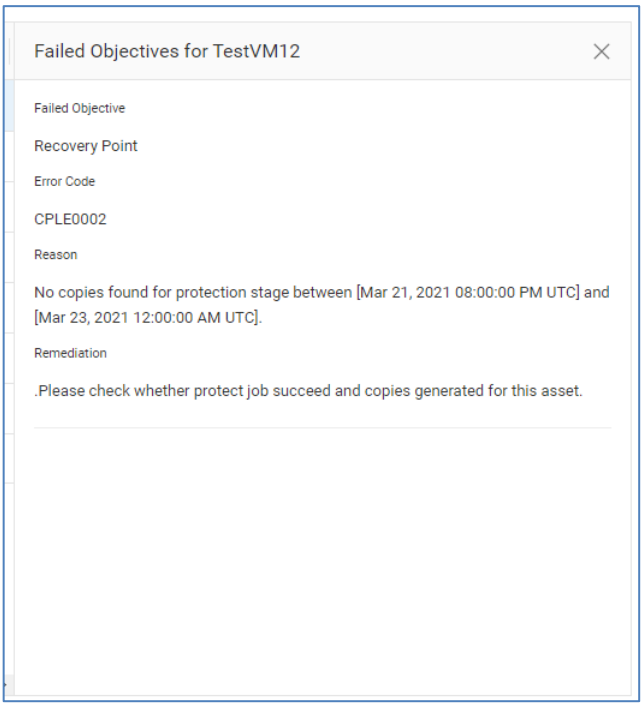
PowerProtect Data Manager Details – Compliance

The Compliance tab displays details of each asset's compliance for each configured activity to the defined service level agreements in the protection policy. This tab includes the asset name and the host on which it is running, the asset type, the active policy, SLA name, activity type, status, and the number of failed objectives.



Details	Asset	Host	Asset Type	Active Policy	SLA Name	Activity	Status	Failed Object...
...	TestVM12	ldpdb016.*****	VM	59Policy	59BackupSLA	Protect	Failed	1
...	TestVM13	ldpdb016.*****	VM	59Policy	59BackupSLA	Protect	Failed	1
...	TestVM12	ldpdb016.*****	VM	59Policy	59CloudTierSLA	Cloud Tier	Success	0
...	TestVM12	ldpdb016.*****	VM	59Policy	59PromotionSLA	Promotion	Success	0
...	TestVM12	ldpdb016.*****	VM	59Policy	59ReplicationSLA	Replicate	Success	0
...	TestVM13	ldpdb016.*****	VM	59Policy	59CloudTierSLA	Cloud Tier	Success	0
...	TestVM13	ldpdb016.*****	VM	59Policy	59ReplicationSLA	Replicate	Success	0
...	TestVM13	ldpdb016.*****	VM	59Policy	59PromotionSLA	Promotion	Success	0

For instances where there is a compliance failure, the Details button provides additional information. This information includes the failed objective, the error code, the reason, and remediation.



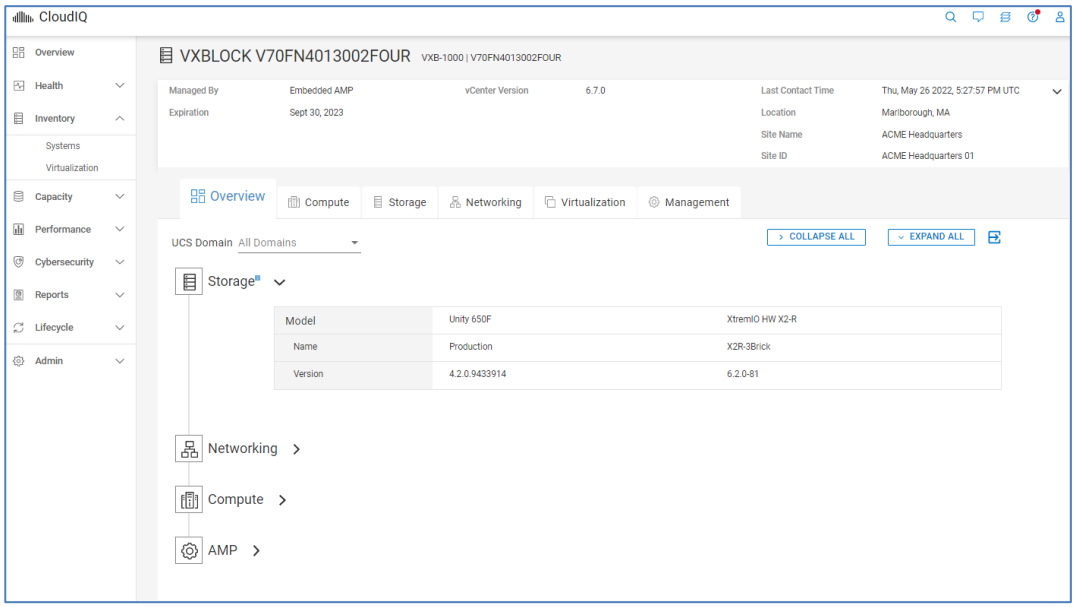
Converged System Details

Introduction

CloudIQ can monitor VBlock and VxBlock Converged Systems. Converged Systems component information is displayed in the Inventory multisystems view under the CONVERGED tab. The Lifecycle menu provides the various milestone dates for each of the components in the Converged System. Each of these areas is described in the following sections.

Converged Systems – Inventory

Selecting the system name hyperlink for the Converged System from the Inventory menu opens the system details page. The top of the system details page provides information similar to what is displayed in the multisystem view. The bottom of the page has six tabs: Overview, Compute, Storage, Networking, Virtualization, and Management for more detailed information.



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

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** – Details of the storage array, managed applications, and server profiles for the Advanced Management Pod (AMP).

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 and the number of UCS blade and rackmount 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 and 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 operating system 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.

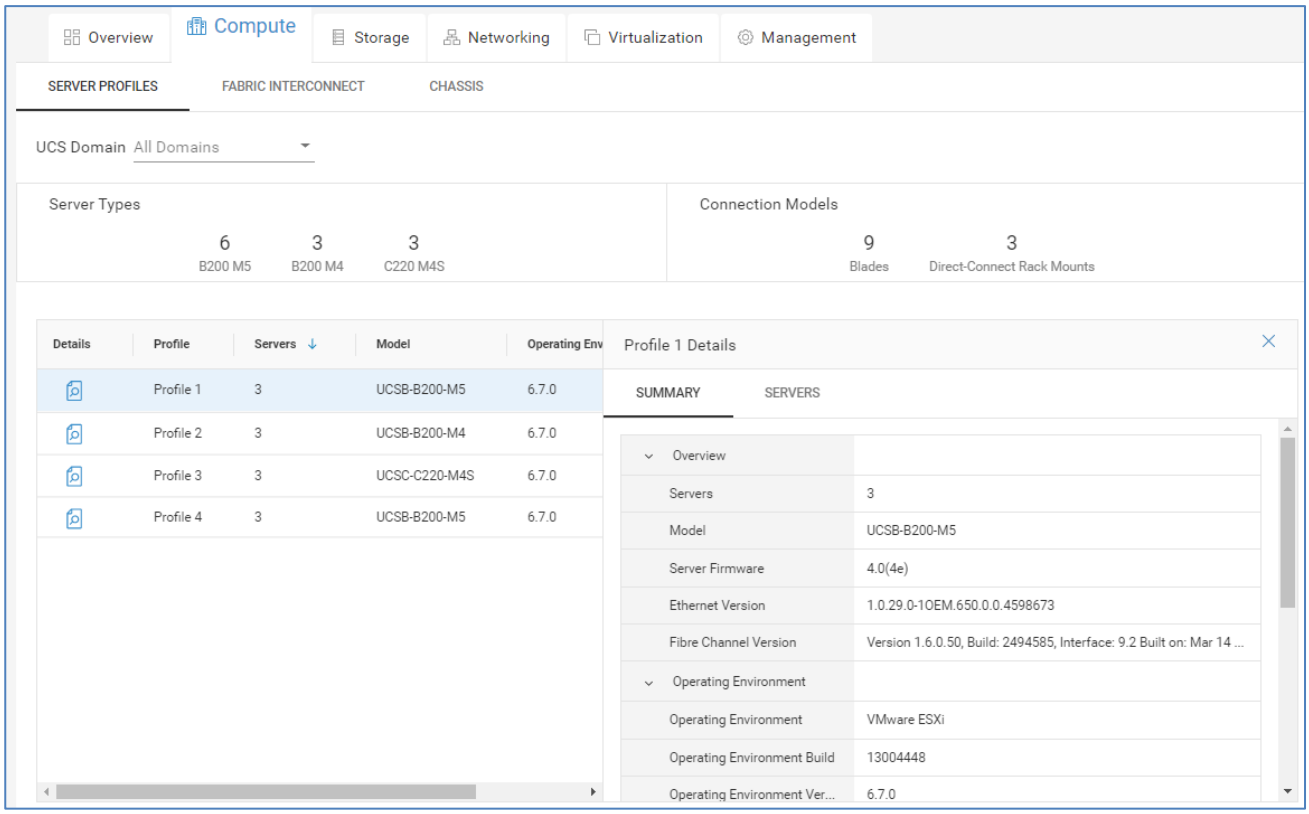
Chassis – Displays information about the UCS Chassis including the number of each type of UCS Blade servers and the number of used and available slots in the chassis. Also displays high-level chassis information including the UCS domain, chassis name, and serial number. The details of the chassis can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

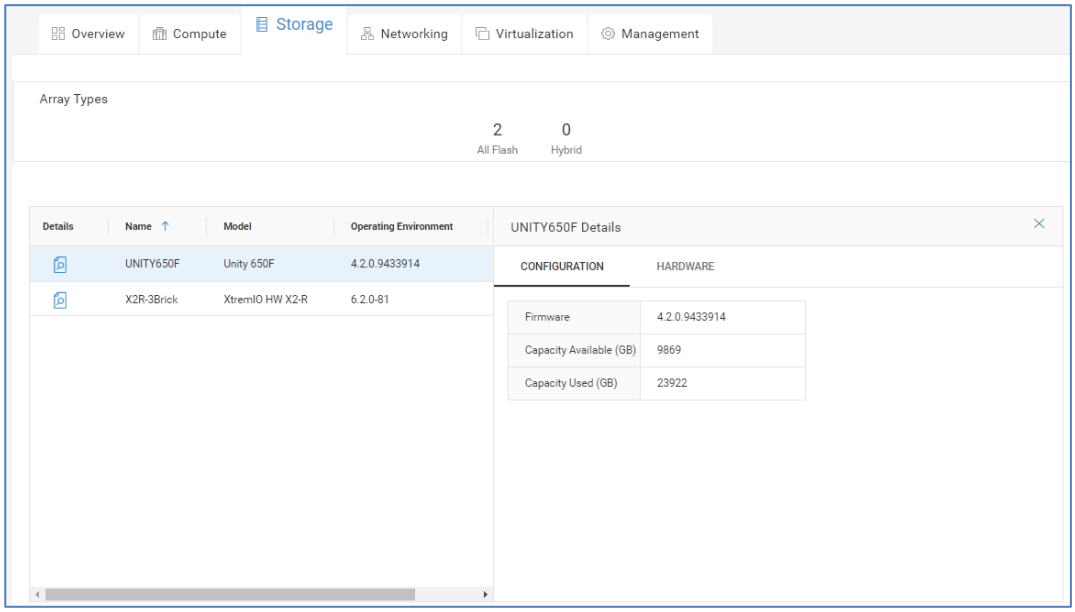
The following shows an example of the Server Profiles tab under Compute.



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 versions, firmware versions, and capacity information.
- **Hardware** – Listing of drive enclosures and disks.

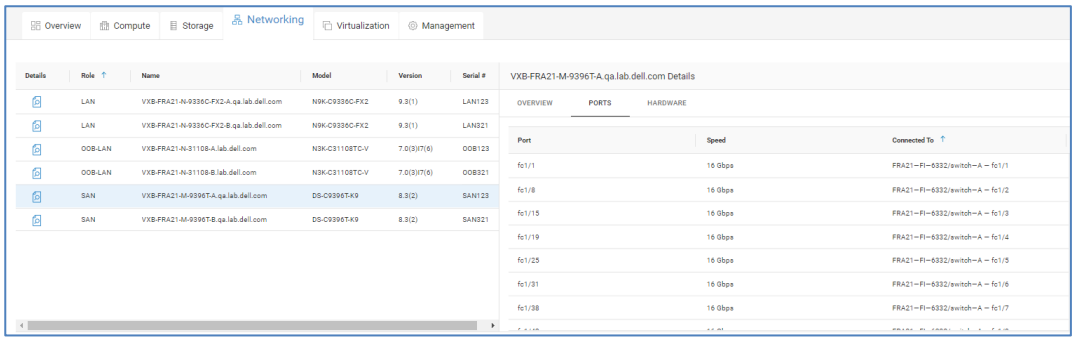


Networking

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, Ports, and Hardware.

- **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



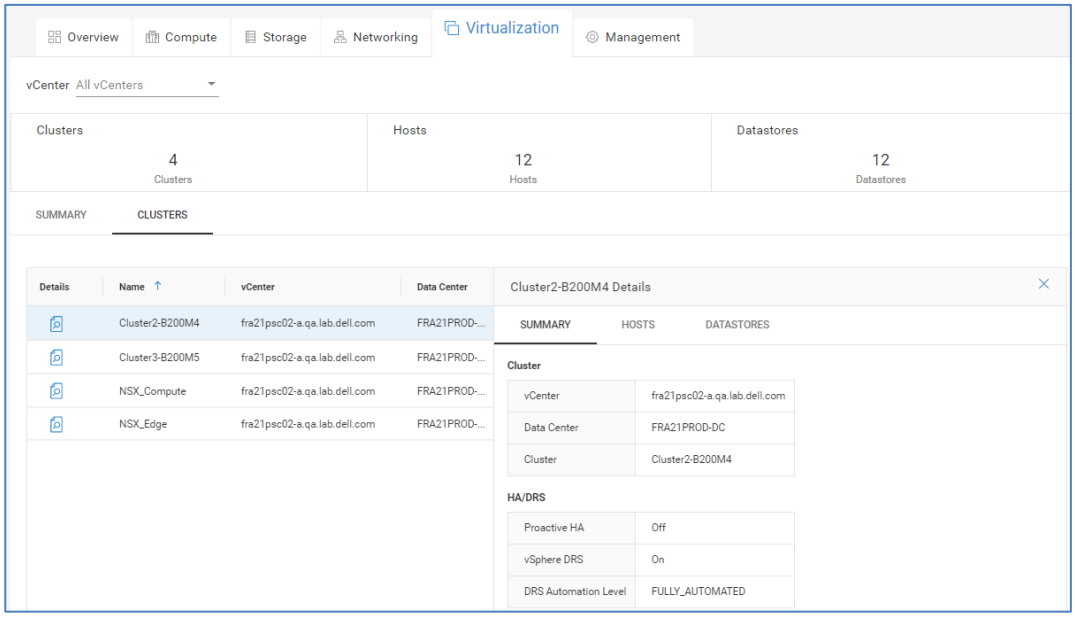
Virtualization

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, hosts, and 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 and the HA or 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.



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.

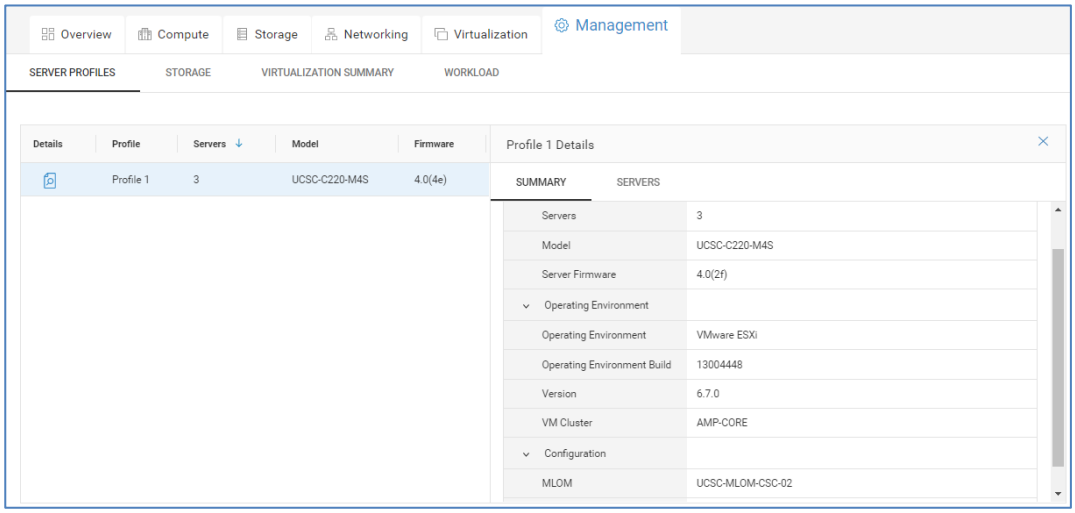
- Servers – Displays the serial number, hostname, and memory for each server in the server profile.

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 and total and free capacity.
- Hardware – Displays number of drive enclosures and disks.

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

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



Converged Systems – Milestones Outlook

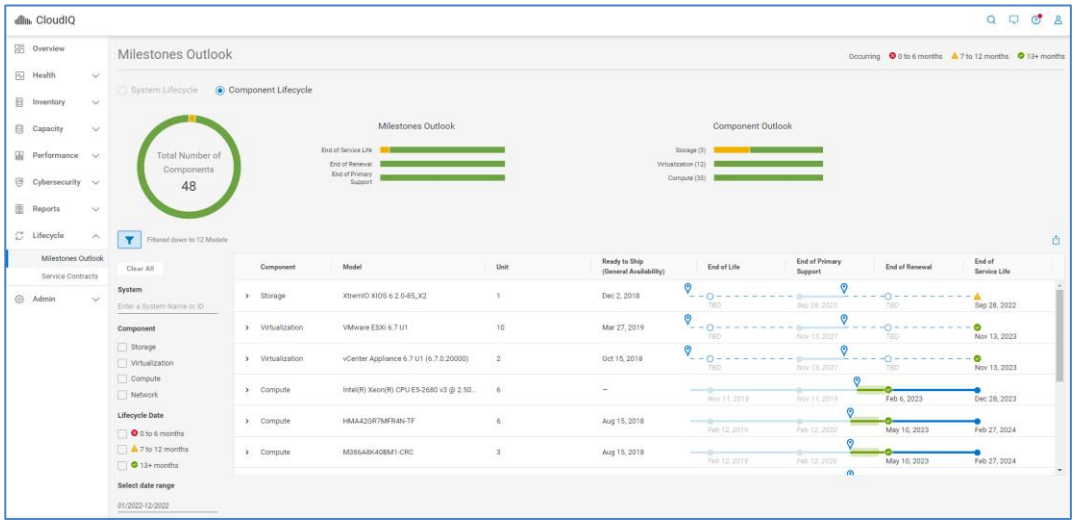
CloudIQ helps provide life-cycle support for the various components of a Converged System. The Milestones Outlook page lists out the various components that make up the Converged System and provides timelines with the following dates: General Availability, End of Life, End of Support Life, End of Renewal and End of Service Life.

The information provided in the timeline helps users to:

- Develop plans to order next generation of components to replace existing components reaching their end of service life date.
- Determine financial needs and budget for components that require replacement in the next 0-6, 7-12, or 12+ months.
- Schedule upgrades and hardware replacements during off peak hours that do not impact operations.

The top of the page provides a graphical representation of the total number of components and highlights in red the number of components reaching a milestone date within 6 months. The bottom of the page provides the timelines for each component. The Refine button allows the user to filter the information based on System Name or Component Type. It also allows the user to select from a predefined set of life-cycle dates

or enter a custom date range. For example, to see all components with a milestone date during 2022, enter a date range of 01/2022-12/2022 as shown below.

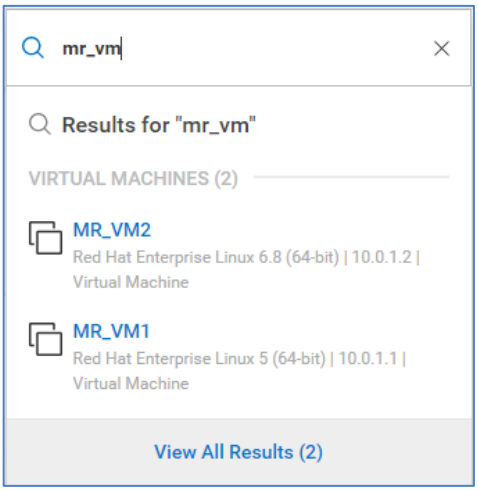


VMware details

Overview

CloudIQ supports integration with VMware environments. It uses a local collector that communicates to vCenter using a read-only privilege. The collector sends the data back to CloudIQ through the Secure Remote Services Gateway or Secure Connect Gateway.

Besides viewing VMs in the Virtual Machines tabs detailed earlier in this document, users can 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, operating system, and IP address. Selecting “View All Results” provides additional details including vCenter, ESXi, Datacenter, and ESXi Cluster.

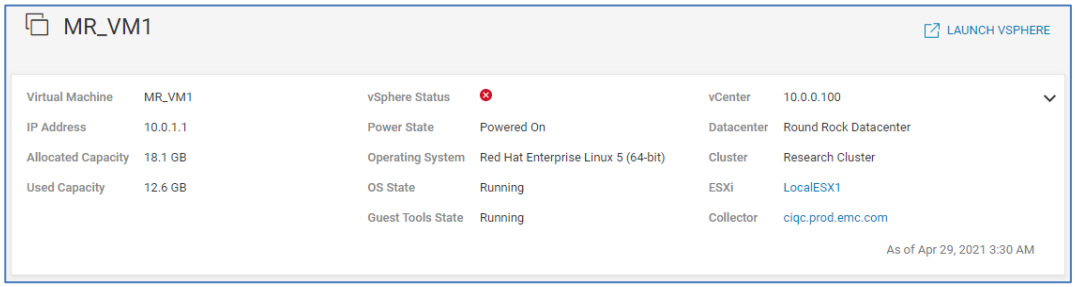
The search feature will find the following VM-related properties:

- VM name
- vCenter

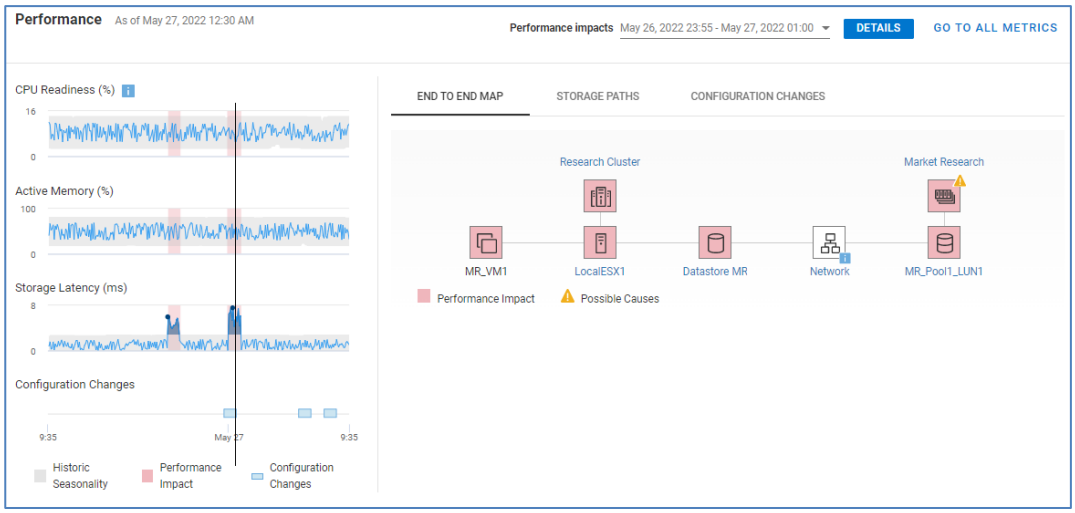
- ESXi Server
- ESXi Cluster
- Datacenter

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 the amount of storage allocated and used by the VM as well as vCenter and ESXi cluster information to understand where the VM resides. The downward pointing carat in the upper right of the window will minimize this section of the UI.



The bottom half of the page is dedicated to performance and storage path information. The left 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 identifies performance impacts on the storage latency chart with pink shading. There is also a 24-hour chart identifying configuration changes. Selecting a box along the horizontal axis opens a window with details of the configuration change. Selecting a point in the performance charts displays a window showing the values of the historic seasonality and actual value at the selected time.



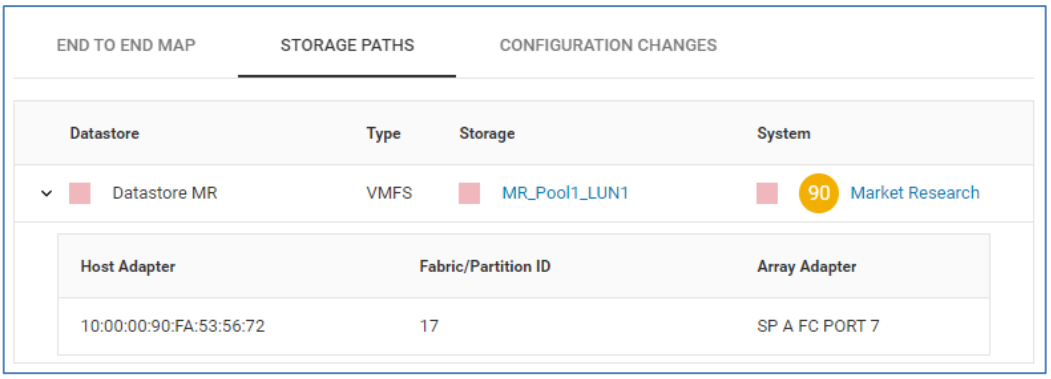
The right side of the window has three tabs: End to End Map, Storage Paths, and Configuration Changes.

End to End Map (shown above) – This tab is an interactive end-to-end map of the following items:

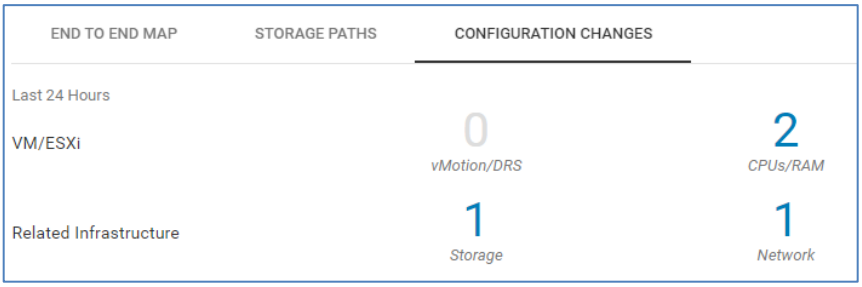
- Virtual machine
- ESXi Server
- ESXi Cluster
- Datastore
- Network
- Storage Object (LUN, volume or storage group)
- Storage System

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. Users can select a time of interest in the VM performance charts and then select various objects in the data path to view their corresponding performance metrics.

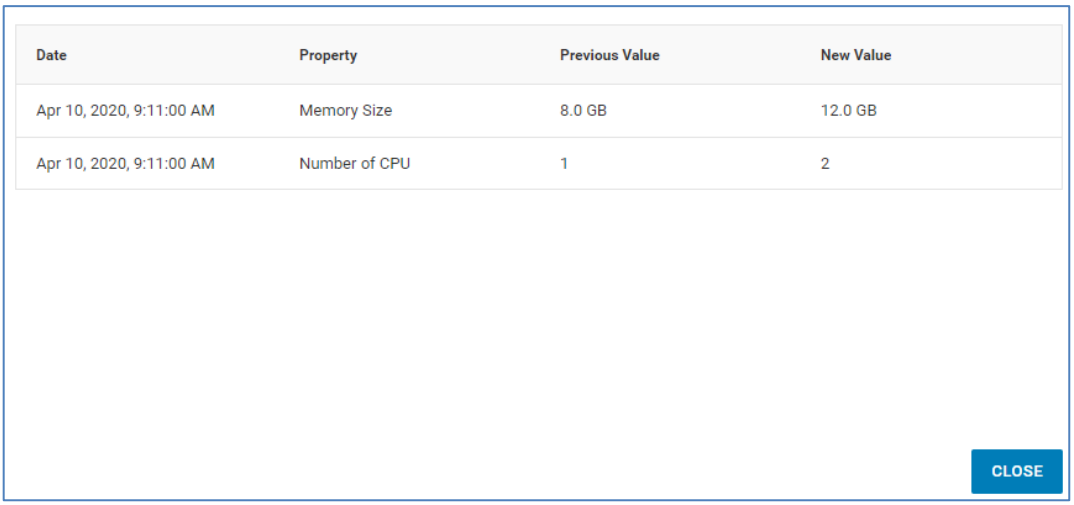
Storage Paths – This tab maps each datastore to the storage object (LUN, volume, or storage group) on each system. This information allows users to map different datastores to different storage objects. If a performance impact is selected in the performance charts, the impacted components are highlighted with a pink square.



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



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



Custom tags and reports

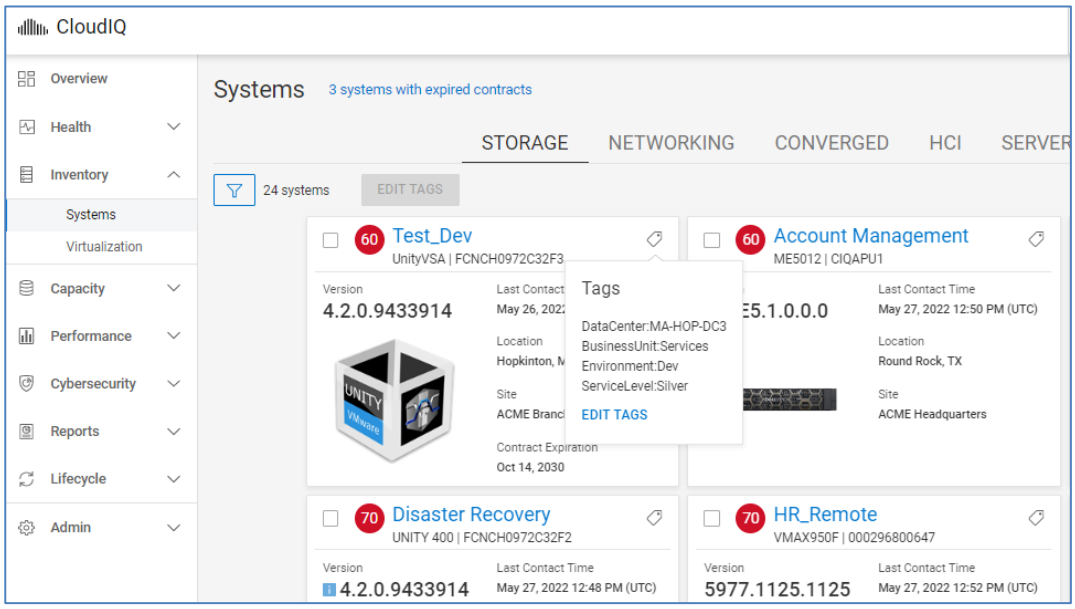
Introduction

Users can enhance the collected data in CloudIQ with customer-specific metadata called tags. Tags can be used to tag systems with business-specific data. Object level tags will be supported in the future. Tags are supported for Storage, SAN, and Hyperconverged systems and are entered as a Key:Value pair. For example, BusinessUnit:Engineering is a tag where BusinessUnit is the tag key and Engineering is the tag value.

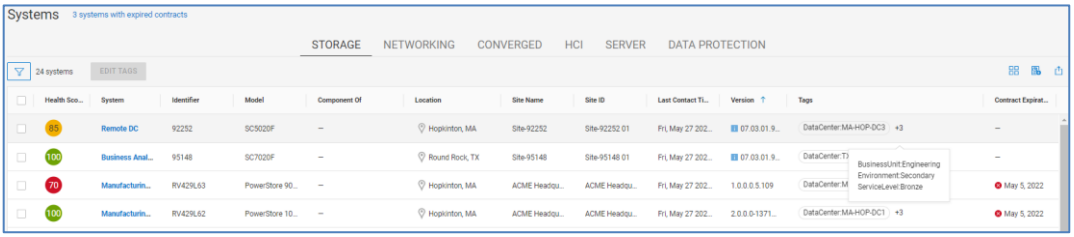
Users can also create custom reports in CloudIQ. A report can consist of a mixture of tables and line charts. Line charts are supported for those performance metrics available in the Metrics Browser. Integration between tags and reports is a key feature that will be delivered in the future. Reports can be manually exported or scheduled for automated delivery to a specified list of recipients.

Accessing tags

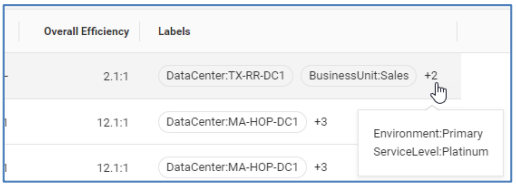
Tags are input and visible in any of the multisystem views. Once systems are tagged, views can be filtered based on one or more tags. The following figure shows the multisystem view for capacity for storage. By hovering over the tag icon in the top-right corner of each card, the user can see the defined tags for the system.



Users can also switch to the list view and see them under the **Tags** column.

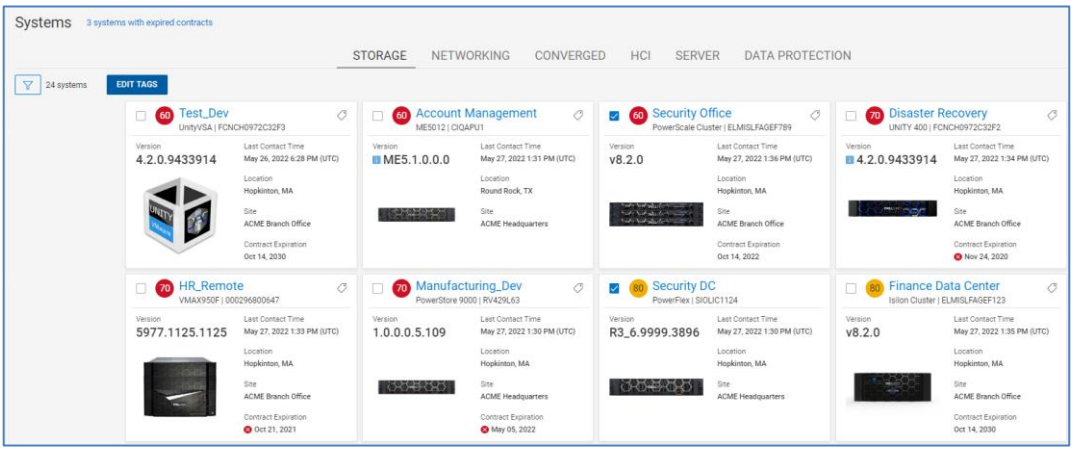


When the text in the Tags field exceeds the column width, a +X is shown where X is the additional number of tags defined for that system. To view the additional tags, hover over the +X.

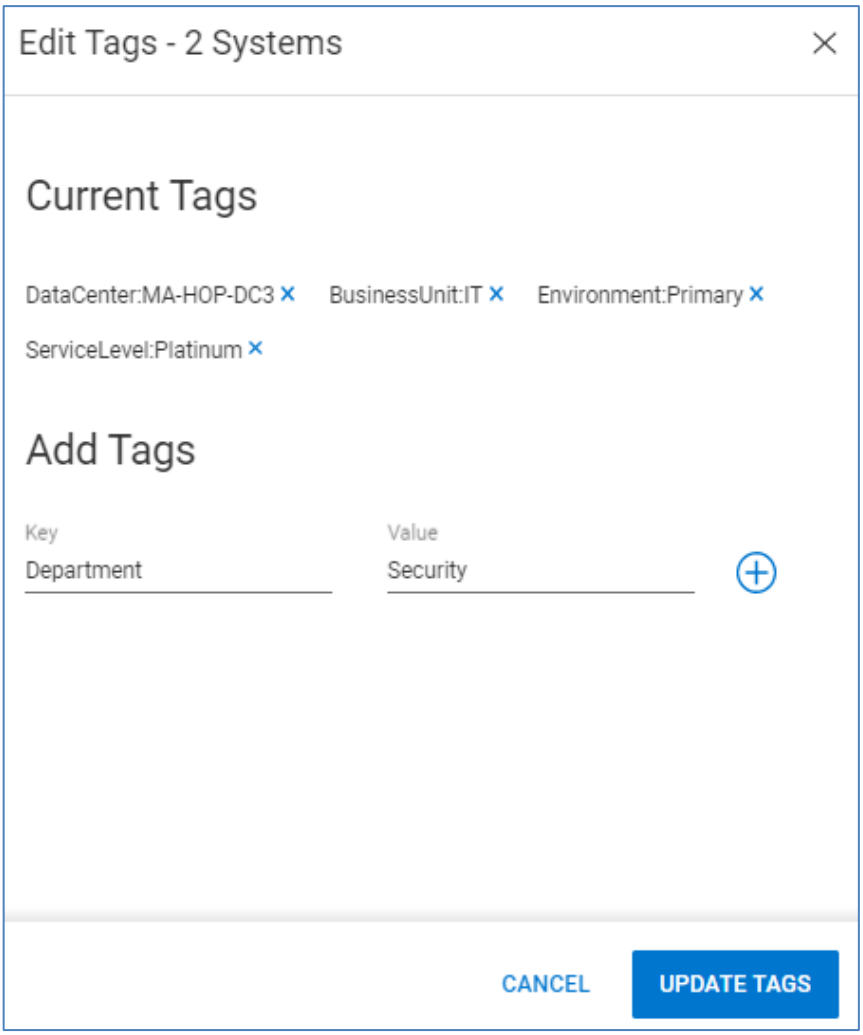


Editing tags

Tags can be edited from either the card view or the list view. In the card view, tags can be added or deleted for an individual system by selecting Edit Tags after hovering the mouse over the tags icon. In the list view, tags can be added or deleted by selecting anywhere in the tags column for the system. Tags can be edited for multiple systems by selecting one or more systems in either the card or list view and selecting the Edit Tags button. The following shows an example of Security Office and Security DC systems selected and the Edit Tags button available.

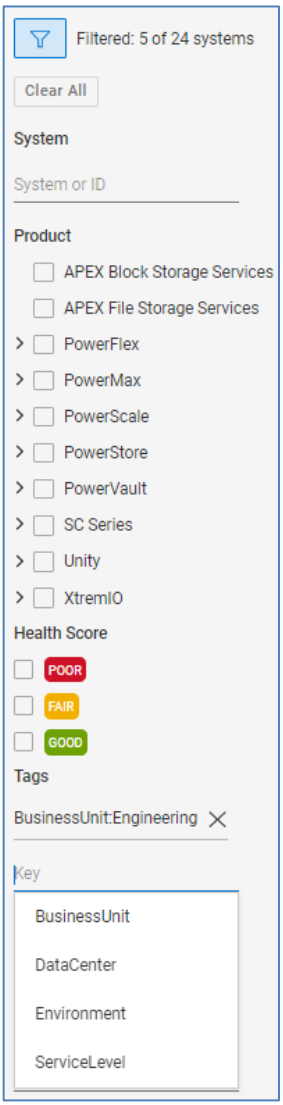


Once the Edit Tags button is selected, the Edit Tags window appears. The current tags are shown and can be deleted by selecting the blue X next to the key:value pair. New tags are added by providing a Key and Value. The following example shows adding a new tag called Department with a value of Security. Select Update Tags to save the changes.



Filtering tags

Once tags have been assigned to systems, the multisystem views can be filtered using the tags.



Select in the “Key” field and begin typing the tag key or select the key tag from the list of defined keys. Once the key is chosen, select in the “Value” field and begin typing the tag value or select it from the list of defined values.

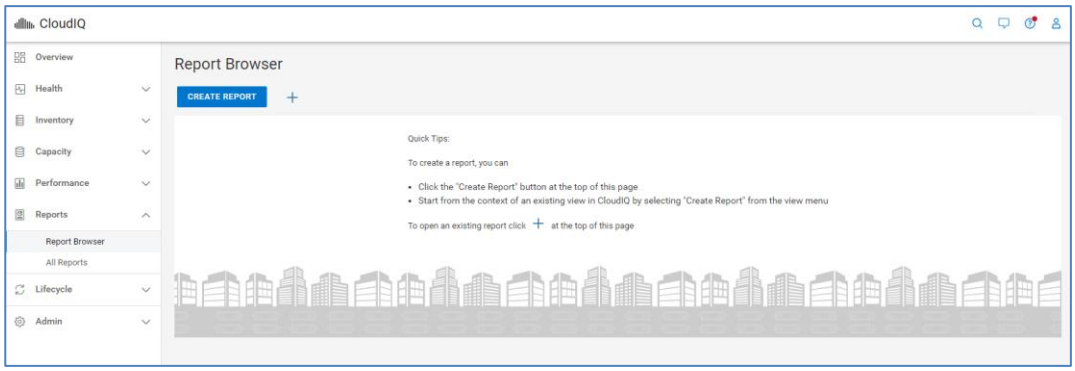
Select ADD to add the tag filter.

Multiple tags can be added.

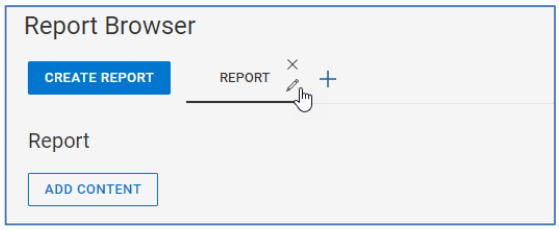
Report Browser

The Report Browser acts as a user’s reporting workspace and dashboard. It allows users to create, view, and modify reports. Reports can be scheduled, duplicated, bookmarked, and exported in PDF format. Reports can consist of any combinations of tables and line charts.

The Report Browser is accessed from under the Reports menu in the left-side navigation pane. The “CREATE REPORT” button is used to create a new report. The plus icon is used to open an existing report.

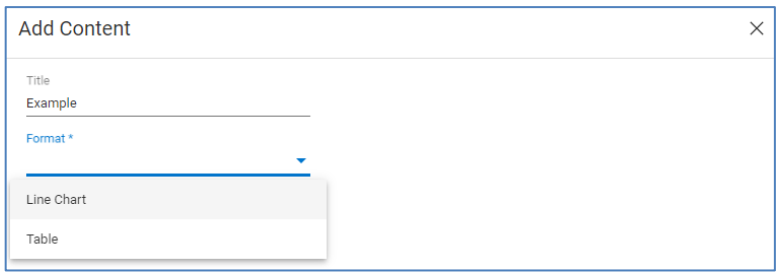


A default name is given to a new report. To edit the name, select the edit icon next to the report name. The icon becomes visible when the mouse is moved over that area. To remove the report from the Report Browser, select the X icon. Removing the report from Report Browser does not delete the report. It is still available from All Reports which is discussed in All Reports.



The ADD CONTENT button is used to add tables and charts to the report.

It opens the Add Content window shown here. This window presents a series of drop-down menus to define the content including the format. The remaining menus differ based on the selected format.

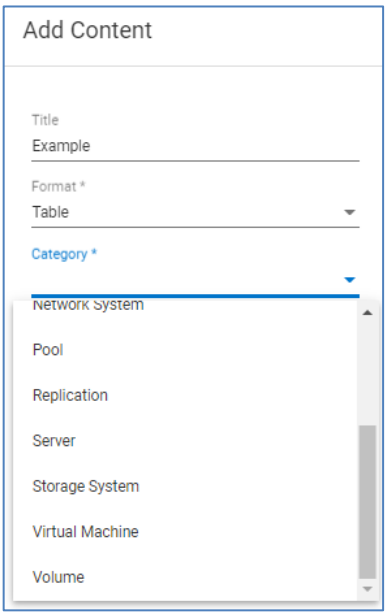


Tables

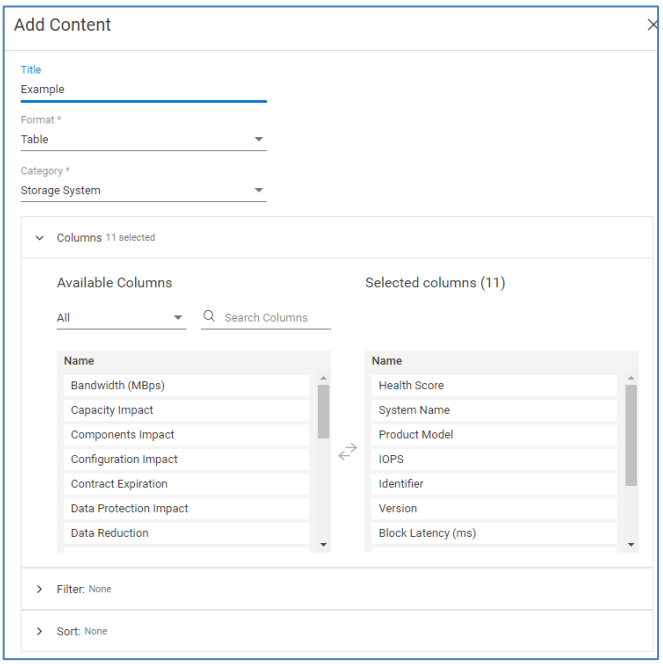
A table allows the user to select one of the following categories:

- Data Protection System
- Filesystem
- Host

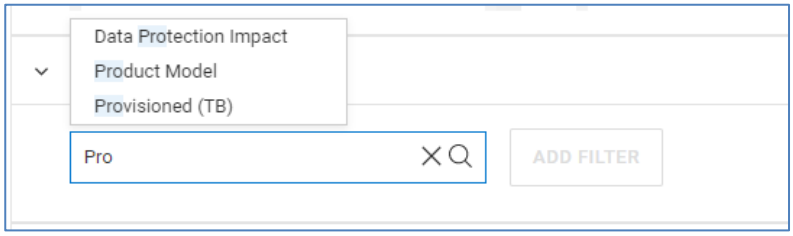
- MTree
- Network System
- Pool
- Replication
- Server
- Storage System
- Virtual Machine
- Volume

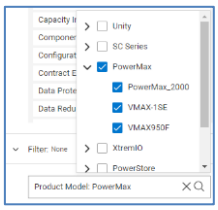


Once the user selects the Category, a list of available and selected columns is displayed. CloudIQ prepopulates the report with common columns. The user can either drag and drop or double-click a column name to add or remove it.



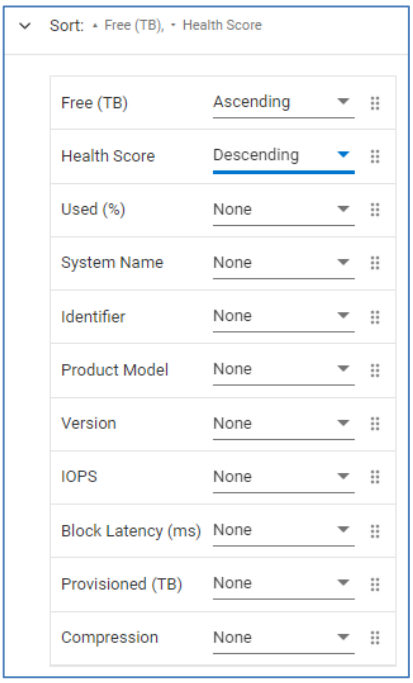
The next section is the filter. The user can select in the Search Filters field and scroll through the full list of columns, or they can begin typing to find a specific one. Once the column is selected, the user can choose from an applicable value. The example below shows a filter on the Product Model column and then on all PowerMax systems.





The final section is Sort. Sort allows the user to add one or more columns to sort the table. Sort columns can be ordered by dragging and dropping the columns to the preferred sort order.

In this example, the first sort is an ascending sort based on Free capacity. The second sort is a descending sort on Health Score.

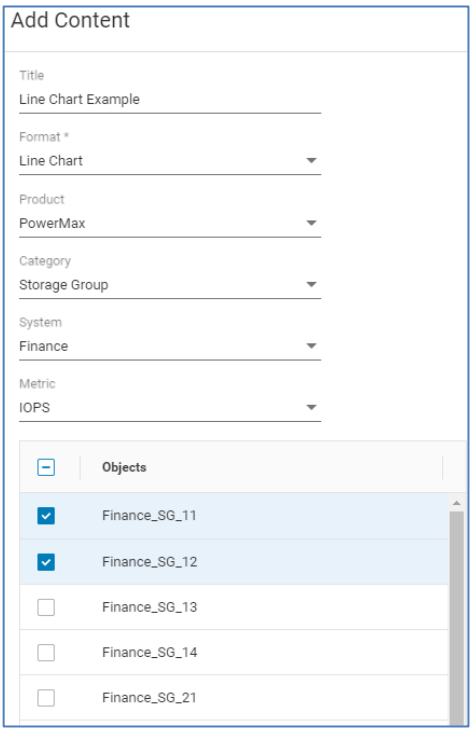


Line charts

A line chart requires the user to select the Product, Category, System, and Metric. If the chosen category is System, the System selection is not necessary. Once the chosen metric is selected, the user selects which Objects to including in the chart.

Metrics available for line charts are shown in Appendix D: Report Browser metrics.

This example shows the configuration of a chart that includes IOPS for the Finance_SG_11 and Finance_SG_12 storage groups.



Report options

Once a report is created, there are several options that are available for the user at the report level.

- SHOW LEGENDS – For line charts, it provides a legend of each object on the right side of the chart. The legend shows the data timestamp and value for each object as the user hovers over the chart.
- Schedule: Schedules the report. Choose initial runtime as well as one of the following intervals: Daily, Weekly, Bi-weekly, Monthly, or Quarterly. Choose format of PDF or CSV. Enter email addresses for recipients.
- Duplicate: Creates a duplicate copy of the report in the Report Browser. This is used to create multiple similar reports where the user wants to make minor changes to a report.
- Bookmark: Adds or removes the bookmark on the report. Bookmarks allow the user to easily find and view the report in the Report Browser from the Add Report icon.
- Export PDF: Exports the report in PDF format.

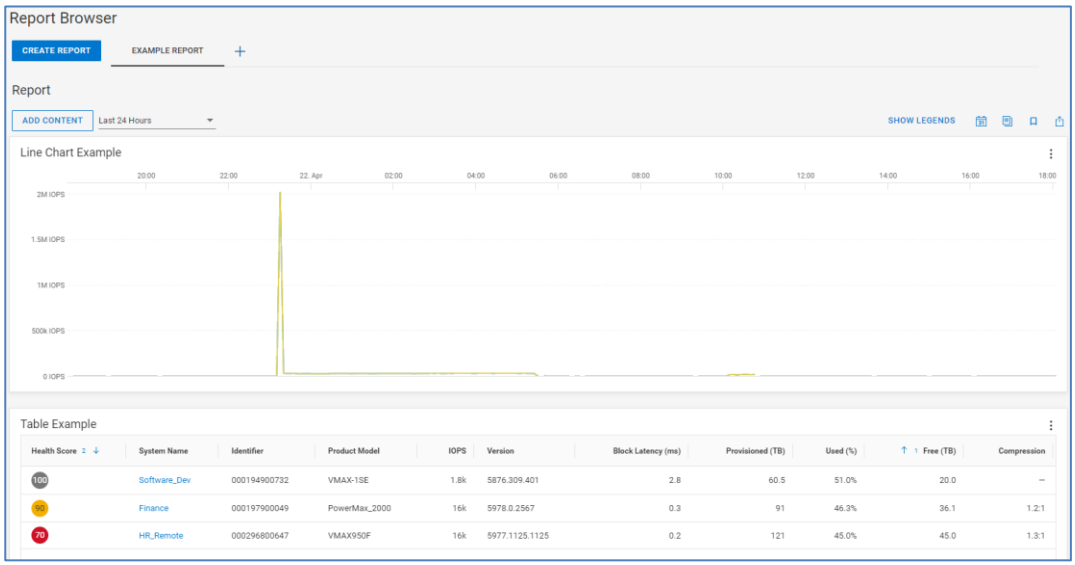
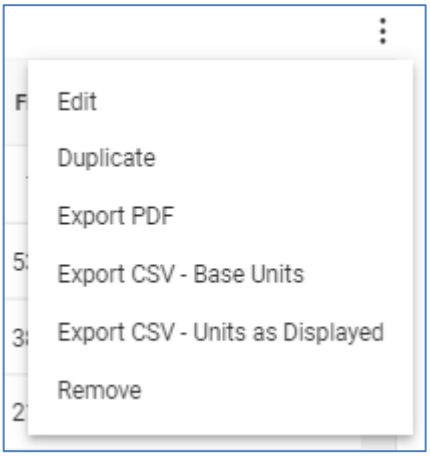


Chart and table options

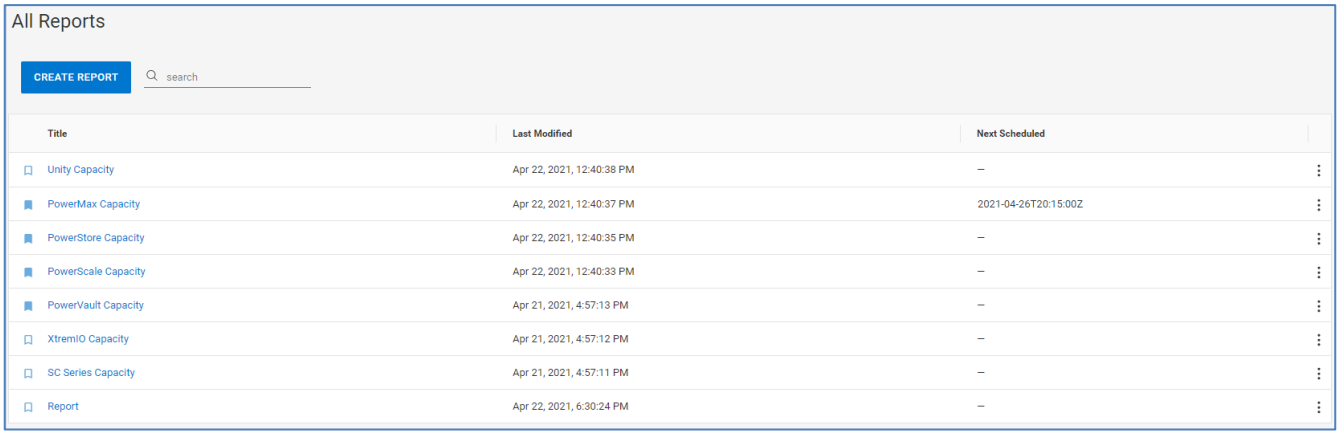
For each individual chart or table, the user is presented several options after selecting the options icon (⋮).

- Edit – Modify the individual chart or table.
- Duplicate – Create a duplicate chart or table in the same report.
- Export PDF – Exports the individual chart or table in PDF format.
- Export CSV – Base Units. Exports the individual table in CSV format.
- Export CSV – Units as Displayed. Exports the individual chart or table in CSV format using scaled values shown in the table.
- Remove – Deletes the chart or table.

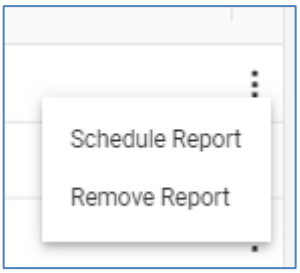


All Reports

The All Reports window is where the user can access any report. In situations where there are many reports, the search field can be used to find a report. The list of reports shows if a report is bookmarked, when it was last modified, and when it is scheduled to run next. The options icon on the right side of each row allows the user to edit the report or delete the report from CloudIQ. The CREATE REPORT button directs the user to the Report Browser to create a report.



Users can schedule and delete a report by selecting the three dots on the right side of the row.



Mobile application

Introduction

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 storage platforms. The user can also configure push notifications to be updated in the app for any health change notifications.

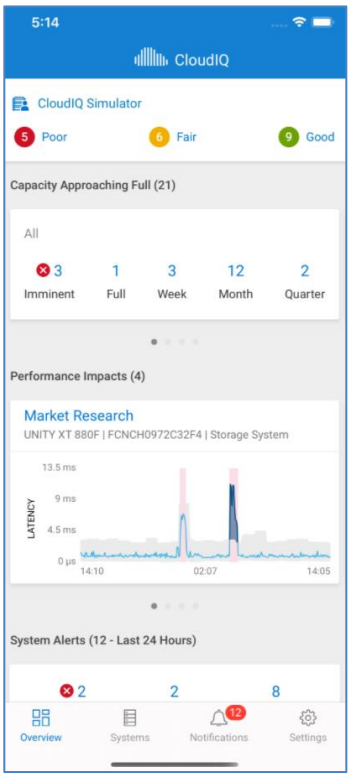
Users can see additional details of the health for any given system and can even text or email the recommended remediation to a colleague for help with performing the resolution.

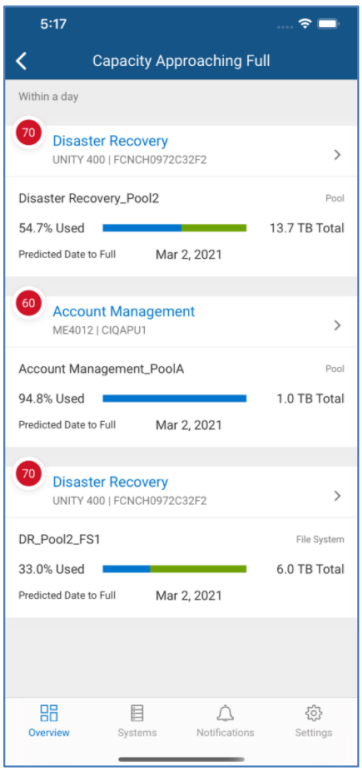
Users can also see if there are any connectivity issues in the environment.

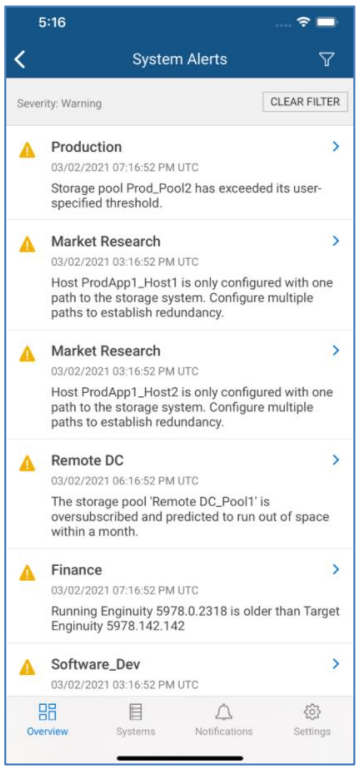
Finally, users can manage push notifications by turning them on or off and can also submit feedback to the CloudIQ team.

Overview

The Overview screen of the mobile app summarizes the health scores, alerts, system connectivity, and capacity approaching full. These views are 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 images show the Overview screen, the details of the Capacity Approaching Full tile, and the details for System Alerts.

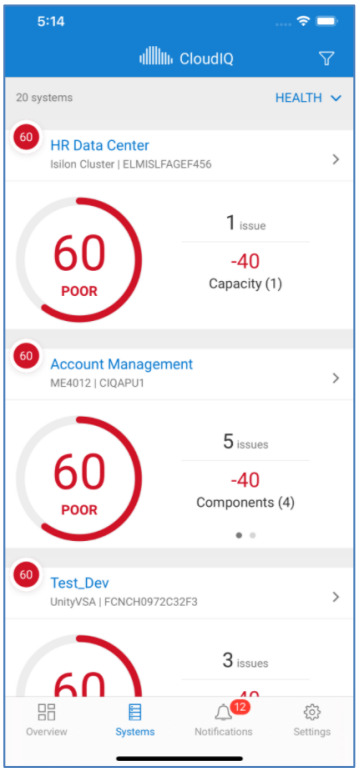


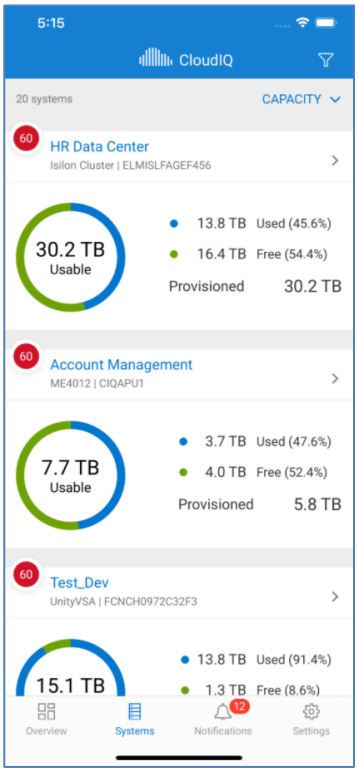


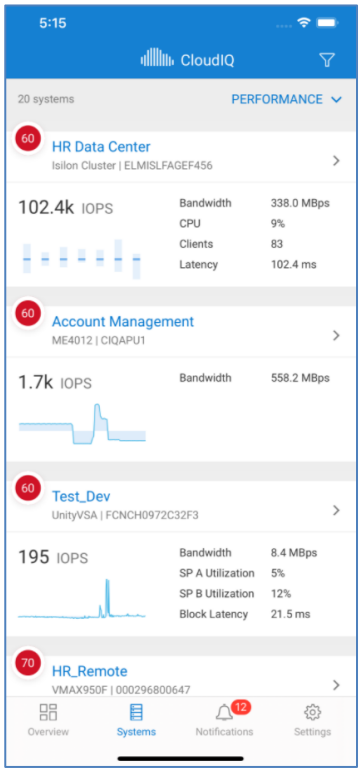


System views

The user can select Systems at the bottom of the screen to see System level views for Health, Capacity, and Performance. Utilize the drop-down menu in the upper right of the screen to switch between the various views: Health, Capacity, and Performance. An example of each is shown below.

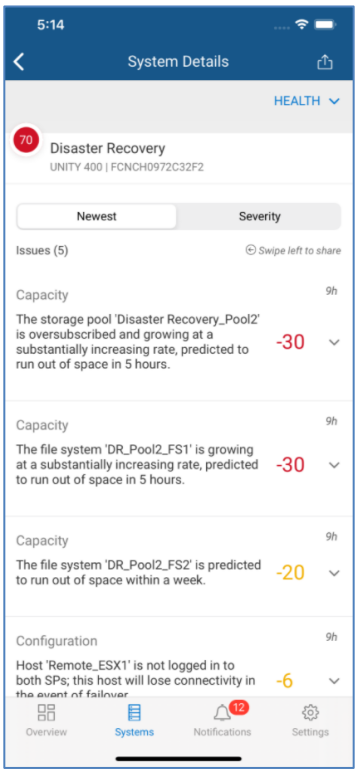


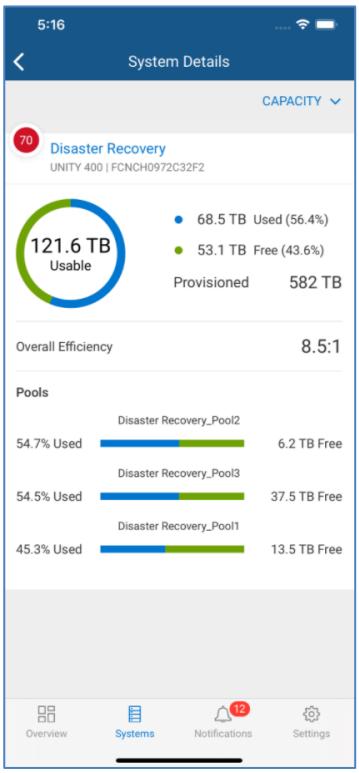


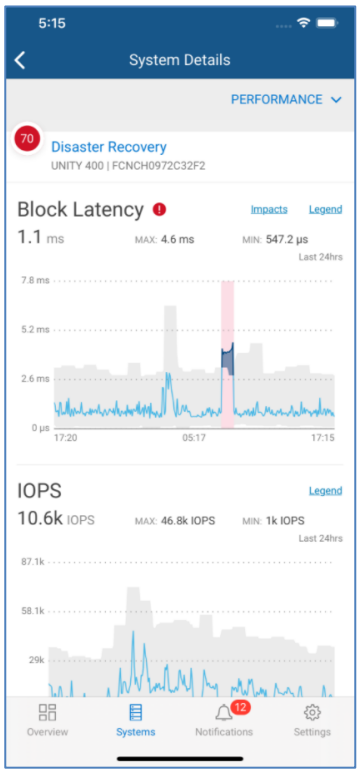


System details

The user can analyze single system details for Health, Capacity, and Performance. These details include 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. The health issue and remediation can be emailed or texted using controls in the app.







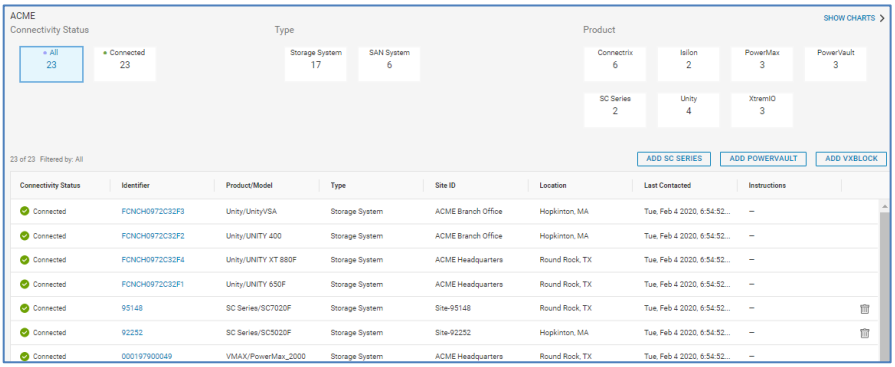
CloudIQ administration

Customization

CloudIQ allows users to temporarily pause host connectivity health checks and file system capacity checks from being included in the system health score. Users may want to do this for nonproduction hosts or during times of maintenance when single-pathed hosts may be expected. Host connectivity checks are supported for both Unity XT family and SC Series systems. File system capacity checks are supported for Unity XT family systems.

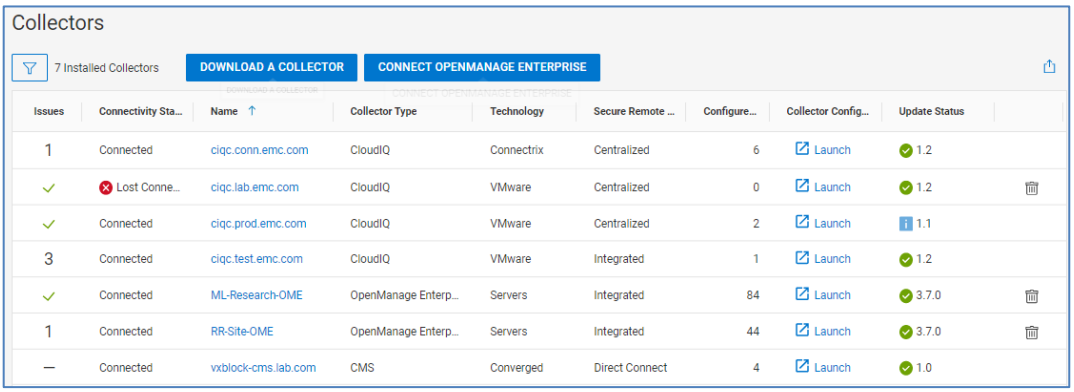
Connectivity

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, VxBlock, and PowerSwitch systems. These systems require the user to enter information into CloudIQ in order to complete the onboarding process. See Appendix A: Enabling CloudIQ at the system for additional onboarding details.

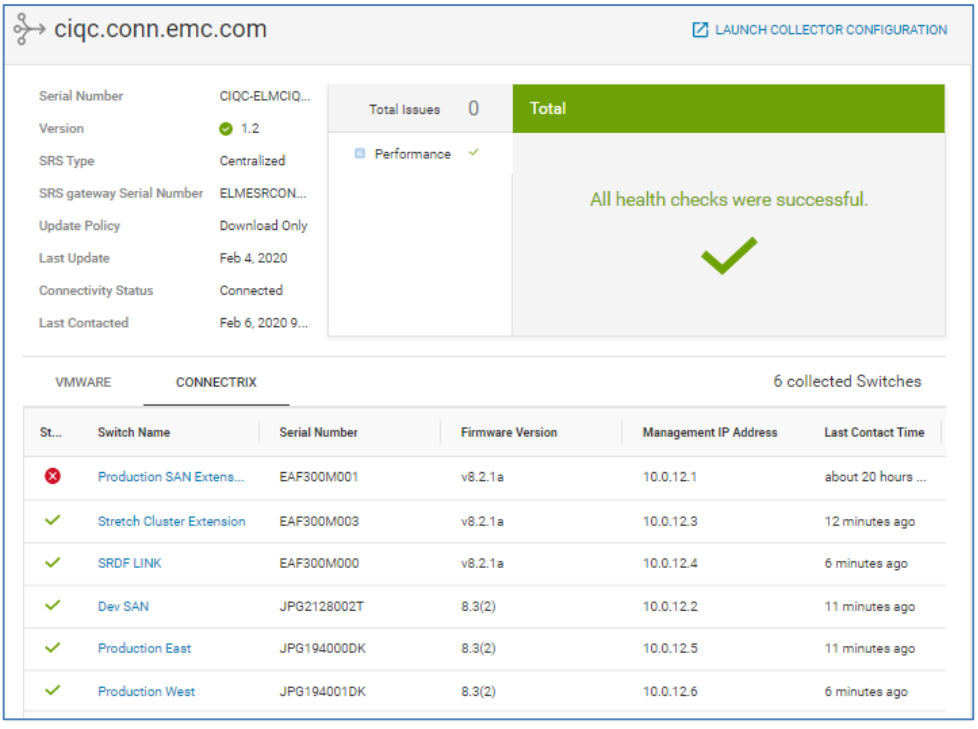

ACME
SHOW CHARTS
Connectivity Status
Type
Product
All 23
Connected 23
Storage System 17
SAN System 6
Connectrix 6
Isilon 2
PowerMax 3
PowerVault 3
SC Series 2
Unity 4
XtremIO 3
23 of 23 Filtered by: All
ADD SC SERIES
ADD POWERVAULT
ADD VXBLOCK
Connectivity Status
Identifier
Product/Model
Type
Site ID
Location
Last Contacted
Instructions
Connected FCNCH0972C32F3 Unity/UnityVSA 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 000197900049 VMAX/PowerMax_2000 Storage System ACME Headquarters Round Rock, TX Tue, Feb 4 2020, 6:54:52... –

Collectors

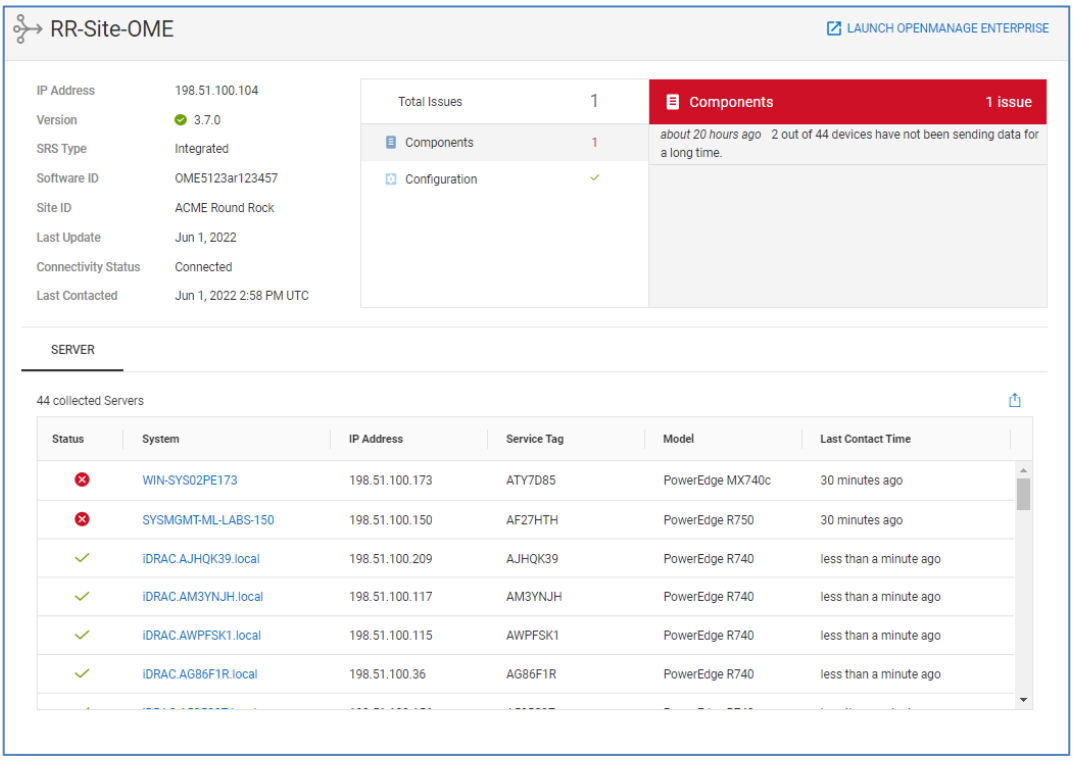
The Collectors page lists each CloudIQ Collector and OpenManage Enterprise installation. The CloudIQ Collector is used to collect VMware and Connectrix data and sends that data back to CloudIQ using Secure Remote Services Gateway or Secure Connect Gateway. This area shows the connectivity status and versions of installed collectors. It also provides a download link to obtain the collector and instructions about how to configure OpenManage Enterprise.



The user can select the hyperlink in the Name column to open the Collector Details page. This page provides health-related information for the selected collector. It also provides as an inventory of the vCenters and Connectrix switches for which it is configured.

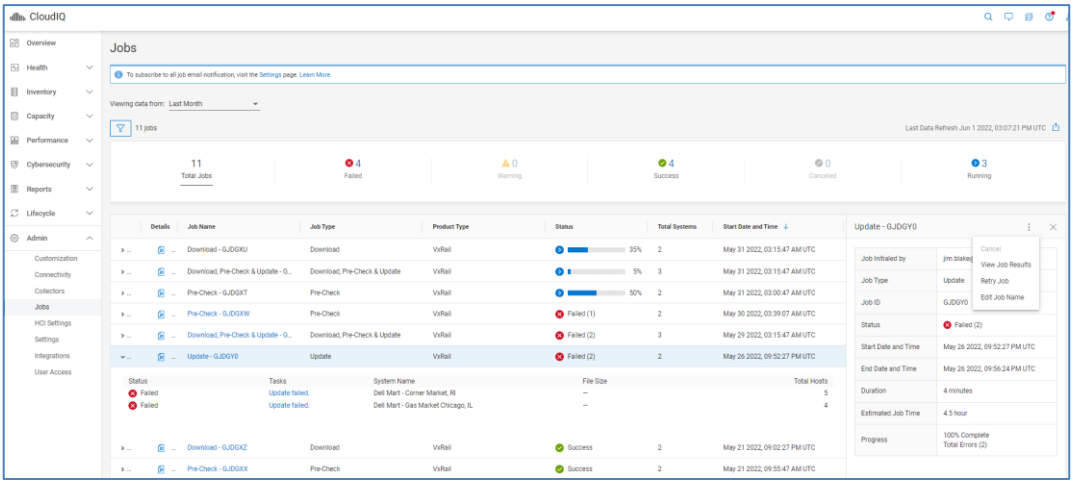


For OpenManage Enterprise instances, it shows the health and the list of monitored PowerEdge servers and their collection status.

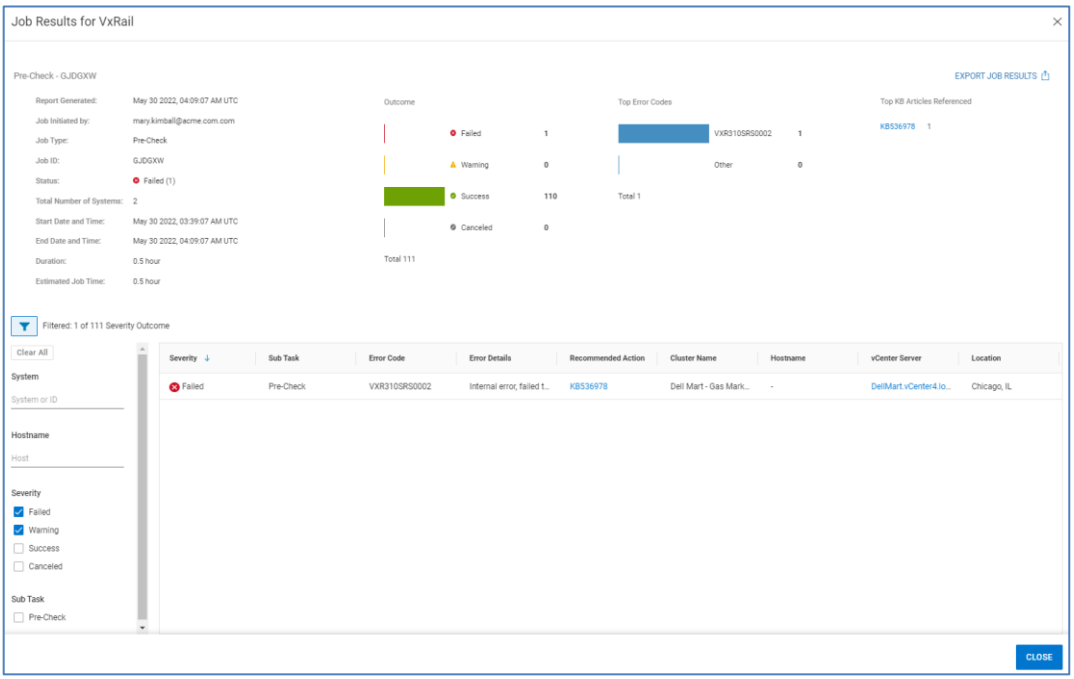


Jobs

The Jobs page lists the existing update tasks and their status. The top of the page provides a summary banner of the total number jobs and their status. It also acts as a filter allowing users to view jobs with a specific status. The bottom of the page lists each job with details about the job. Selecting the Details icon on the left opens the details window on the right which shows start and end times, duration of the job, and total number of errors if any were encountered. From the job details window, the user can choose to cancel a running task, view job results, retry a failed job, or edit the job name.



When a user selects View Job Results, the Job Results window is displayed showing details of the job and each action. The top of the page summarizes each outcome by status and lists the top error codes and KB articles if a failure occurred. The bottom of the page lists the actions with a failed or warning status by default along with the recommended action. The filter allows users to filter on additional status as well as system name, hostname, or sub task type.



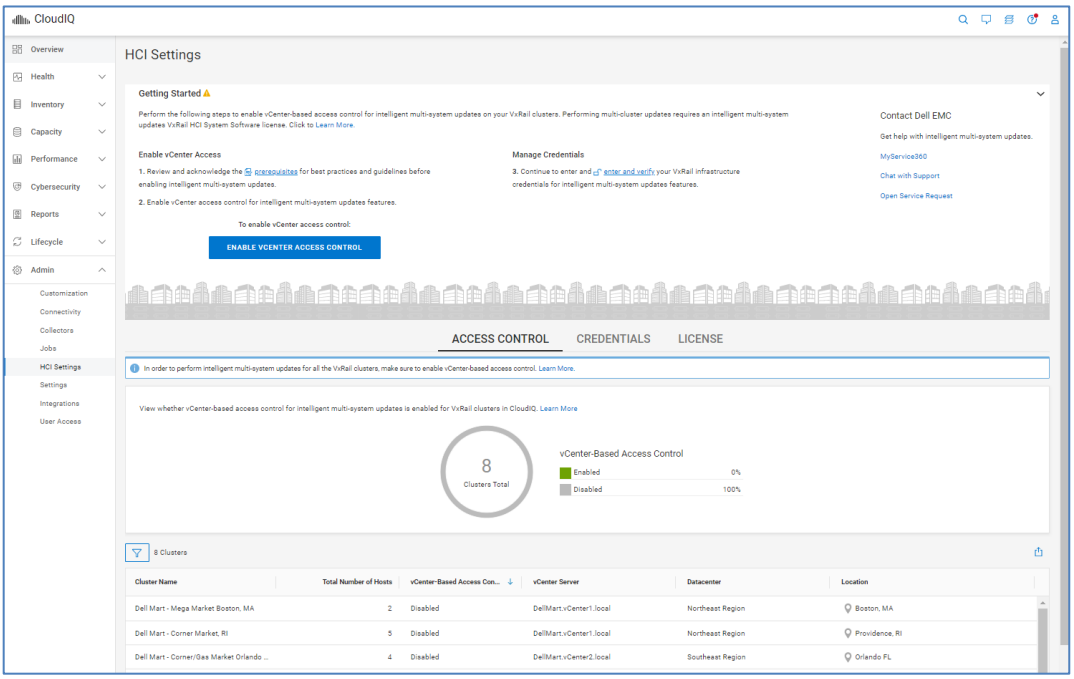
HCI Settings

The HCI Settings page has three tabs that allow users to set up vCenter access controls, enter user credentials, and verify VxRail HCI System Software licenses. Each function and tab is described below.

Access Control

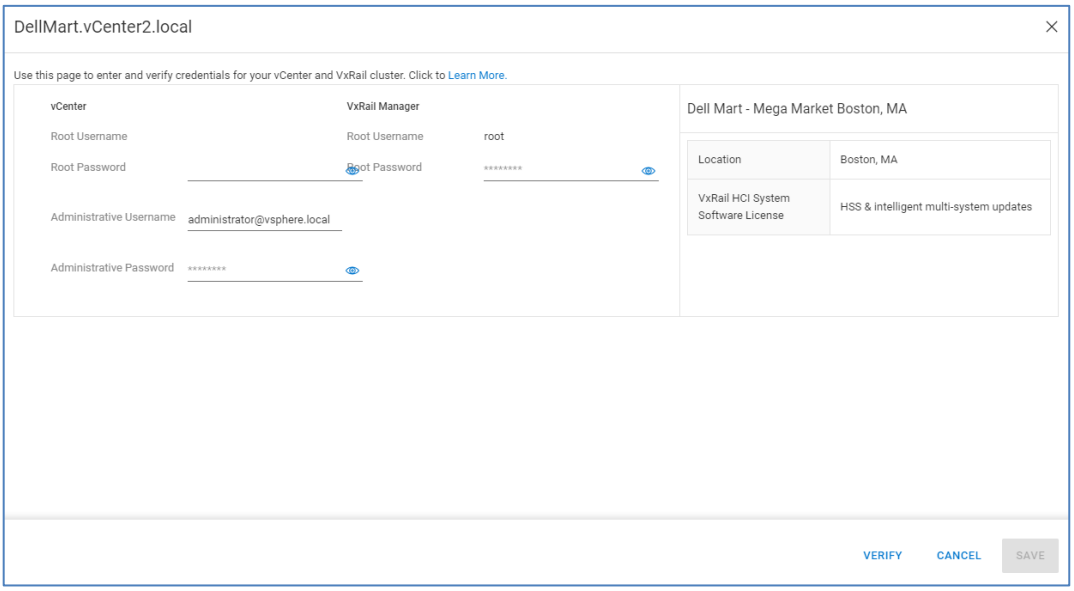
The Access Control tab allows users to enable vCenter-based role-based access controls for intelligent multi-system updates. Users enter the vCenter Administrator account to build out the following privileges on vCenter which can then be assigned to the appropriate roles to which user accounts can be associated:

- Download software bundle: Downloads and stages the VxRail software bundle to the cluster
- Execute health check: Performs an on-demand pre-update health check on the cluster
- Execute cluster update: Initiates the cluster update operation on the cluster
- Manage update credentials: Modifies the VxRail infrastructure credentials used for active management



Credentials

The Credentials tab is used to manage and verify the user credentials used to perform cluster updates. Typically, when performing a cluster update, users need to enter root account credentials for vCenter server, Platform Services Controller, and VxRail Manager. This becomes cumbersome when performing updates on multiple clusters. This allows administrators to enter the credentials once while setting up active management and then provide the appropriate update permissions to users without sharing the credentials. Credentials entered are stored in an encrypted RSA lockbox on each VxRail Manager. CloudIQ does not store passwords and credentials.

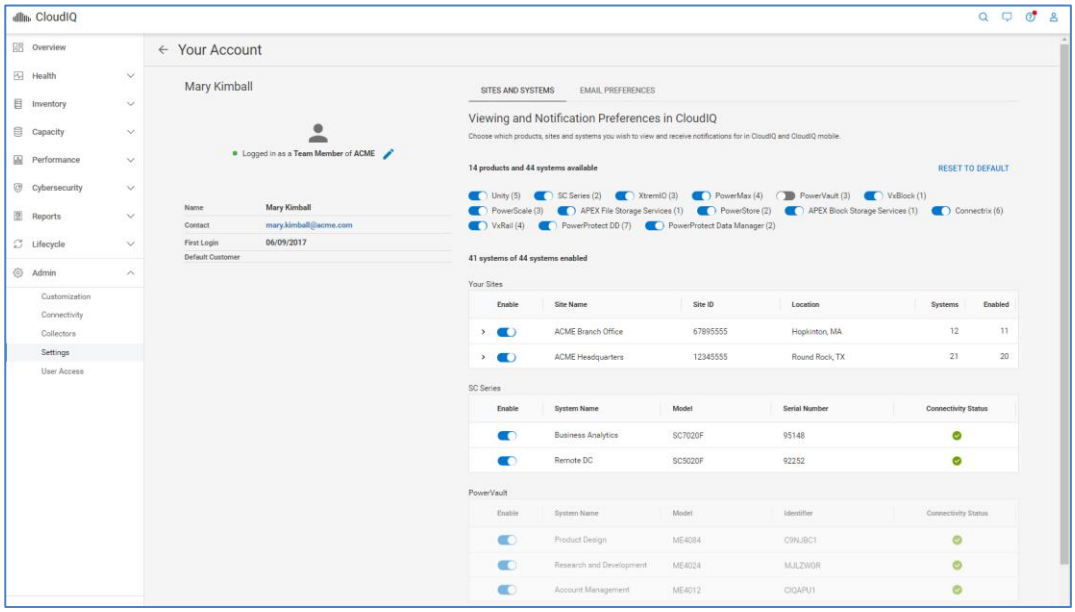


Settings

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

Controlling asset visibility

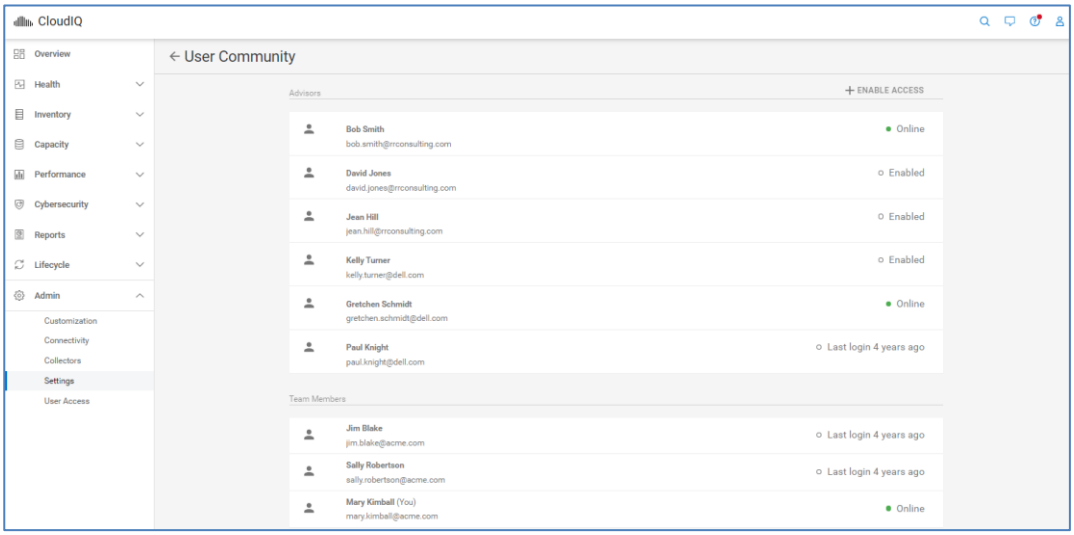
Users can set filters on which systems are available to view and receive notifications for in CloudIQ and the CloudIQ mobile app. This also filters the systems from Webhook configuration. For example, an administrator can set their view to see systems from certain sites or see systems of one or more storage types such as Unity XT family and PowerMax. 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 under the Admin > Settings > Your Account menu pick. This view shows a user that has removed the visibility of their PowerVault systems.



User Community

Users can enable and disable CloudIQ access for Dell Trusted Advisors and Partners in the User Community section. They can also see the login status of other members of their company under Team Members. Dell Trusted Advisors are members of the account team or other Dell employees whom customers want to proactively and routinely view their systems in CloudIQ. The purpose of this role is to provide assistance and recommendations to customers to help them optimize their storage usage. Dell employees and Partners must explicitly be provided access to CloudIQ from the customer. See the following KB article for details:

https://www.dell.com/support/kbdoc/000020659

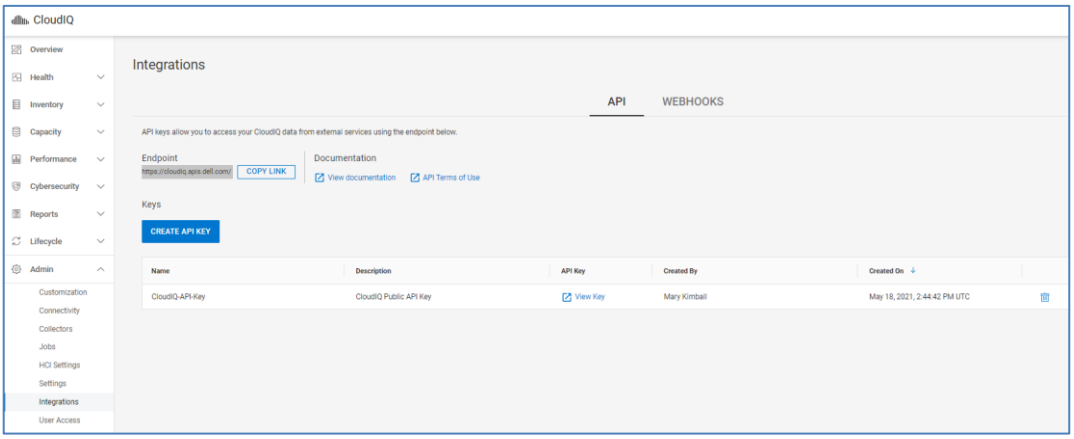


Integrations

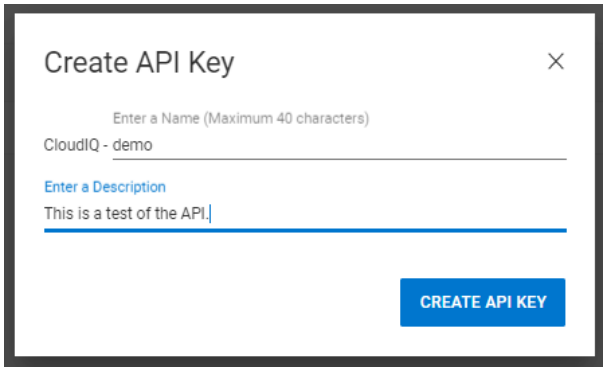
The Integrations section allows users with the CloudIQ DevOps role to configure Webhooks and REST API credentials. Users must have the role of CloudIQ DevOps to access the Integrations menu. This is discussed in the User Access section.

REST API

The public REST API allows users to pull data from CloudIQ to integrate with collaboration and automation tools used in day-to-day IT operations. It is a read-only API allowing users to access inventory, configuration, performance, and capacity metrics available in CloudIQ. It uses the OAuth2 protocol for authentication and authorization. The API client credentials are obtained by selecting the Create API Key button under the API tab.



Enter an API key name and description and select Create API Key.



Once created, the user selects the View Key link to obtain the Client ID and Client Secret. The user utilizes these credentials to authenticate to a specific API endpoint to obtain an Access Token. Once the user obtains the Access Token, the user can make the chosen REST API calls. The access token is active for one hour, and the client credentials are valid for one year.

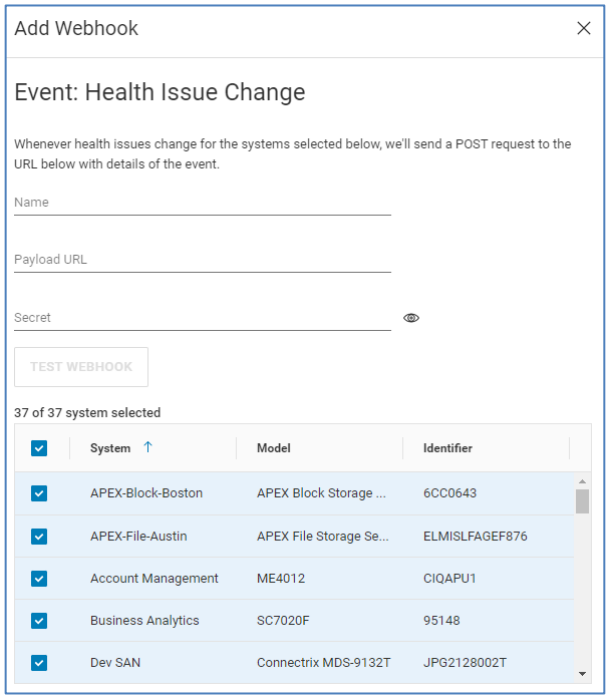
Documentation for syntax and available API calls is available at https://developer.dell.com/apis/products/analytics/cloudiq.

Webhooks

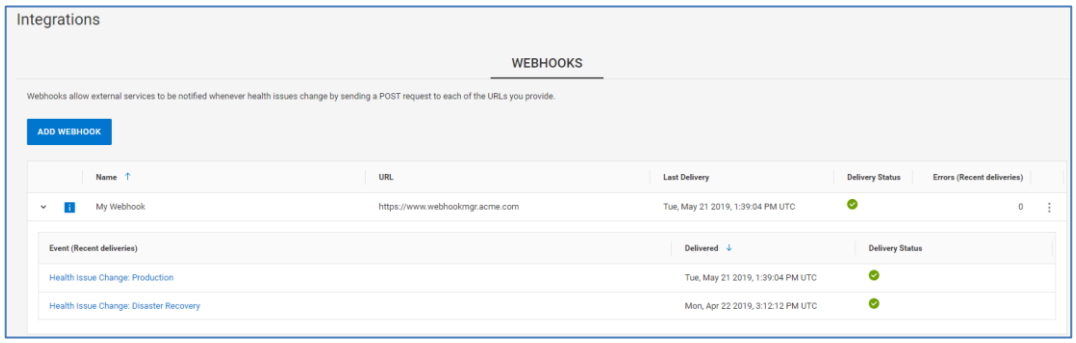
Webhooks is a push mechanism to integrate with third-party applications such as ServiceNow and Slack. Notifications are sent from CloudIQ when a health issue change is identified on a system. A brief tutorial for ServiceNow and Slack integration can be found here.

Configuration of Webhooks requires the user to enter a Name, the Payload URL (destination to send the Webhook), and a Secret. The secret is a user supplied string sent along with the payload and is used to create a signature that is passed as a header during

the POST request. The URL server can create its own matching signature using its stored secret and the POST payload to verify that the signature in the header matches its own generated signature. Users can then select which systems to monitor. The Test Webhook button sends a test notification to the server with a NULL payload. This is used to quickly test connectivity to the Webhook destination.



Once a Webhook is configured and triggered, those events are captured on the Integrations page showing the time and status of the delivery.



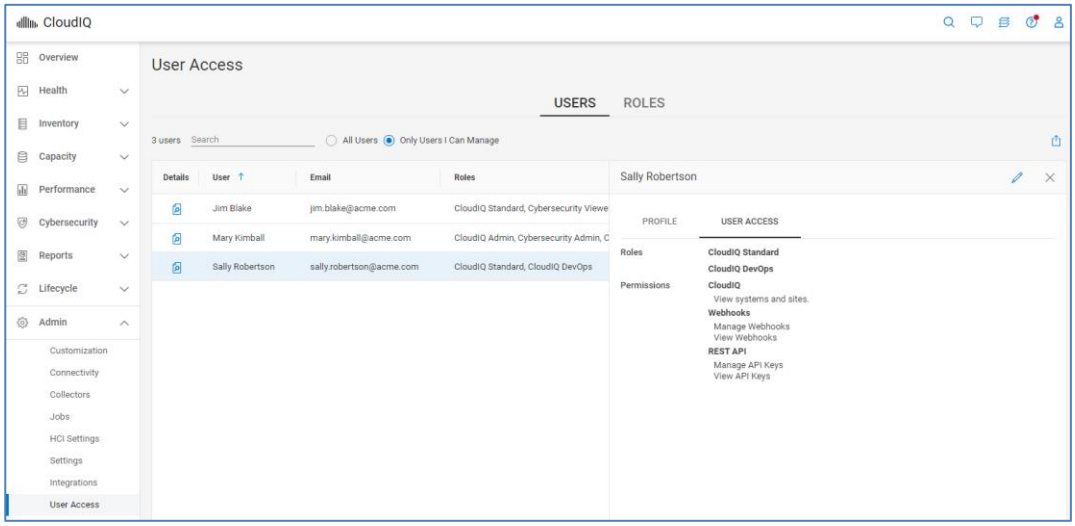
The user can select an event to see the Headers and Payload of the request and the response. A Redeliver button allows users to resend the event which is helpful for testing Webhook integration.

User Access

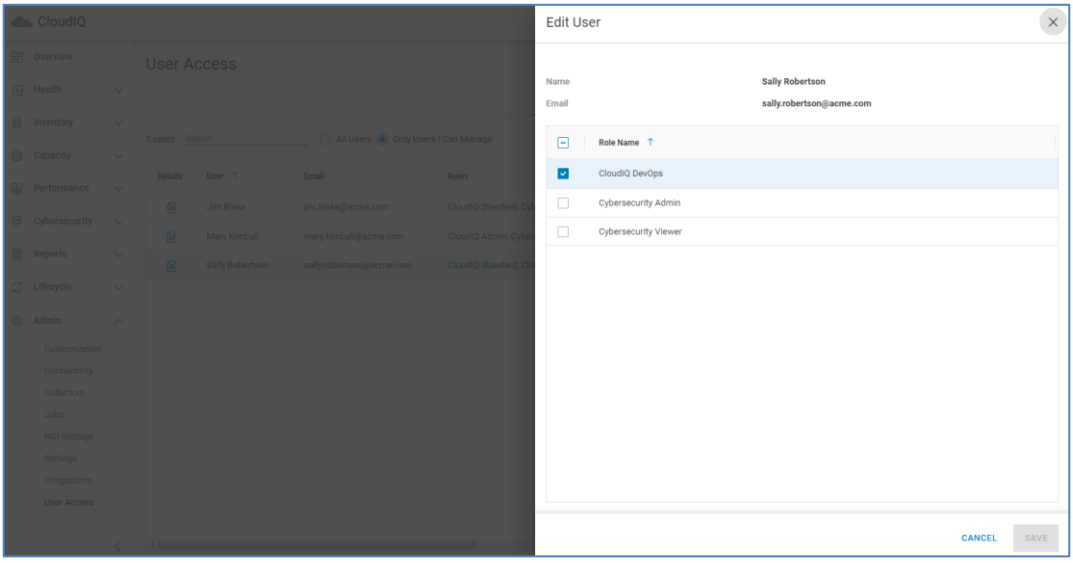
The User Access section allows CloudIQ administrators to set up access controls by assigning users to predefined roles. The administrator of an organization uses MyService360 to define the organization profile. See KB#000183704 for details on using MyService360 for company administration. See KB#000191817 for details on determining CloudIQ Admins for a company.

Note: MyService360 users with a company admin role are automatically mapped to the CloudIQ Admin role.

There are two tabs in the User Access page: The USERS tab lists out all users who have logged into CloudIQ at least once. This tab shows the username, email address, and assigned roles. Selecting the Details icon for an individual user provides details about the user profile and assigned roles and permissions.



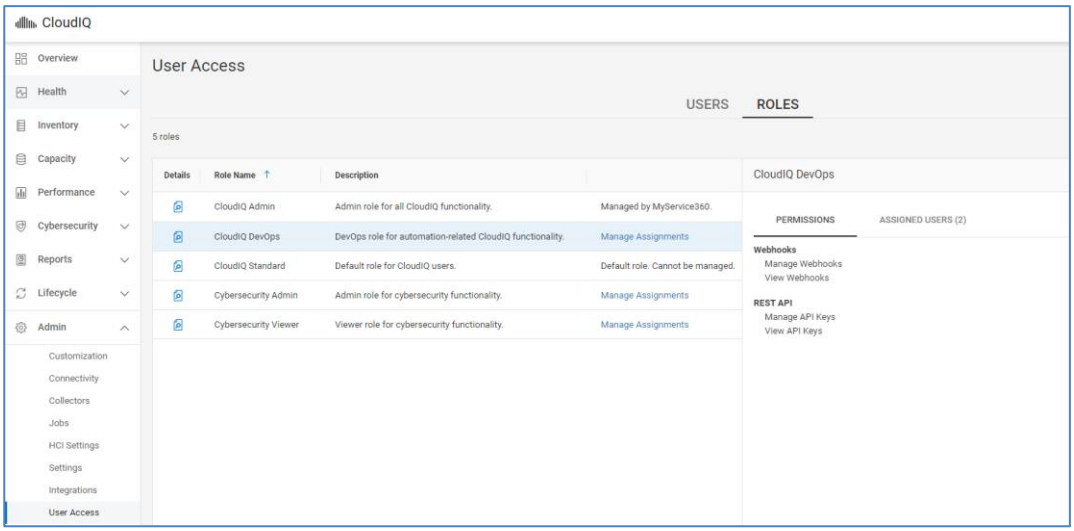
CloudIQ Administrators can select the Edit button to assign a role to a user.



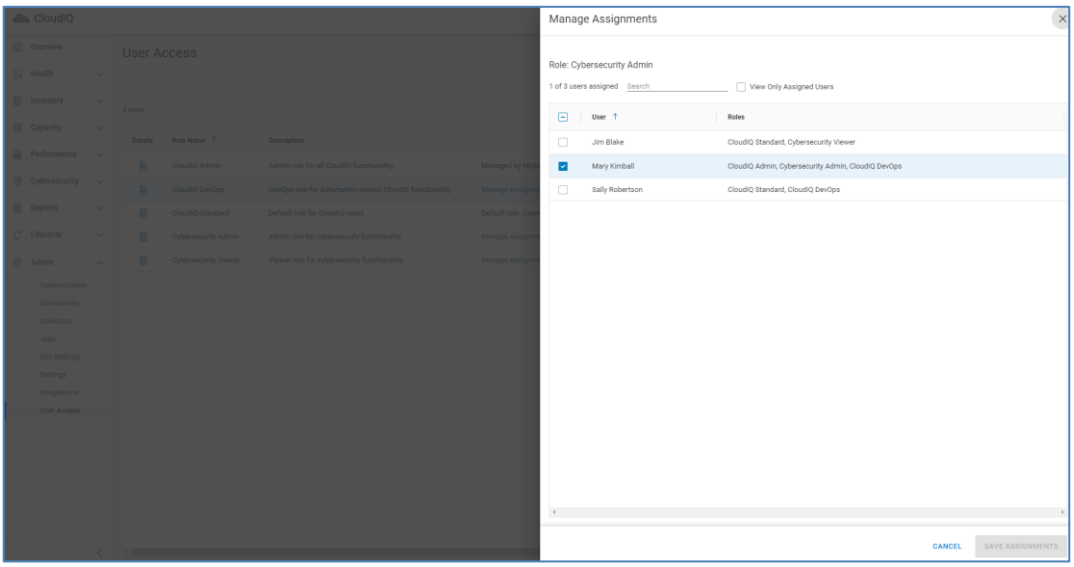
The ROLES tab lists out the available roles with their description. There are five roles in CloudIQ: CloudIQ Admin, CloudIQ Standard, CloudIQ DevOps, Cybersecurity Admin, and Cybersecurity Viewer. Users with an Administrator role in an organization are automatically assigned the CloudIQ Admin role. Users who do not have an Administrator role are automatically assigned the CloudIQ Standard role. These roles are automatically assigned based on the user's role in their organization and cannot be managed within CloudIQ. Only Users in the CloudIQ Admin role have access to the User Access page.

The CloudIQ DevOps role allows users access to the Integrations menu to view and configure Webhooks and REST API credentials. CloudIQ Admins can assign this role to any CloudIQ user, including themselves.

The other two roles are Cybersecurity Admin and Cybersecurity Viewer. Users in the CloudIQ Admin role can manage Cybersecurity access for users by assigning them either the Cybersecurity Admin role or the Cybersecurity Viewer role. Users who are members of the Cybersecurity Admin role have full access to the Cybersecurity feature. They can edit, enable, or disable the Evaluation Plan for a system and select or clear individual Evaluation Tests within the Evaluation Plan. Users who are assigned the Cybersecurity Viewer role can access the Cybersecurity feature and view system risks and Evaluation Plans. They are unable to enable, disable, or edit the Evaluation Plan.



CloudIQ Admins can select the Manage Assignments link to assign users to the CloudIQ Advanced, Cybersecurity Admin, or Cybersecurity Viewer role.



Appendix A: Enabling CloudIQ at the system

Unity XT family, XtremIO, PowerMax/VMAX, PowerScale/Isilon, and PowerFlex systems

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

- Unity XT family
  - For Unity XT 4.2 and later, go to **Settings** > **Support Configuration** > **CloudIQ**, and then select Send data to CloudIQ.
  - For Unity XT 4.1, go 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, go to **Settings** > **Management** > **CloudIQ**, ensure the checkmark to **Send data to CloudIQ** is checked, and then click **Apply**.
  - For Cybersecurity, in Unisphere 9.2.1 or higher, go to **Settings** > **Management** > **CyberSecIQ** and select **I agree to send data to CyberSecIQ**.
- 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>]
    ```

- PowerFlex software and Ready Node with PowerFlex Gateway
  - Log in to PowerFlex Installer and go to **Maintain** tab
  - Enter MDM admin username and password, LIA authentication type, and LIA password
  - Select **Retrieve system topology**
  - On **Maintain** tab, select **System Logs & Analysis**
  - Enter Secure Remote Services information
  - Verify **Send data to CloudIQ** box is checked
- PowerFlex Appliance with PowerFlex Manager

- Log in to PowerFlex manager and go to **Settings** > **Virtual Appliance Management**
- Select **Add Alert Connector**
- Under **Device Registration** section, Enter Device Type, ELMS Software ID, Solution Serial Number
- Check **SRS** box
- Check **Enable CloudIQ** box
- Under **Connector Settings** section, Enter Secure Remote Services information

The user can then go to https://cloudiq.dell.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 Unity Requirements and Configuration* document that can be found at https://support.dell.com.

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

Unity XT family – https://www.dell.com/support/kbdoc/000067484

XtremIO – https://www.dell.com/support/kbdoc/000155454

PowerMax/VMAX – https://www.dell.com/support/kbdoc/000062039

PowerScale/Isilon - https://www.dell.com/support/kbdoc/000157794

PowerFlex – https://www.dell.com/support/kbdoc/000187624

Dell PowerStore

Dell PowerStore systems use 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, go to **Settings > Support > SupportAssist**. Click 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://www.dell.com/support/kbdoc/000157595.

Dell SC Series

The Dell SC Series CloudIQ solution leverages Dell’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

Log in to the CloudIQ UI and go 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://www.dell.com/support/kbdoc/000155957.

Dell PowerVault

The Dell PowerVault systems use 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 use the CLI to collect the above information.

Login to the CloudIQ UI and go 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 PowerVault systems, see: https://www.dell.com/support/kbdoc/000022224.

Dell VxBlock/VBlock

Dell Converged systems use Secure Remote Services or Secure Connect Gateway for CloudIQ data collection. This must be enabled and configured successfully within VxBlock Central.

To configure Secure Remote Services in VxBlock Central, go to **Dashboard > SRS**. Confirm the SRS or Secure Connect 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

Log in to the CloudIQ UI and go 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 VxBlock/VBlock systems, see: https://www.dell.com/support/kbdoc/000020473.

Dell VxRail

VxRail Hyper-Converged Infrastructure systems use Secure Connect Gateway for CloudIQ Data Collection. See the appropriate VxRail Administration Guide (section “Enabling Secure Remote Services”) for the correct procedures.

V4.5.x – VxRail Administration Guide
V4.7.x - VxRail Administration Guide
V7.0.x – VxRail Administration Guide

Alternately, see Solve Online for VxRail.

Telemetry must also be enabled for CloudIQ collections.

For VxRail v4.5.x, you must enable Telemetry Settings. The default and recommended collection level is Basic. This collects samples once per hour.

For VxRail v4.7.x and 7.0.x, you must enable Customer Improvement Program. The default and recommended collection level is Medium. This collects samples once per hour.

For detailed information about onboarding VxRail systems, see: https://www.dell.com/support/kbdoc/000184396

PowerEdge

OpenManage Enterprise 3.7 or greater is used to collect data from PowerEdge servers and sends the data to CloudIQ. The CloudIQ plug-in is required to be installed in OpenManage Enterprise to enable the flow of data to CloudIQ.

1. Install OpenManage Enterprise 3.7 or greater.
2. In OpenManage Enterprise, go to **Application Settings > Console and Plugins.**
3. Select the CloudIQ plug-in, and click **Install Plugin.**
4. Select **Accept** on the licensing agreement.
5. Select **I agree that I have captured a snapshot of the OpenManage Enterprise appliance.**
6. Click **Confirm Install.**

Once installed, the CloudIQ plug-in must be configured.

1. In OpenManage Enterprise, go to **Plugins > CloudIQ > Overview.**
2. Select **Activate Now.**
3. On the Authentication page, enter the Access Key and PIN to register OpenManage Enterprise with the Dell Connectivity Service. Generate the Access Key and PIN as documented in Dell KB article 000180688.
4. Enter a **Collector Name** on the Collector Name page.
5. Click **Select Groups** on the Device Groups page, and select devices for monitoring in CloudIQ.
6. Select **Next** to see the summary of the configuration, and click **Finish** to complete the configuration.

For detailed information about onboarding PowerEdge servers to CloudIQ, see: https://www.dell.com/support/kbdoc/000189403.

Dell PowerProtect DD

PowerProtect DD systems use Secure Remote Services for CloudIQ data collection. To configure Secure Remote Services in DD System Manager, open the **Configuration** tab under **Maintenance** > **Support**.

Enable Secure Remote Services under the **Channel** section.

Select the Enable button under the **CloudIQ** section.

Verify “Share Data with CloudIQ” is set to Enabled.

For detailed information about onboarding PowerProtect DD systems, see: https://www.dell.com/support/kbdoc/000183656

Dell PowerProtect Data Manager

PowerProtect Data Manager uses Secure Remote Services or Secure Connect Gateway for CloudIQ data collection. To configure Secure Remote Services in PowerProtect Data Manager, go to the **Support** menu under the **System Settings** menu.

In the **Secure Remote Services** section, enter the SRS or Secure Connect Gateway Hostname, Username, and Password.

In the **Auto Support** section, switch **Enable Auto Support** to Enabled.

Select **Save** to save the configuration.

For detailed information about onboarding PowerProtect Data Manager systems, see: https://www.dell.com/support/kbdoc/000184014

Connectrix Switches

Connectrix switches use the CloudIQ Collector to collect the data from the switches and send the data back to CloudIQ using Secure Remote Services or Secure Connect Gateway. The collector is a vApp that is downloaded from the Admin > Collectors menu in the CloudIQ user-interface or from support.dell.com. Then, it must be installed locally in the data center.

Once deployed, the collector is configured to communicate to the SRS/Secure Connect Gateway and the Connectrix switches by accessing the collector administration UI using a web browser: https://<collector hostname or IP>.

Communication between the Collector and the switches is done using REST API. The following guidelines can be used to verify and 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://www.dell.com/support/kbdoc/000157620.

PowerSwitch

Each PowerSwitch must have SupportAssist configured. On each PowerSwitch, enter configuration mode:

```
OS10# configure terminal
OS10(config)#
```

Accept the EULA.

```
OS10(config)# eula-consent support-assist accept
```

Enter SupportAssist mode.

```
OS10(config)# support-assist
OS10(conf-support-assist)#
```

(Optional) Configure VRF for SupportAssist if using the management VRF.

```
OS10(conf-support-assist)# vrf management
```

Specify the SupportAssist server URL as default:

```
OS10(conf-support-assist)# server url default
```

Configure contact information for your company.

```
OS10(conf-support-assist)# contact-company name <your company
name>
OS10(conf-support-assist-<your company name>)#
OS10(conf-support-assist-<your company name>)#address city
<string> state <string>
country < predefined country code> zipcode <string>
```

Generate the Access Key and PIN as documented in KB#000180688.

Enter Access Key and PIN to generate the Universal key.

```
OS10(conf-support-assist)# do support-assist generate universal-
key 570E904C 1234
OS10 (conf-support-assist)# success
```

Schedule hourly collections in EXEC mode.

```
OS10# support-assist-activity full-transfer schedule hourly min 59
```

Once SupportAssist is enabled on the PowerSwitch, the switch must be manually added to CloudIQ. Use the `show license status` command to collect the required information.

Log in to the CloudIQ UI, and go to the **Admin > Connectivity** page. Select ADD POWERSWITCH, and step through the wizard which prompts the System Serial Number (PPID), System Service Tag (service tag), PowerSwitch Version, and PowerSwitch Model.

For detailed information about onboarding PowerSwitch, see https://www.dell.com/support/kbdoc/000192029.

VMware

VMware uses the CloudIQ Collector to communicate to vCenter and send data back to CloudIQ using Secure Remote Services or Secure Connect Gateway. The collector is a vApp that is downloaded from the Admin > Collectors menu in the CloudIQ user-interface or from https://support.dell.com. It is then installed locally in the data center. 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 SRS/Secure Connect Gateway and vCenter by accessing the collector using a web browser: https://<collector hostname or IP>.

For detailed information about onboarding VMware, see: https://www.dell.com/support/kbdoc/000021264.

Appendix B: CloudIQ security

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 standard secure development life cycle. This standard defines the security-focused activities that Dell product teams must follow when building and releasing products. It enables Dell Technologies to minimize the risks to our products and customer environments from security vulnerabilities.

CloudIQ data in transit to Dell

CloudIQ subscribes to notifications from Dell Secure Remote Services, Secure Connect Gateway, and Dell Phone Home services when storage system metadata arrives over those channels. This metadata can include, for example, system logs, system configuration, system capacity, and performance metrics. No customer data is sent, and only data generated by the customer's systems is sent. Customers control which systems send information over these channels. See the document Secure Connect Gateway Security for more information.

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 IT-managed infrastructure. In addition, Secure Remote Services provides for dedicated VPN and multifactor authentication. Once the data arrives, CloudIQ stores data relating to those systems which have CloudIQ management enabled in its own Dell IT-managed infrastructure.

CloudIQ data at rest

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

The Dell 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 data center. The Information Security Policy ensures that all Dell 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 in the core network behind corporate firewalls, and is not exposed to external direct access. No individual direct login to the database server and database is allowed, expect for the members of System Administrator and Database Administrator teams. Database application accounts are managed using standard database password authentication.

Dell has implemented an industry best practice Change Management process to ensure that Dell 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 to users.

Accessing CloudIQ data

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

CloudIQ leverages information in the user profile stored in Dell 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.

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 in 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 Service Center.

Appendix 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
PowerFlex	5 minutes	1 hour	1 hour
Unity XT family	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
PowerEdge	5 minutes	N/A	1 hour
Connectrix	5 minutes	5 minutes	5 minutes
PowerSwitch	N/A	1 hour	1 hour
VMware	5 minutes	5 minutes	5 minutes
APEX Block	5 minutes	1 hour	1 hour
APEX File	5 minutes	1 hour	1 hour
VxRail[1]	5 minutes	5 minutes	24 hours
PowerProtect DD	5 minutes	1 hour	1 hour

1. VxRail sends the 5-minute performance and capacity data to CloudIQ at 30 minute, 60 minute, or 24-hour intervals. The telemetry setting in VxRail Manager determines the upload interval.

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. See Metrics Browser for a full list of individual performance metrics collected for each component type.

	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	✓	✓			✓	✓	✓	✓					✓	✓	✓	✓
PowerFlex	✓	✓														
Unity XT family	✓	✓			✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
XtremIO	✓	✓					✓	✓								
SC Series	✓	✓			✓		✓	✓					✓	✓	✓	✓

Connectrix Switches

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

VMware

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

Appendix D: Report Browser metrics

The following charts provide the time series metrics available in Report Browser.

APEX Block Storage Services

Metric	System	Volume	Volume Group
Bandwidth	X	X	X
Bandwidth by Read/Write	X	X	X
IOPS	X	X	X
IOPS by Read/Write	X	X	X
IO Size		X	X
IO Size by Read/Write			X
Latency	X	X	X
Latency by Read/Write	X	X	X
Queue Depth		X	

Connectrix

Fibre Channel only

Metric	Switchport	System
Buffer Errors	X	
Buffer Errors by All Buffer Errors	X	
Buffer Errors by B2B Credit Zero	X	
Class-3 Discards	X	
Congestion Ratio	X	
CRC Errors	X	
Link Resets	X	X
Link Resets by In/Out		X
Physical Layer Errors	X	
Physical Layer Errors by All Physical Layers	X	
Physical Layer Errors by FEC Blocks	X	
Protocol Errors	X	
Throughput	X	X
Throughput by Rx/Tx	X	
Time at Zero Tx Credit	X	
Utilization	X	X

Metric	Switchport	System
Utilization by Rx/Tx	X	
B2B Credit Zero/sec		X
Errors		X

PowerEdge

Available PowerEdge metrics vary based on model, license, and firmware. See the CloudIQ section of the OpenManage Portfolio Software Licensing Guide for more details.

Drives	
NVMe	Storage Disk
Available Spare Threshold (%)	Command Timeout (Count for last hour)
Composite Temp (C, Max over last 15 min)	CRC Errors (Count for last hour)
Critical Warnings	Drive Life Remaining
Percentage Used (Max over last 1 hour)	Drive Temperature (C, Avg over last hour)
	Erase Failures (Count for last hour)
	Exception Mode Status (Count for last hour)
	Media Writes (Count for last hour)
	Power On Hours
	Program Fail (Count for last hour)
	Read Error Rate (Count for last hour)
	Reallocated Block (Count for last hour)
	Uncorrectable Error (Count for last hour)
	Uncorrectable LBA (Count for last hour)
	Volatile Memory Backup Source Failures (Count for last hour)

FC Port
Invalid CRCs (Count for last 5 min)
Link Failures (Cout for last 5 min)
Received Bytes (Total over last 5 min)
Transmitted Bytes (Total over last 5 min)

Network Port
Discarded Packets (Count for last 5 min
Excessive Collision Packets (Count for last 5 min)
FCoE Packets Received (Count for last 5 min)

Network Port
FCoE Packets Transmitted (Count for last 5 min)
FCoE/FIP Link Failures (Count for last 5 min)
FCS Error Packets Received (Count for last 5 min)
Jabber Packets (Count for last 5 min)
Multiple Collision Packets (Count for last 5 min)
RDMA Bytes Transmitted (Total over last 1 min)
RDMA Packets Received (Count for last 5 min)
RDMA Packets Transmitted (Count for last 5 min)
Received Bytes (Total over last 5 min)
Transmitted Bytes (Total over last 5 min)

Processor (CPU/GPU)
CPU Temperature (°C, Avg. over last 5 min)
GPU: Board Temperature (°C, Avg. over last 15 min)
GPU: DBE Retired Pages (Count for last 15 min)
GPU: Power Consumption (W, Avg. over last 15 min)
GPU: Primary Temperature (°C, Avg. over last 15 min)
GPU: SBE Retired Pages (Count for last 15 min)
GPU: Secondary Temperature (°C, Avg. over last 15 min)

Server System
CPU Usage (%, Avg. over last 5 min)
Inlet Temperature (°C, Avg. over last 15 min)
Memory Usage (%, Avg. over last 5 min)
Peak Inlet Temperature (°C, Max. over last 15 min)
Power Consumption (W, Avg. over last 15 min)
Power Consumption (W, Max. over last 15 min)
Power Consumption (W, Min. over last 15 min)
System Board IO Usage (%, Avg. over last 5 min)
System Net Airflow (CFM, Avg. over last 15 min)
System Usage (%, Avg. over last 5 min)
Total CPU Power (W, Total over last 15 min)
Total Memory Power (W, Total over last 15 min)

Chassis
Amount of Energy Consumed (kWh, Avg over last 15 min)
Amount of Energy Consumed (kWh, Max over last 15 min)
Amount of Energy Consumed (kWh, Min over last 15 min)
Inlet Temperature (°C, Avg. over last 15 min)
Peak Inlet Temperature (°C, Max. over last 15 min)
Peak Inlet Temperature (°C, Min. over last 15 min)
Power Consumption (W, Avg. over last 15 min)
Power Consumption (W, Max. over last 15 min)
Power Consumption (W, Min. over last 15 min)
Power Headroom (W, Avg Available power minus peak consumed over last 15 min)
Power Headroom (W, Max Available power minus peak consumed over last 15 min)
Power Headroom (W, Min Available power minus peak consumed over last 15 min)

PowerMax

Metric	FE Dir	FE Port	Host	RDF Dir	RDF Port	RDFA Group	RDFS Group	Storage Group	Storage Resource Pool	System
% Busy	X	X		X	X					
% Hit							X			
% Write							X			
% Read								X	X	
Allocated Size								X		
Used Size									X	
Bandwidth	X	X	X	X	X		X	X	X	X
Bandwidth by Read/Write		X	X	X	X			X	X	X
IO Size		X			X			X		
IO Size by Read/Write		X			X			X		
IOPS	X	X	X	X	X		X	X	X	X
IOPS by Read/Write		X	X		X		X	X	X	X
Latency		X	X				X	X	X	X
Latency by Read/Write		X	X				X	X	X	
Queue Length								X	X	

Metric	FE Dir	FE Port	Host	RDF Dir	RDF Port	RDFA Group	RDFS Group	Storage Group	Storage Resource Pool	System
Queue Length by Read/Write								X	X	
Queue Depth Utilization	X									
Read Latency	X									
Write Latency	X									
Avg IO Service Time						X				
Compressed Bandwidth						X				
Compressed Bandwidth by Read/Write						X				
RDF R1 to R2 Bandwidth						X				
RDF R1 to R2 IOPS						X				
RDF R2 to R1 Bandwidth						X				
RDF R2 to R1 IOPS						X				
RDF/A WP Count						X				

PowerScale

Metric	System	Pool
Configured Size	X	
Free Size	X	X
Used Percent	X	X
Used Size	X	X

PowerStore

Metric	Appliance	File System	System	Volume	Volume Group
% Read		X			
Bandwidth	X	X	X	X	X
Bandwidth by Read/Write	X	X	X	X	X
CPU Utilization	X				

Metric	Appliance	File System	System	Volume	Volume Group
Data Reduction Ratio			X		
Free Size		X	X		X
IO Size		X		X	X
IO Size by Read/Write		X		X	X
IOPS	X	X	X	X	X
IOPS by Read/Write	X	X	X	X	X
Latency	X	X	X	X	X
Latency by Read/Write	X	X	X	X	X
Logical Size			X		
Queue Depth				X	X
Total Size		X		X	X
Used Size		X	X	X	X

PowerVault

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

Metric	Controller	Drive	Host	Pool	Pool Backend	System	System Backend	Volume
Total Size								X
Used Size				X				X

SC Series

Metric	Drive	FC, SAS, iSCSI	Pool	Pool Backend	System	System Backend	Volume
% Read	X	X	X	X	X	X	X
Bandwidth	X	X	X	X	X	X	X
Bandwidth by Read/Write	X	X	X	X	X	X	X
CPU Utilization					X		
Free Size			X				
IO Size		X	X	X	X	X	X
IO Size by Read/Write		X	X	X	X	X	X
IOPS	X	X	X	X	X	X	X
IOPS by Read/Write	X	X	X	X	X	X	X
Latency	X	X	X	X	X	X	X
Latency by Read/Write	X	X	X	X	X	X	X
Queue Length	X	X	X	X	X	X	X
Total Size							X
Used Size			X				X

Unity XT family

Metric	Block	Drive	Ethernet	Fibre Channel	File	iSCSI	Pool	Pool Backend	System	System Backend	System-Cache
% Read	X	X			X		X	X	X	X	
Allocated Size	X										
Bandwidth	X	X	X	X	X	X	X	X	X	X	
Bandwidth by In/Out			X								

Metric	Block	Drive	Ethernet	Fibre Channel	File	iSCSI	Pool	Pool Backend	System	System Backend	System-Cache
Bandwidth by Read/Write	X	X		X	X	X	X	X	X		
Bandwidth by SP	X	X					X	X	X		
Bandwidth by SP and Read/Write	X	X					X	X	X		
Block Latency	X						X		X		
Block Latency by Read/Write	X										
Block Latency by Read/Write and SP	X										
Block Latency by SP	X										
CPU Utilization									X		
Errors			X								
Errors by In/Out			X								
Free Size							X		X		
IO Size	X				X		X	X	X	X	
IO Size by Read/Write	X						X	X	X		
IO Size by SP	X						X	X	X		
IO Size by SP and Read/Write	X						X	X	X		
IOPS	X	X			X		X	X	X	X	
IOPS by Read/Write	X						X		X		
IOPS by SP	X						X		X		
IOPS by SP and Read/Write	X						X		X		
Latency							X		X		

Metric	Block	Drive	Ethernet	Fibre Channel	File	iSCSI	Pool	Pool Backend	System	System Backend	System-Cache
Latency by Read/Write							X		X		
Latency by SP							X		X		
Latency by SP and Read/Write							X		X		
Packets			X								
Packets by In/Out			X								
Queue Length							X		X		
Requests				X		X					
Requests by Read/Write				X		X					
Total Size	X										
Used Size							X		X		
vVol Latency							X		X		
Total Link Errors				X							
Total Link Errors by Link Error				X							
% Clean											X
% Dirty											X
% Free											X
% Read Hits											X
% Write Hits											X
Flushed											X

VMware

Metric	ESXi	Virtual Machine	Datastore
Active Memory	X	X	
Bandwidth per Datastore		X	
CPU Readiness		X	

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

XtremIO

Metric	Initiator	System	Target	Volume
Bandwidth	X	X	X	X
Bandwidth by Read/Write	X	X	X	X
Block Latency	X	X	X	X
Block Latency by Read/Write	X	X	X	X
CPU Utilization		X		
Free Size		X		
IOPS	X	X	X	X
IOPS by Read/Write	X	X	X	X
Logical Size		X		
Used Size		X		