Module 10
Cluster maintenance

About this module

This module focuses on enabling you to do the following:

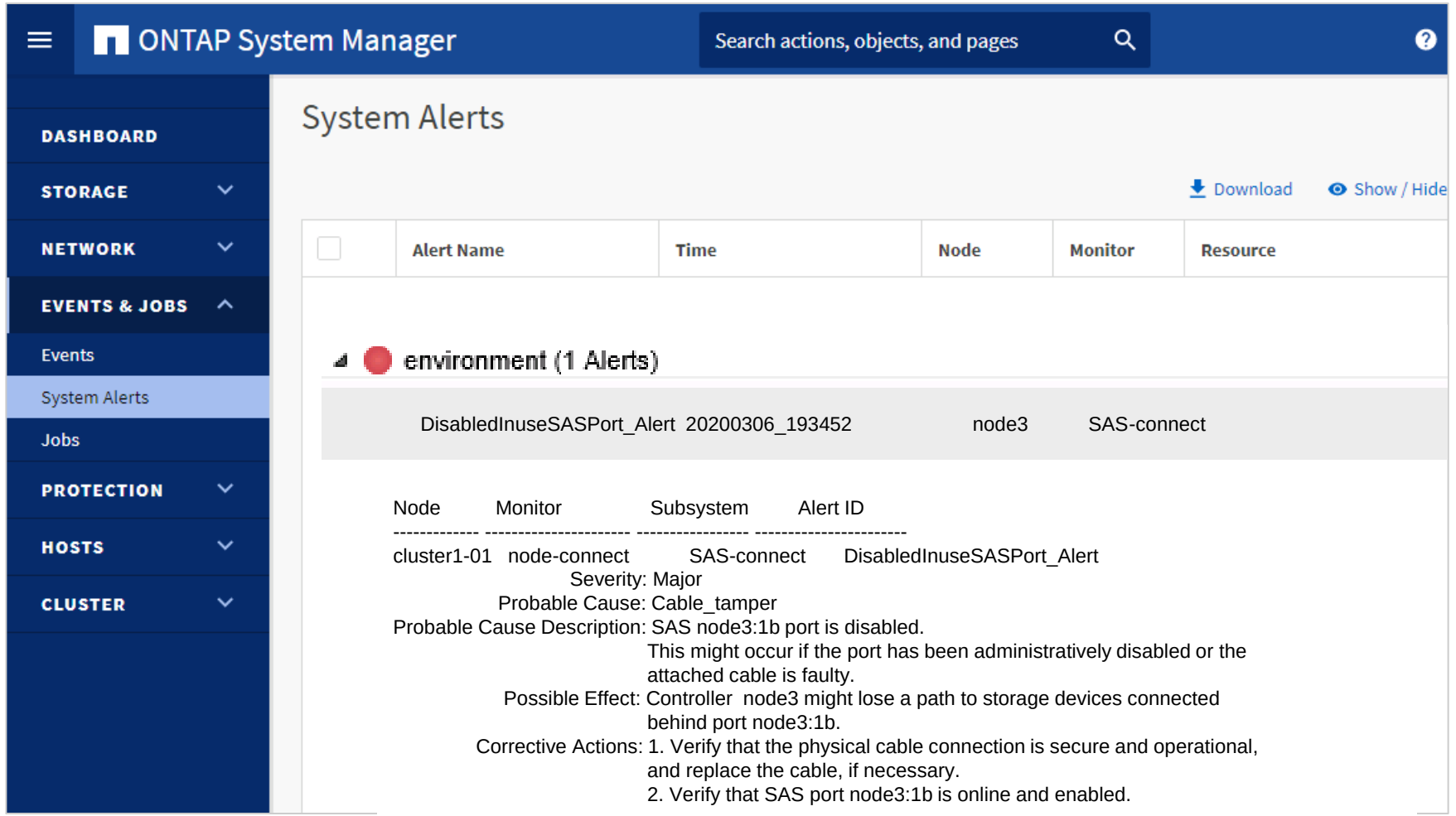
- Navigate the NetApp Active IQ customer dashboard
- Plan for NetApp ONTAP software upgrades
- Follow recommended practices for peak performance
- Configure event notifications and alerts
- Prepare to engage NetApp technical support
- Perform cluster maintenance

Lesson 1
Data collection, monitoring, and automation tools

Alerts

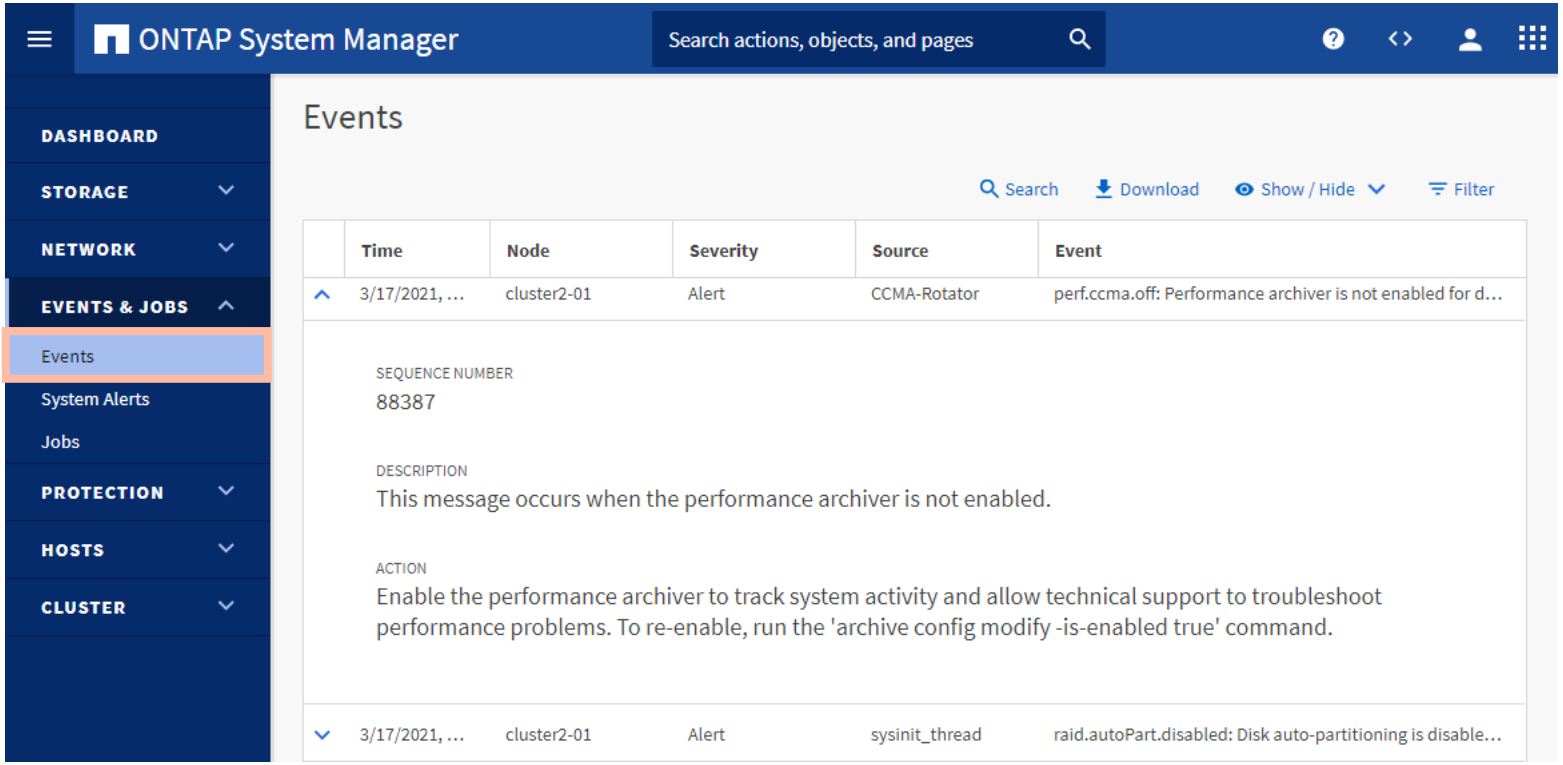
Tools for monitoring the system:

- NetApp ONTAP System Manager
- Event management system (EMS)
- AutoSupport
- NetApp Active IQ Unified Manager (formerly OnCommand Unified Manager)



EMS

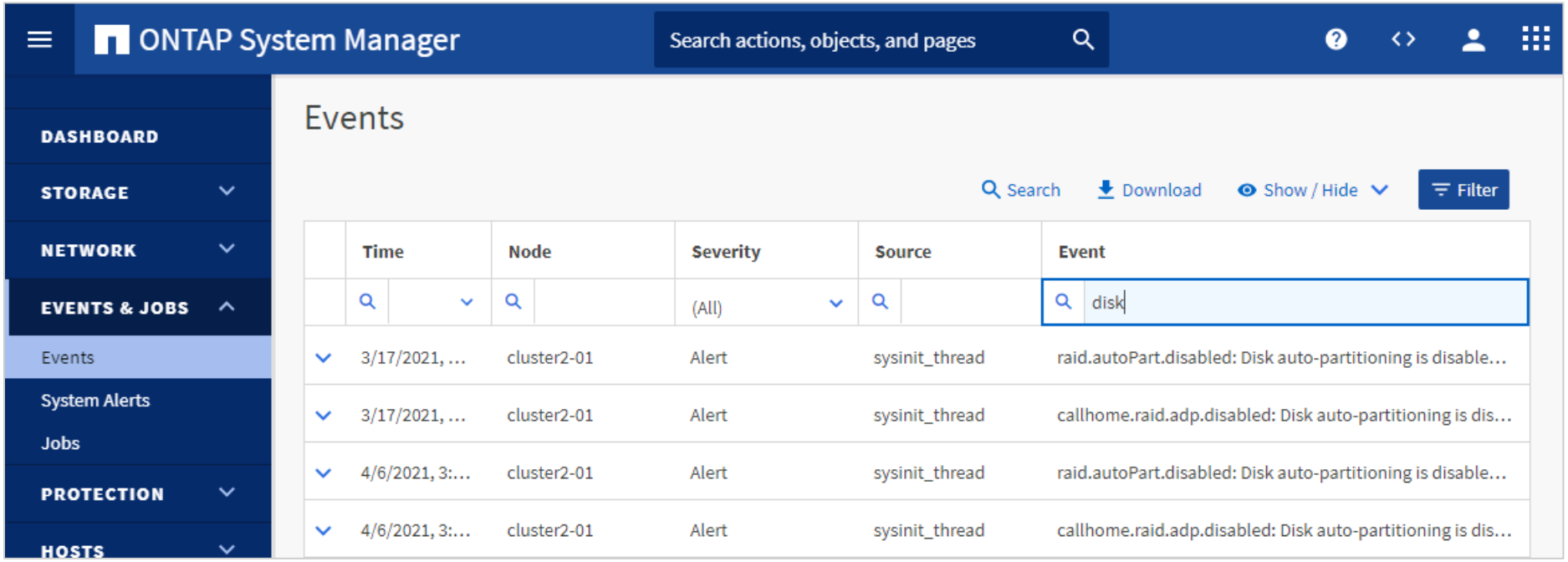
- The event management system (EMS) does the following:
  - Writes events to the event log
  - Sends and routes notifications of events
  - Collects events throughout the cluster
  - Can view events of all nodes from any node
    `::> event log show`
- Each event contains the following:
  - Message name
  - Severity level
  - Description
  - Corrective action, if applicable



Event log filtering

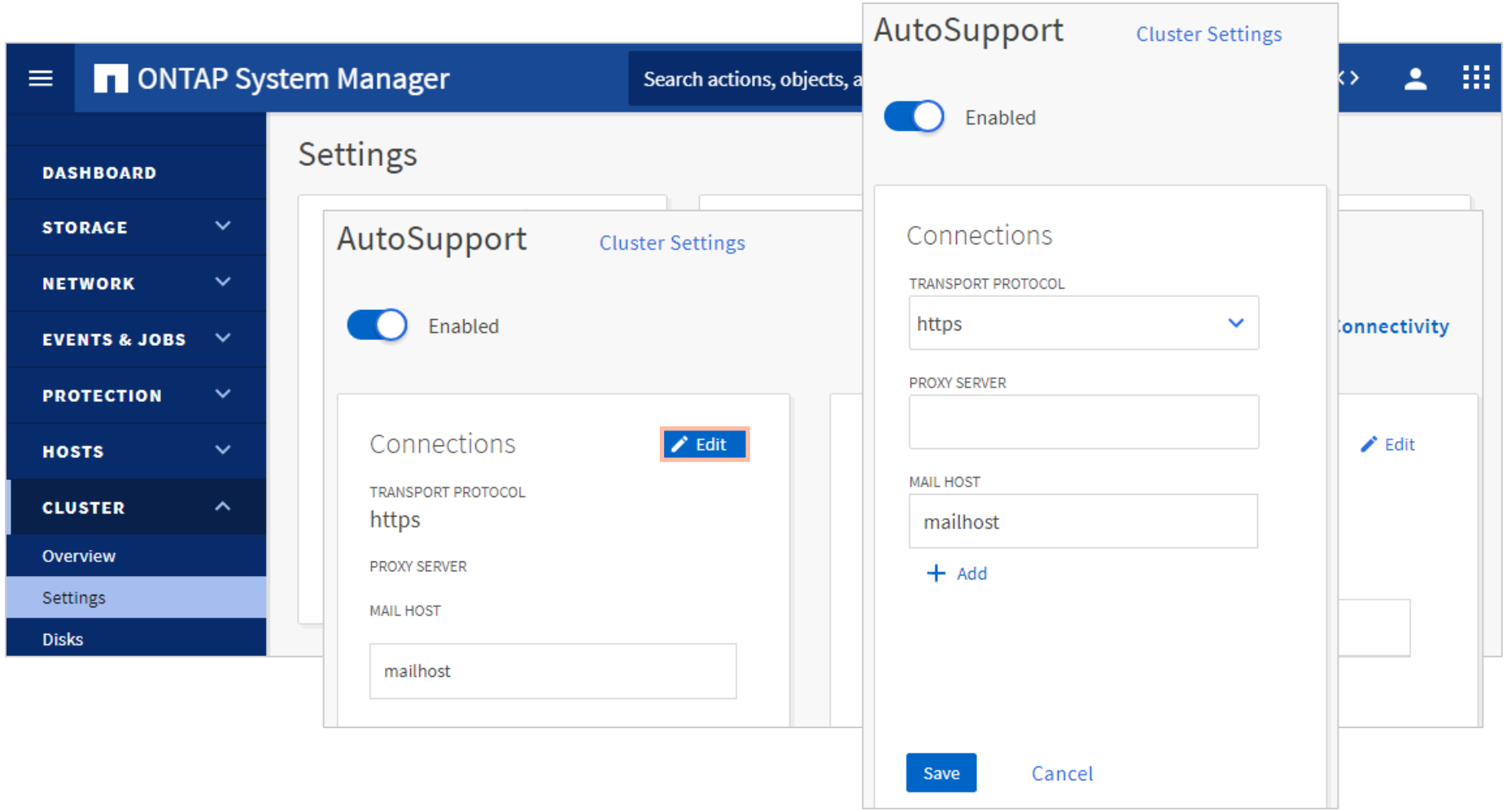
Filter EMS log messages by severity, time, message name, and other criteria.

```
::> event log show -severity {EMERGENCY|ALERT|ERROR|NOTICE|INFORMATIONAL|DEBUG}
::> event log show -time "08/30/2020 10:00:00".."08/30/2020 11:30:00"
::> event log show -severity informational -message-name kern.uptime.filer
```



AutoSupport

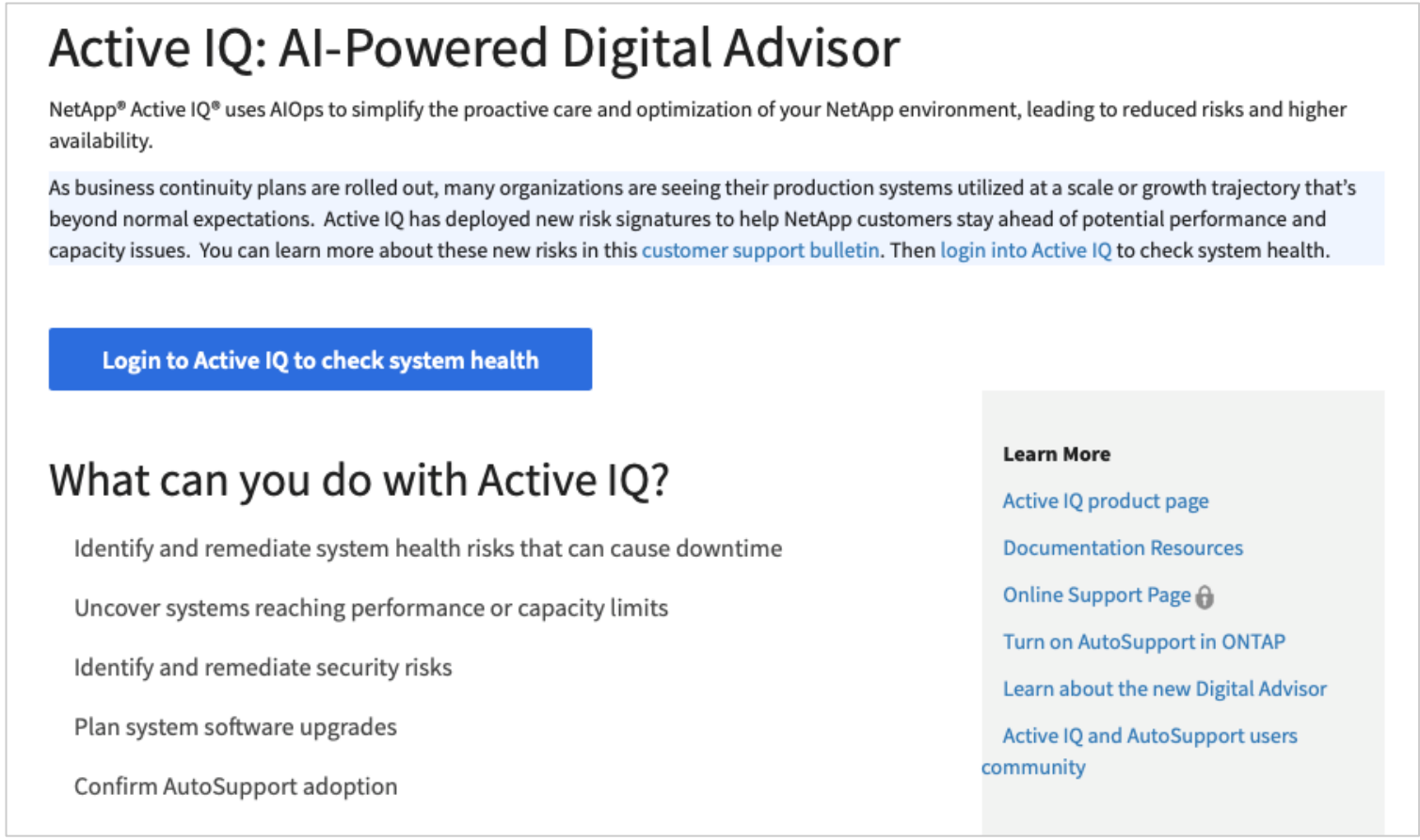
- Is an integrated monitoring and reporting technology
- Checks the health of NetApp systems
- Should be enabled on all ONTAP clusters



Active IQ

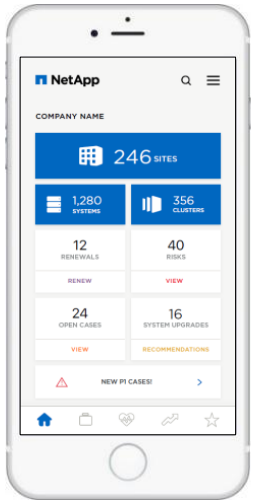
The evolution of AutoSupport

- Actionable intelligence
- Predictive, self-healing care
- Global analytics



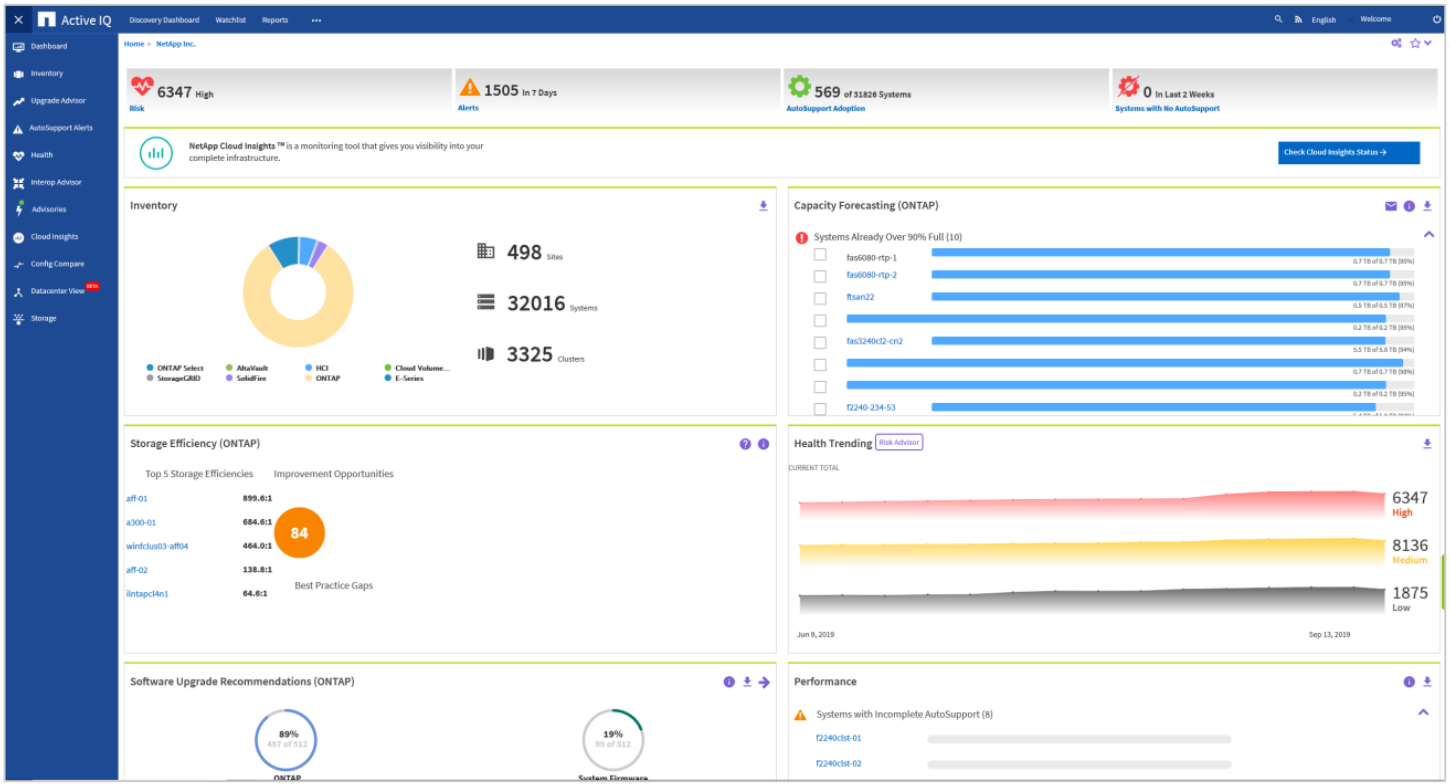
Active IQ

- Dashboard
  - Inventory of NetApp systems
  - Health summary and trends
  - Upgrade Advisor
  - Storage efficiency and risk advisors
- Mobile app for iOS and Android

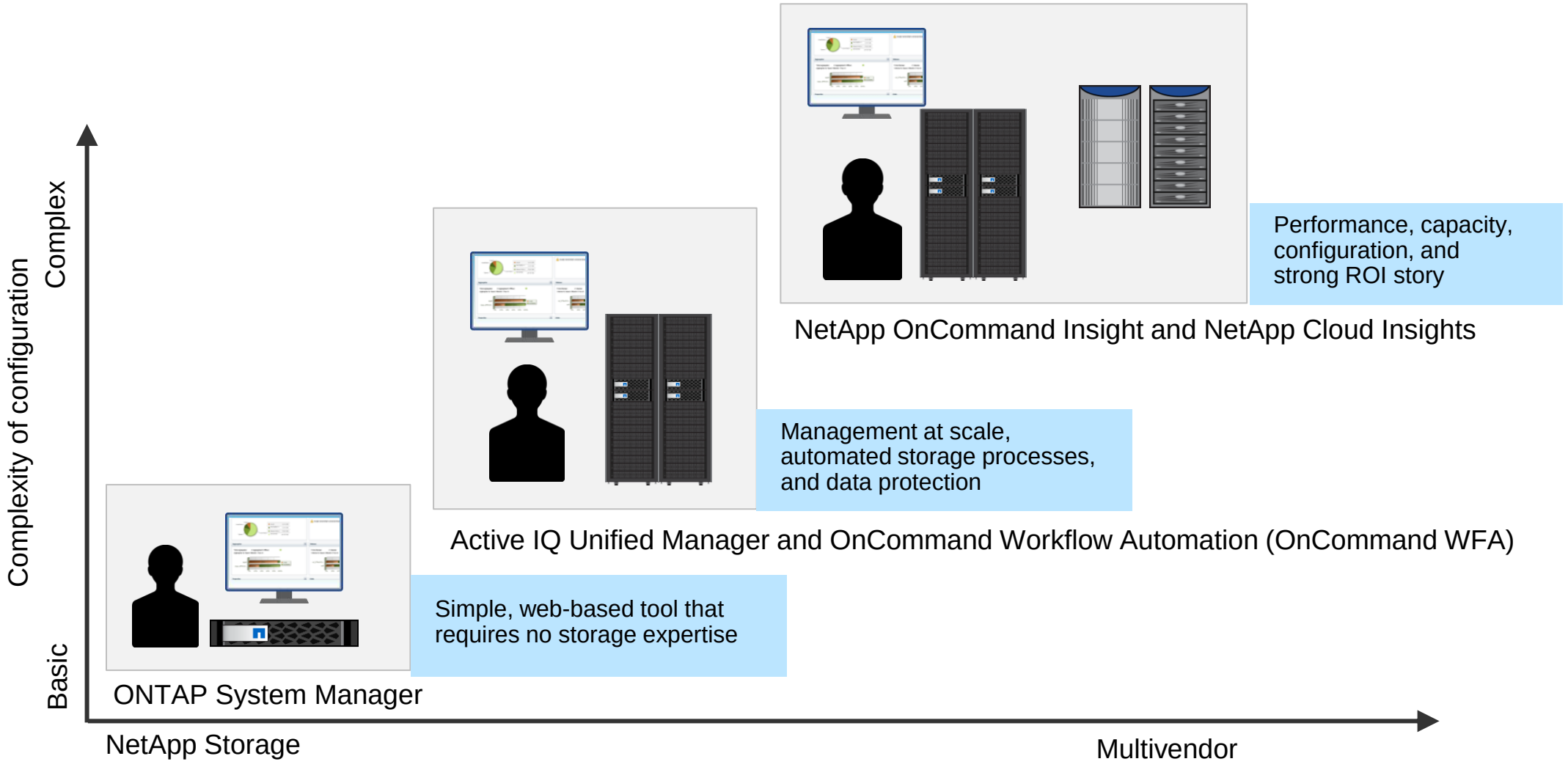


DOWNLOAD ON THE App Store

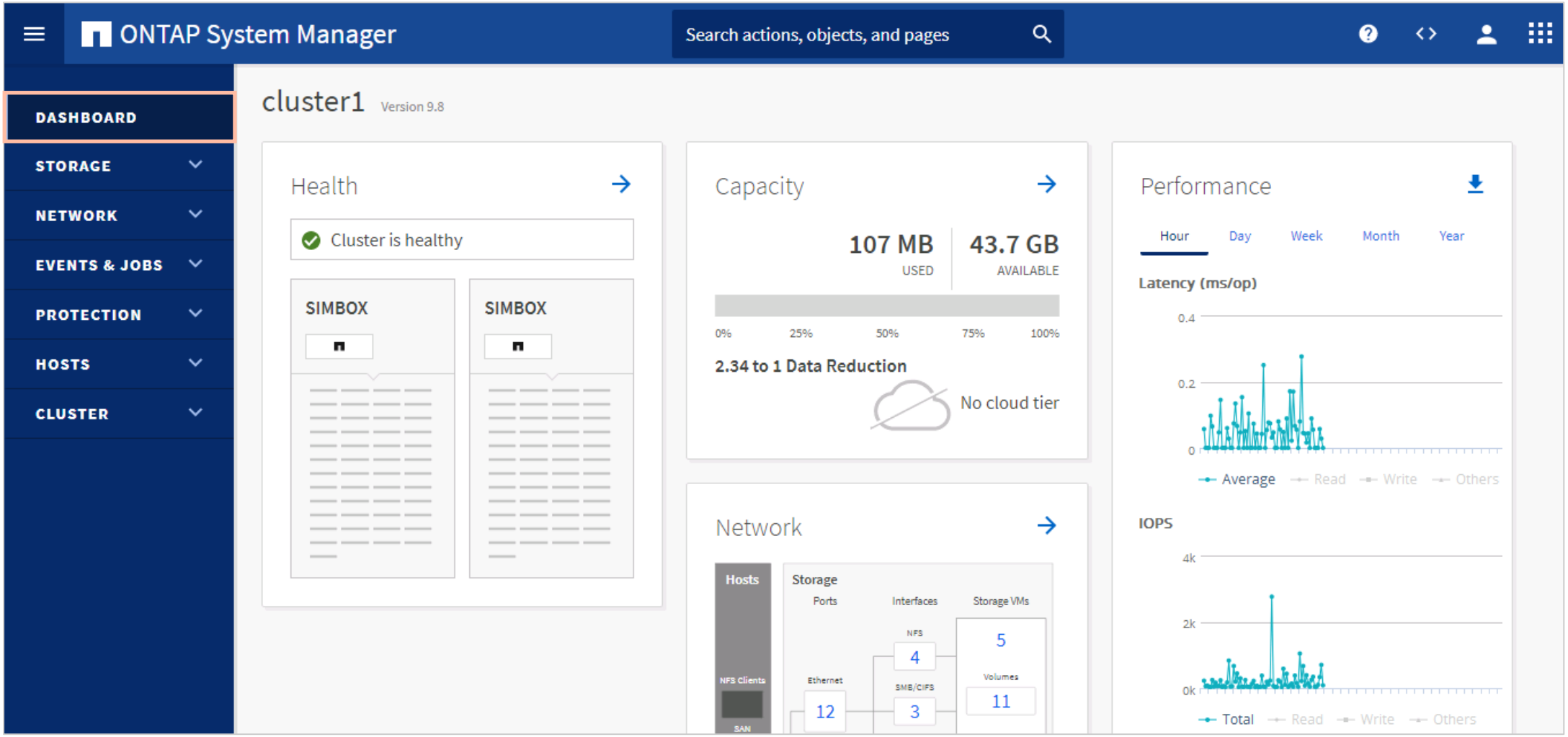
GET IT ON Google Play



Management portfolio



System Manager dashboard



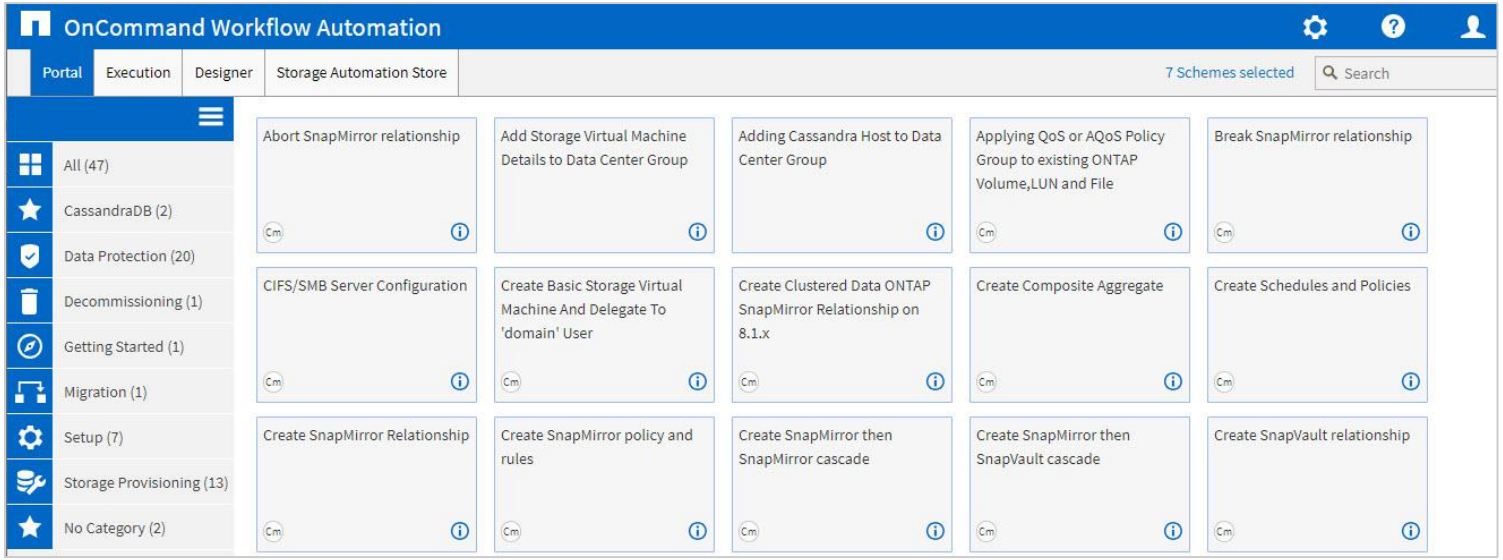
OnCommand WFA

What is OnCommand Workflow Automation?

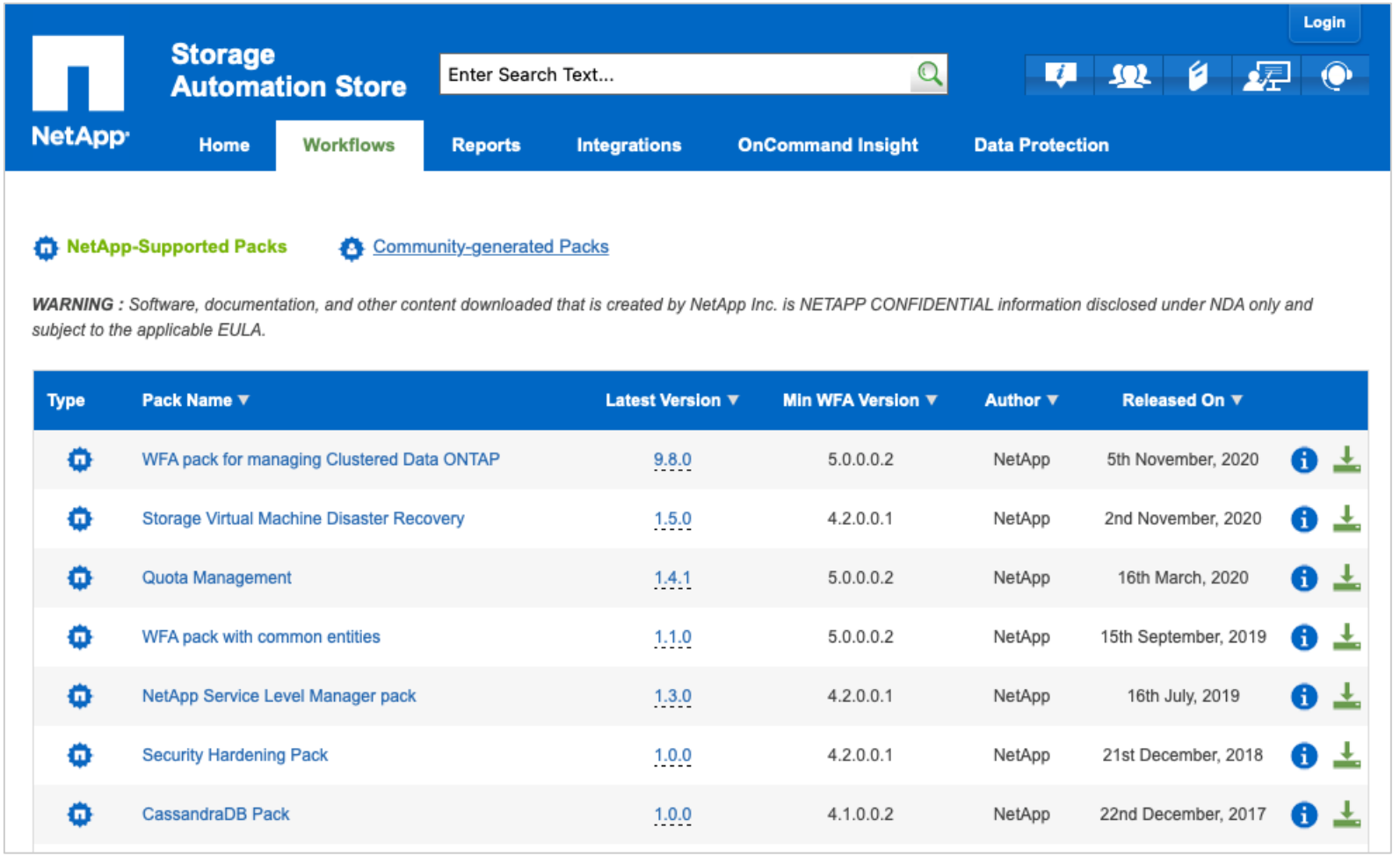
- Highly flexible automation framework

  Enables automation of simple to complex storage processes

- Operations portal
  - One click to perform frequently seen tasks, with more than 45 built-in workflows
  - Authentication and authorization
- Point of integration
  - Initiate third-party actions
  - Drive OnCommand WFA from web services



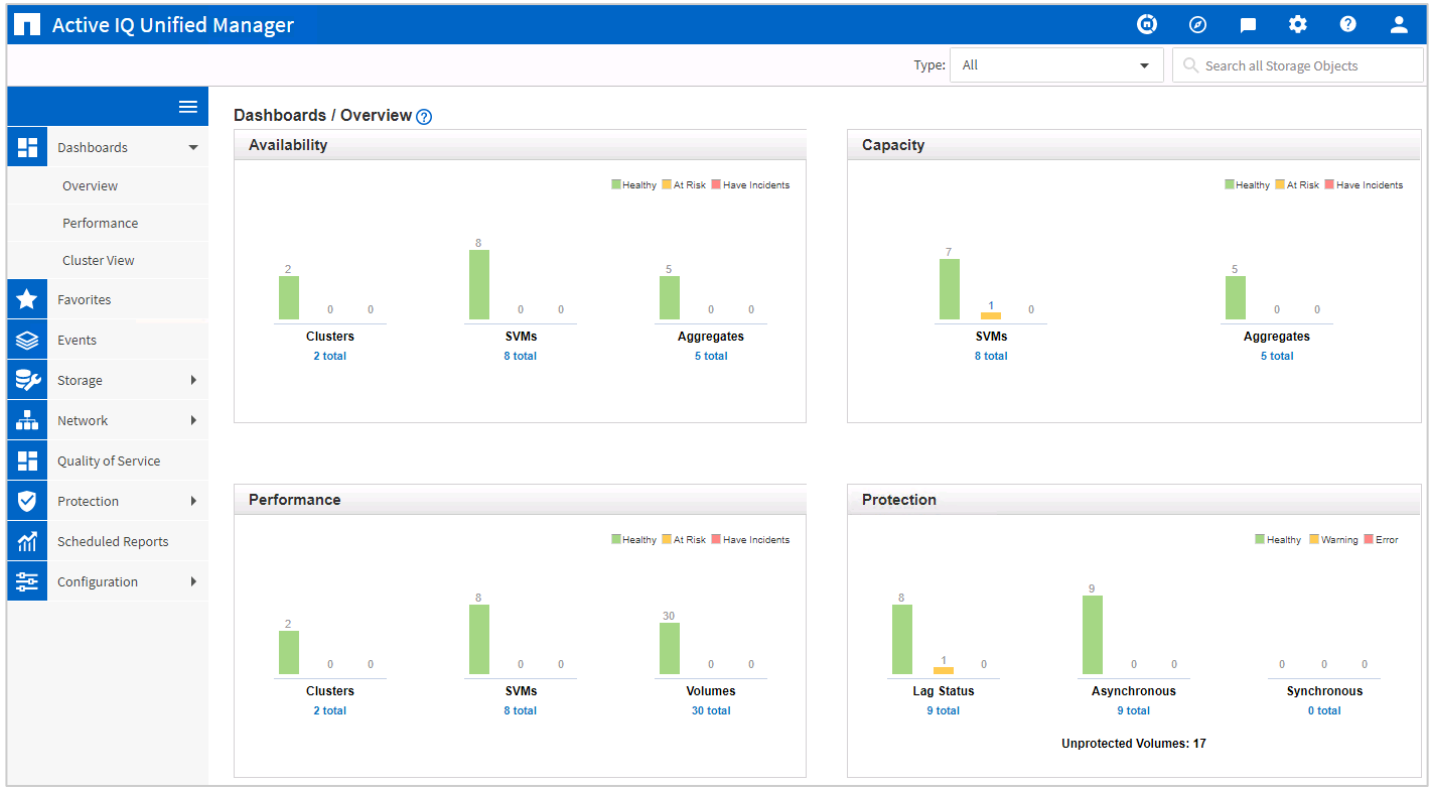
NetApp Storage Automation Store



Active IQ Unified Manager

NetApp-centric application for monitoring multiple NetApp storage systems

- Works with ONTAP System Manager on each storage system
- Supports plug-in modules to extend functionality



To learn more about Unified Manager and how it integrates with OnCommand WFA, enroll in the instructor-led course *Administration of Active IQ Unified Manager.*

OnCommand Insight

- Provides monitoring of your entire storage infrastructure: NetApp and competitor storage, SAN fabric switches, virtualization servers, and virtual machine (VM) hosts that are on premises and in the cloud
- Provides reports on the following:
  - Inventory
  - Capacity
  - Performance
  - Showback and chargeback
- Is highly customizable through APIs and scripting

To learn more, enroll in the online course *OnCommand Insight: Fundamentals.*

NetApp Active IQ OneCollect

- Collects data from a wide array of data center components
- Performs data collection on the following:
  - Hybrid, FC, and Ethernet switches
  - Windows, Linux, Solaris, HPUX, ESXi, AIX, KVM, XenServer, and Oracle VM Manager host types
  - NetApp ONTAP software, ONTAP operating in 7-Mode, E-Series, and EMC Isilon storage controllers
  - NetApp SnapCenter software
  - Hyperconverged infrastructure (HCI) components including NetApp SolidFire, ONTAP Select, and VMware vCenter
- Uses an interface like the NetApp Active IQ Config Advisor UI

Lesson 2
Backing up and restoring your cluster configuration

Cluster configuration backup files

Backing up the cluster configuration enables you to restore the configuration of any node or the entire cluster in a disaster or emergency.

- Configuration backup files are archive files (.7z) that contain information for all configurable options that are necessary for the cluster and cluster nodes to operate properly.
- There are two types of configuration backup files:
  - Node configuration backup file
  - Cluster configuration backup file
- Configuration backup files do *not* include any user data.

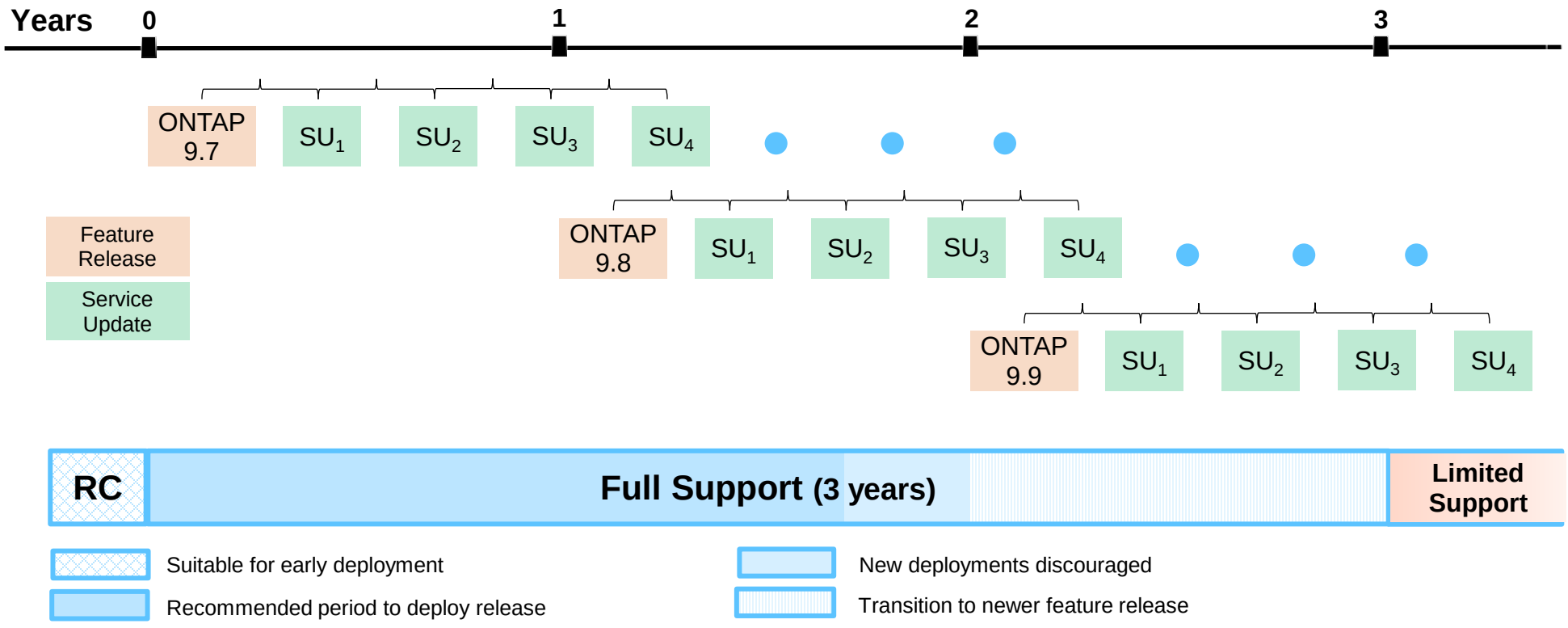
Cluster backup scheduling

- ONTAP software automatically creates the configuration backup files every 8 hours, daily, and weekly.
- Use the `system configuration backup` commands to manage cluster and node configuration backup files and backup schedules and to perform a configuration restore.
- Before you restore a node or cluster configuration, *always* see the *ONTAP® 9 System Administration Reference* and contact technical support.

  There might be discrepancies between the configuration backup file and the configuration that is present in the cluster.

Lesson 3
Upgrading your cluster

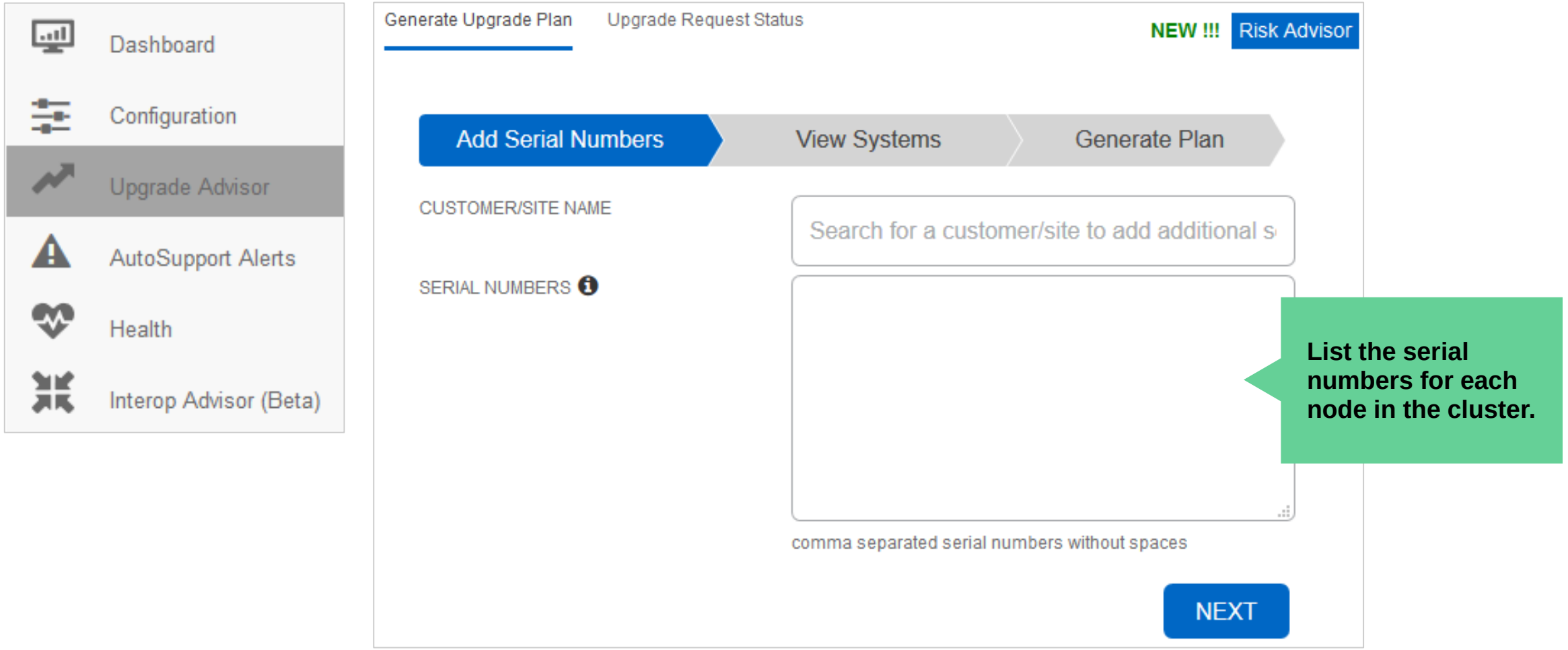
Release support



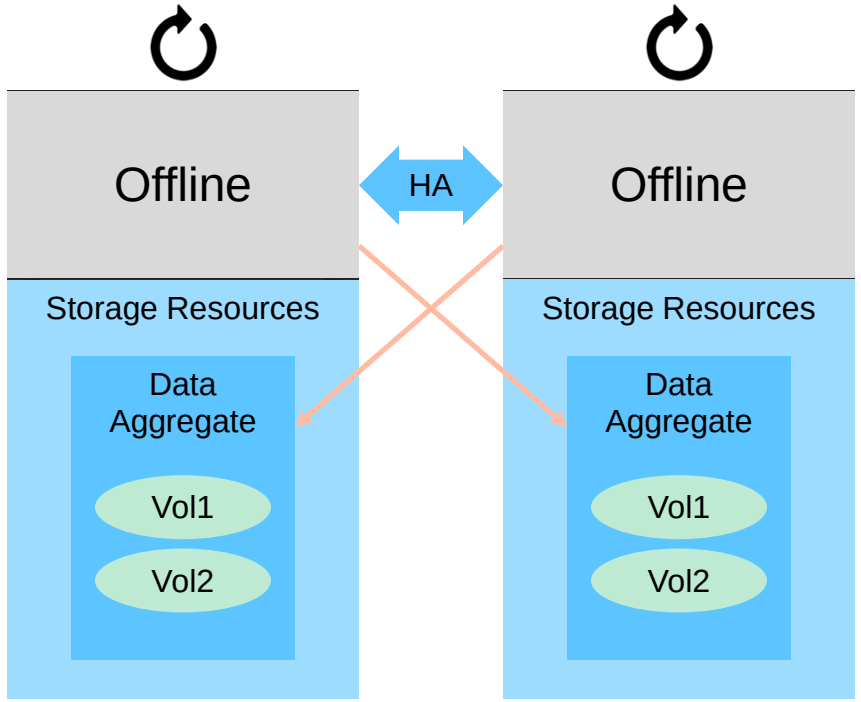
Learning about new ONTAP features

- NetApp recommends upgrading your systems to the latest ONTAP general availability release.
- How can you learn what has changed since your current running version?
  - The release notes in the ONTAP documentation
  - The *What Is New in ONTAP <version #>* online courses
  - The CLI Comparison Tool:
    https://mysupport.netapp.com/NOW/products/support/cli-comparison.shtml

Active IQ Upgrade Advisor



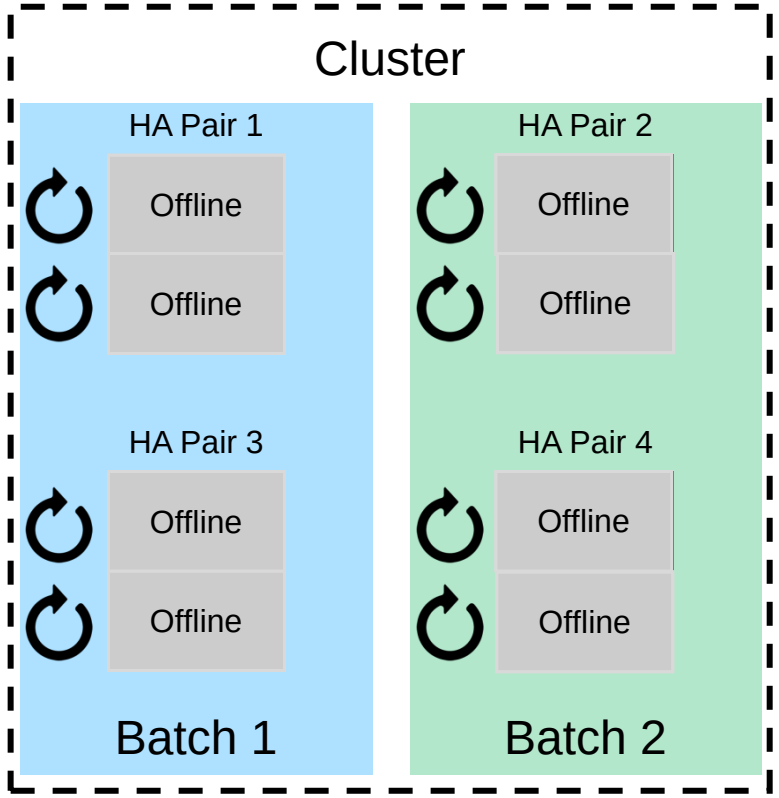
Rolling upgrade



To upgrade software in a cluster of two or more nodes, complete the following steps:

1. Have the high-availability (HA) partner take control of the storage resources.
2. Take the node that is being upgraded offline.
3. Wait as the node reboots and is upgraded.
4. After the upgrade is complete, verify that the failed-over resources are returned home.
5. Repeat the process on the other node of the HA pair.
6. Repeat the process on other HA pairs.

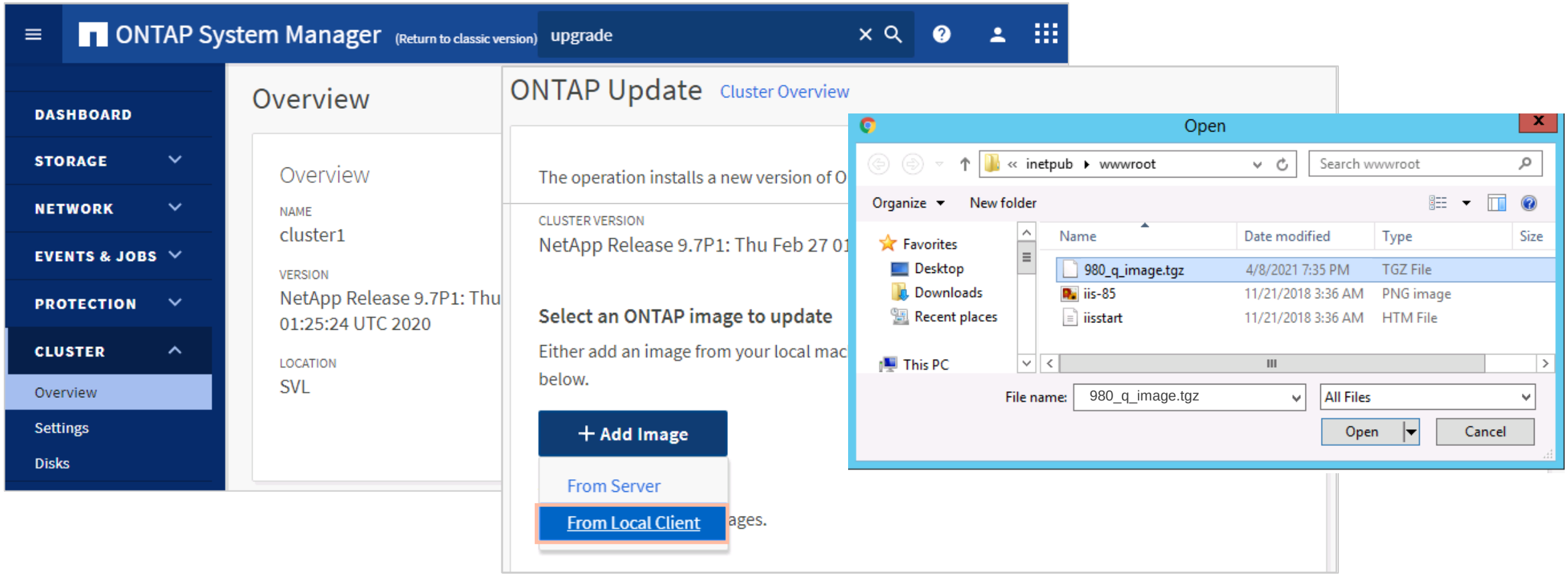
Batch upgrade



To upgrade software in a cluster of eight or more nodes, complete the following steps:

1. Separate the cluster into two batches, each of which contains multiple HA pairs.
2. In the first batch, take one node in each HA pair offline and upgrade the nodes while the partner nodes take over the storage.
3. After upgrades are completed on the first nodes, upgrade the other nodes of the HA pairs.
4. Repeat the process on the second batch.

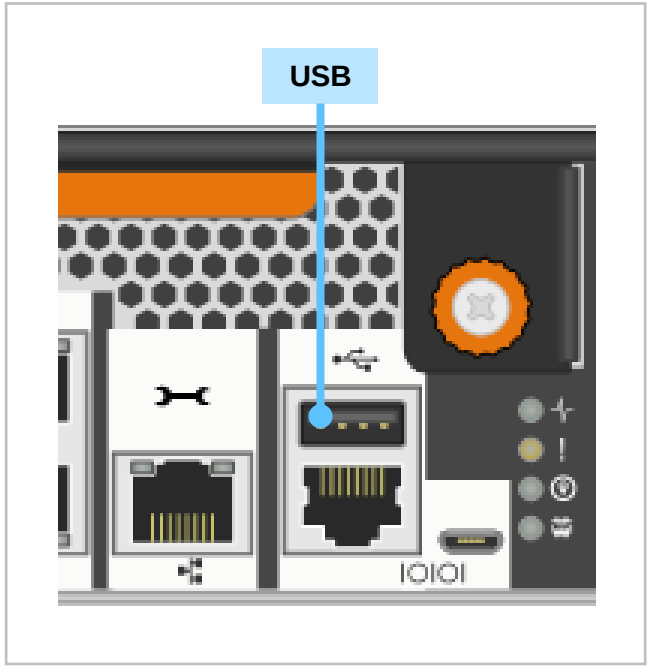
Automated nondisruptive upgrade



More info in Addendum

Install and upgrade from a USB drive

- Many FAS and AFF systems support the installation of ONTAP software and firmware from a FAT32 formatted USB device to do the following:
  - Perform boot device recovery from the LOADER prompt
  - Copy ONTAP software for installation
  - Copy service images for a firmware update
- Use the `system node image` CLI commands.



More info in Addendum

Try this task

From the clustershell on cluster1, type:

```
system node image show –instance
```

1. How many nodes are in your cluster?
2. Which version of ONTAP software is current on each node?
3. Can you tell which image is booted?

Cluster expansion

Complete the following steps in the CLI to add nodes to a multinode switched cluster:

1. Verify that the nodes are configured as HA pairs and are connected to the cluster interconnect.
2. Power on both nodes of the HA pair.
3. Start the Cluster Setup wizard on one of the nodes.
4. Use the **`join`** command and follow the wizard.
5. Repeat Steps 3 and 4 on the partner node.

```
::> cluster setup

Welcome to the cluster setup wizard.

You can enter the following commands at any time:
 "help" or "?" - if you want to have a question clarified,
 "back" - if you want to change previously answered questions, and
 "exit" or "quit" - if you want to quit the cluster setup wizard.
 Any changes you made before quitting will be saved.

You can return to cluster setup at any time by typing "cluster
setup".
To accept a default or omit a question, do not enter a value.

Do you want to create a new cluster or join an existing cluster?
{create, join}: join
```


Lesson 3
Performance recommended practices

Performance considerations

Workloads

I/O operation types:

- Random
- Sequential

Quality of service (QoS)

Analyzing I/O

I/O operations per second

- I/O is measured in IOPS.
- IOPS measures *how many* requests are being managed in 1 second.
- IOPS data is most useful if I/O has any of the following features:
  - I/O request patterns are random.
  - I/O requests are small.
  - Multiple I/O sources must be managed.

Analyzing I/O

Latency and response time

Latency is measured in microseconds and milliseconds.

Latency is a measurement of how long data processing takes.

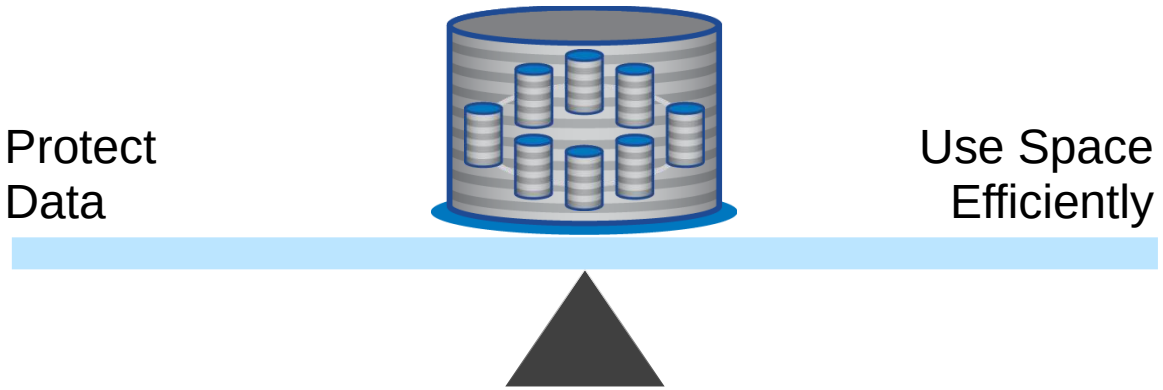
Response time is the elapsed time between an inquiry and the response to that inquiry.

Response time is a sum of all latency that is encountered between the inquiry and receipt of a response.

ONTAP performance

You must balance the need for performance and the need for resilience:

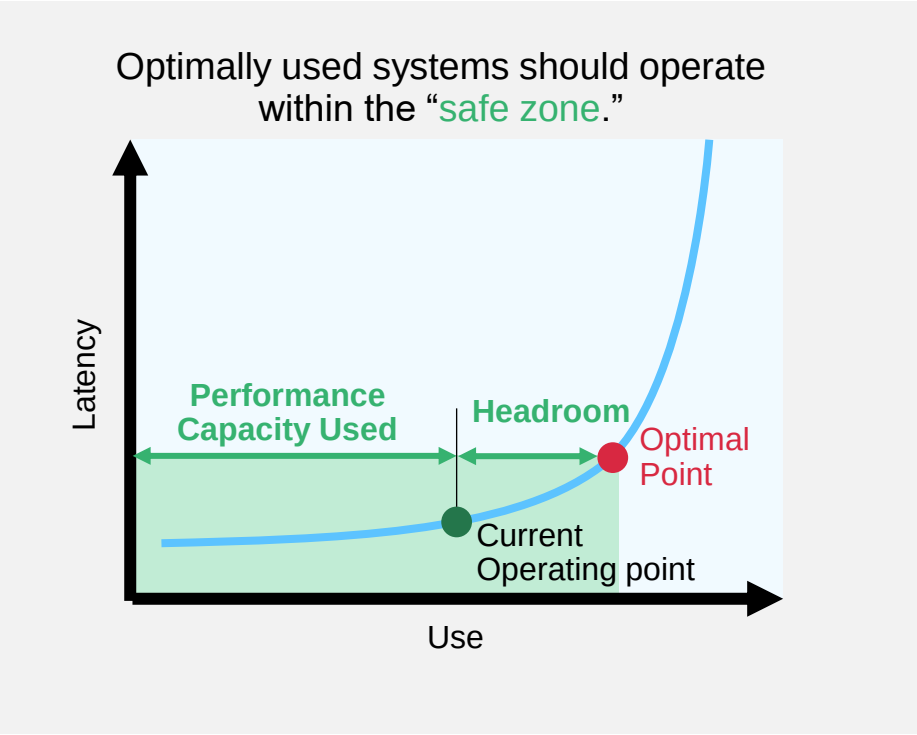
- Performance: More drives per RAID group spread the workload over more drives.
- Resilience: Fewer drives per RAID group mean that parity must protect fewer drives.



Avoid being above the maximum optimal operating point.

Headroom and performance capacity used

Key for optimal use of a system



- Optimal point:

  The maximum optimal operating point for a system

  A small increase beyond this point results in a bigger increase in latency.

- Headroom:
  - A metric that is used in ONTAP 9 software
  - The remaining useful capacity of a resource, when measured from the optimal point

- Performance capacity used:
  - A metric that is used in Unified Manager
  - Equal to the optimal point minus headroom
  - Performance metric for node and aggregate

Remaining Performance Capacity

- Available performance capacity or “headroom” for additional workload.
- Steps to collect a CPU sample

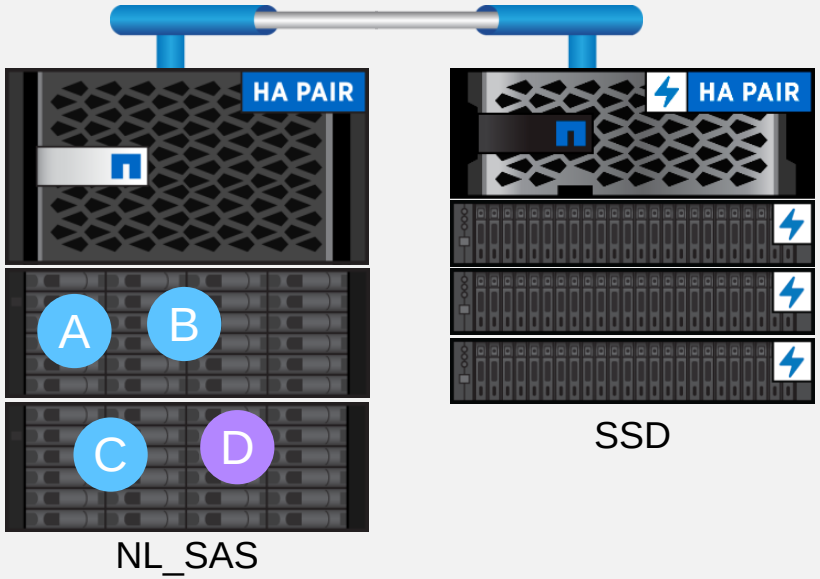
```
rtp-nau::> set -privilege advanced
rtp-nau::*> statistics start –object resource_headroom_cpu
rtp-nau::*> statistics show -object resource_headroom
```

```
 Counter                                                     Value
    -------------------------------- ----------------------------------
    ewma_hourly                                                     -
                                 ops                             4376
                             latency                            37719
                         utilization                               60
                   optimal_point_ops                             2573
               optimal_point_latency                             3589
          optimal_point_utilization                               72
     optimal_point_confidence_factor                               1
```

72%-60%=12%

Maintain optimal operating point

Adding and relocating resources

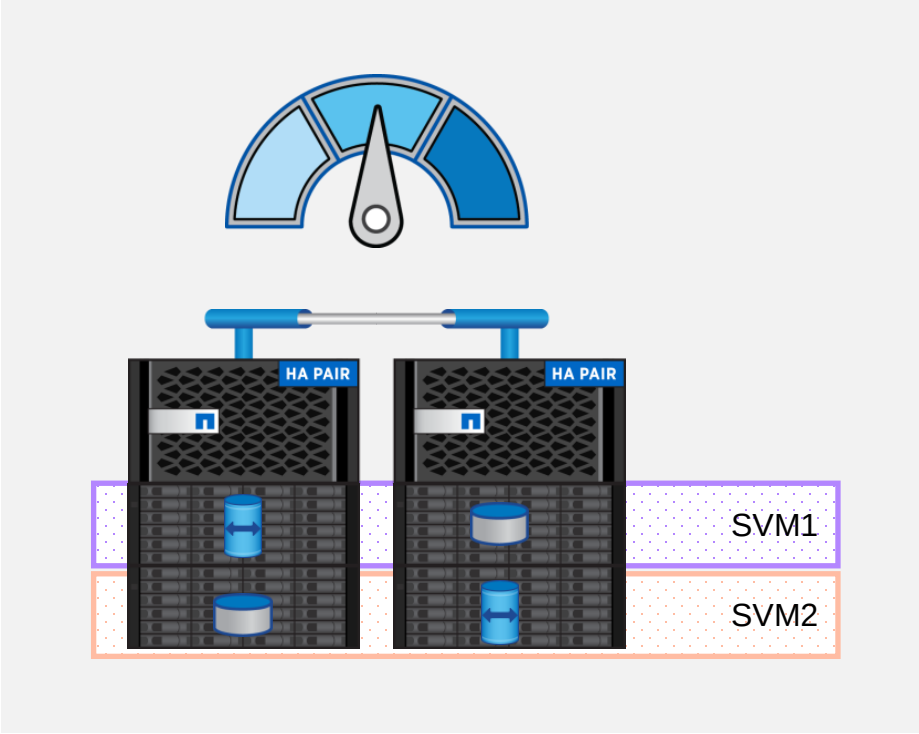


Relocating resources nondisruptively:

- Moving volumes and LUNs
- Moving an aggregate between the nodes of an HA pair

Maintain optimal operating point

Quality of service



SVM = storage virtual machine or storage VM

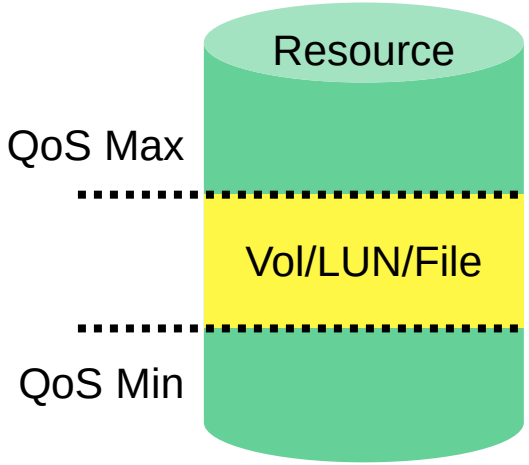
- Key capability to *manage* and *control* performance
- Effective in *optimally* used systems
- Increasingly sought by both enterprise and service provider market segments

Use cases:

- Contain “runaway” workloads (QoS Max)
- Experience dedicated workload performance (QoS Min)
- Enable performance services classes

Managing workloads

Guaranteeing performance



QoS Max:

- Throttles performance for IOPS, megabytes per second, or both
- Enables service-level objectives
- Prevents “runaway” applications
- Is applicable to storage VMs, volumes, LUNs, and files
- Scales up to 40,000 objects per cluster

QoS Min:

- Guarantees IOPS performance
- Enables service classes
- Prevents application timeouts
- Is applicable to volumes, LUNs, and files
- Scales up to 40,000 objects per cluster

Maximizing performance

Ways to minimize performance issues:

- Correctly size and follow recommended practices for the specific workload.
- Verify the supported minimums and maximums.
- Adhere to the ONTAP storage system mixing rules (Hardware Universe).
- Verify the compatibility of components, host operating system, applications, and ONTAP software (NetApp Interoperability Matrix Tool [IMT]).

Potential performance issues:

- **Controller:** Resource overuse, ONTAP version, offline, or rebooting
- **Storage:** Drive types, aggregate configuration, volume movement, or free space
- **Networking:** Configuration, LIF location, port saturation, port speeds, or indirect access
- **Host or clients:** Application, drivers, network adapter, or user knowledge

Create free space in an aggregate

Simple steps

A full aggregate affects performance and might lead to an inability to write new data. Use these no-risk measures to free space:

- Add drives to the aggregate.
- Move some volumes to another aggregate with available space.
- Enable space-saving features, such as deduplication or compression.

Create free space in an aggregate

Complex steps

Use these measures with caution:

- Shrink the size of volume-guaranteed volumes in the aggregate.

  You can do so manually, or you can use the `growshrink` option of the automatic resize capability.

- Change volume guarantee type to `none` on volumes that use large amounts of space so that the volumes take up less space in the aggregate.

- Delete unneeded volume Snapshot copies if the volume has a guarantee type of `none`.

  Note: Blocks are returned to free space only when there are no pointers to the block. You might need to delete multiple Snapshot copies before you gain any space.

- Delete unneeded volumes.

  The volume recovery queue holds a deleted volume for 12 hours. Contact NetApp technical support if you need to purge the queue sooner.

Lesson 5
Technical support

System logs

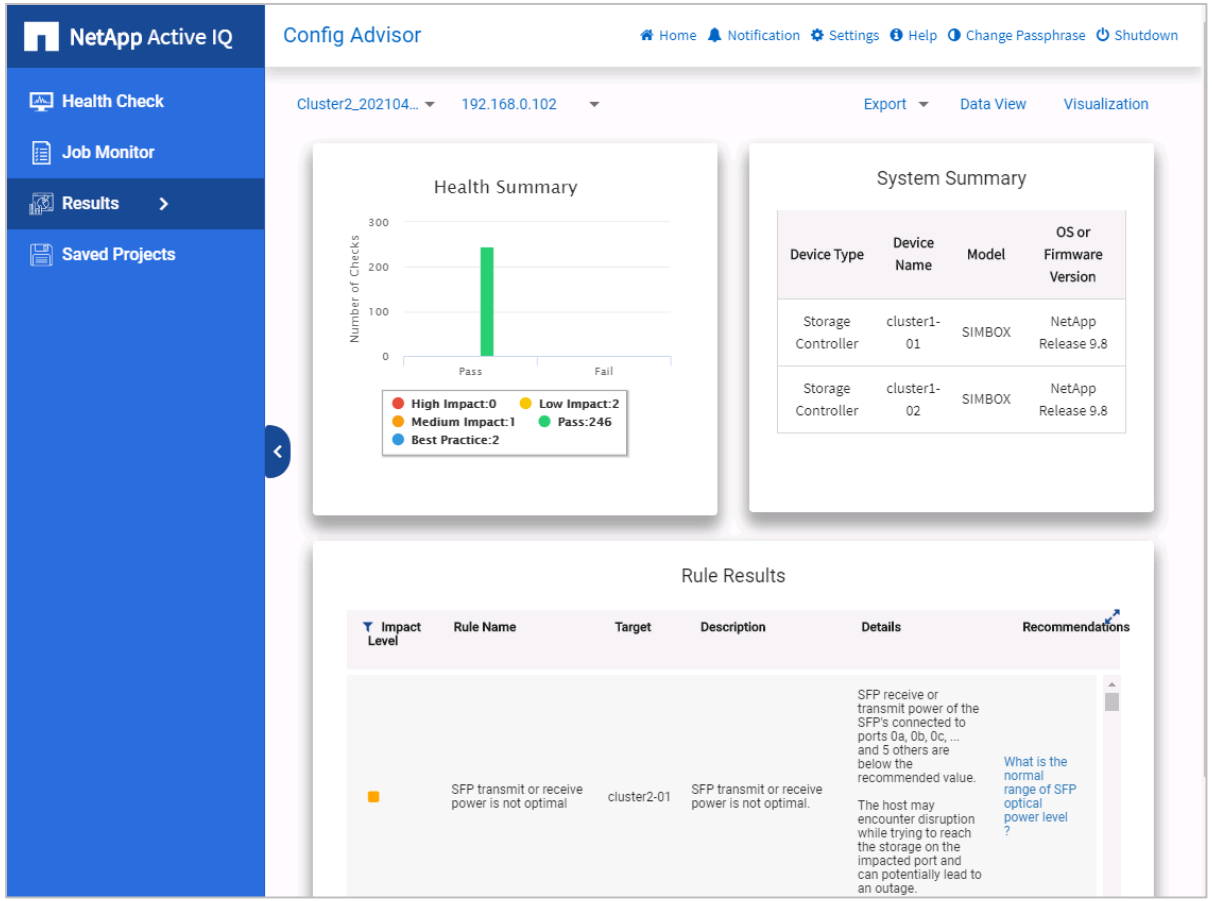
- Log messages can be sent to the following:
  - The console
  - The message log
- You can access the message log by using the following:
  - The `debug log` command
  - System Manager
  - NetApp Active IQ OneCollect
  - A web browser: https://<*cluster-mgmt-ip*>/spi/<*nodename*>/etc/log/

Use the **`debug log`** command to browse the messages.log file.

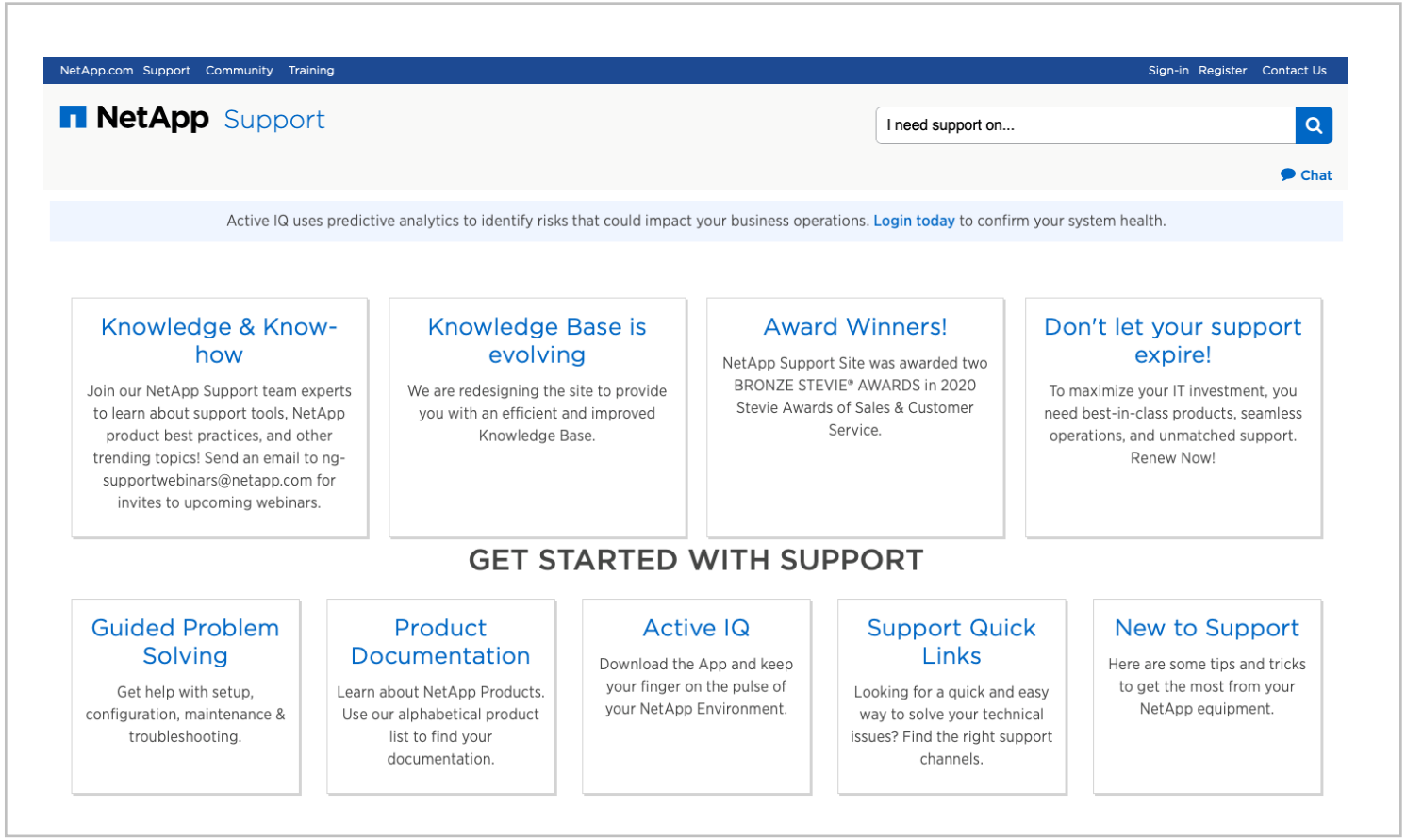
Use Config Advisor before and after maintenance

What is Config Advisor?

- Use to verify or troubleshoot cabling and configuration of cluster and switches.
- Can be configured to run on a schedule.
- Download from the Support site and run from PC connected to the serial port or over the network.



NetApp Support



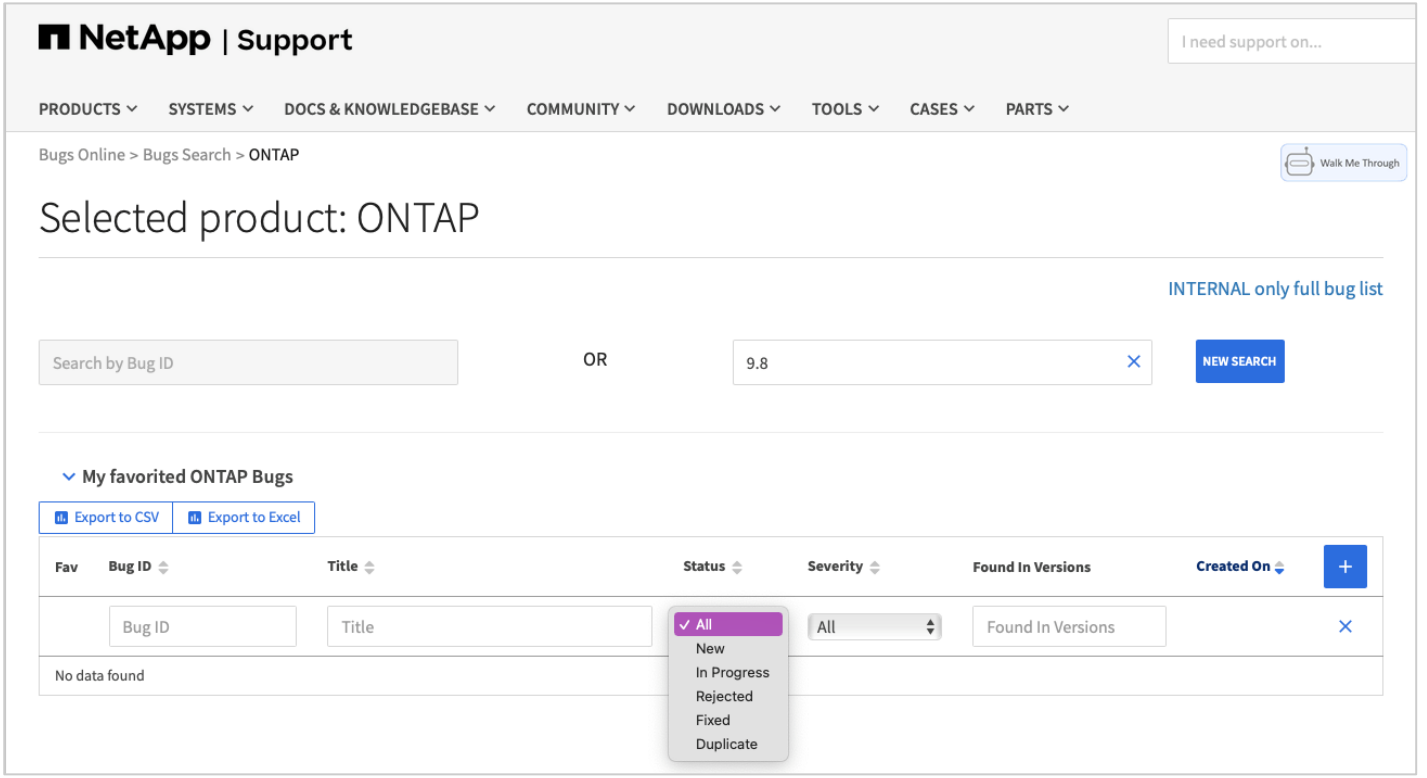
- **NetApp Support:** mysupport.netapp.com
- **Hardware Universe:** hwu.netapp.com
- **NetApp IMT:** mysupport.netapp.com/matrix

Bug tools and reports

Stay up to date about bugs and bug fixes with the tools on the NetApp Support site.

https://mysupport.netapp.com/site/bugs-online/product

- Bug Search
- Release Bug Comparison Tool
- Release Bug Advisor
- Bug Watcher Summary
- New Bug Alerts Profiler



Lesson 6 Documentation

Maintenance-related documentation

- Checklists
  - Create a plan. Follow the plan. Document the outcome and refine the plan.
  - Submit checklists with change control procedure documentation.
  - Pro tip: Include go/no-go checkpoints.
- Change control procedures
  - Implement a formal approval change control process to track changes to the storage system (and protect yourself when the unexpected happens).
  - Use the NetAppDocs NetApp PowerShell Toolkit (available in the Tools menu on the NetApp Support site) to build configuration documentation.

Maintenance-related documentation

Communication and call logs

- Maintenance downtime communication
  - Become familiar with the work of end users and how downtime affects them.
  - Provide end users frequent warnings.
  - Create and use a short, standardized email template so that end users recognize it and know to read it.
  - Set an established maintenance window. Use it even if there is no maintenance to perform. This practice trains users to see downtime as mandatory and not negotiable.
- Call logs
  - Track every support call with your vendors: what the problem was, how long it took to get a solution, and the effectiveness of the solution.
  - Ensure that you are receiving the level of support that your company paid for and that you expect.

Manage log files

- Consider setting up log forwarding of systems and servers to a central system log (syslog) server.

  Use the `cluster log-forwarding` command to set up forwarding on ONTAP clusters.

- Establish a schedule to roll forward the log files of applications, like PuTTY, that do not have the capability built in.

- Add the creation of dedicated log files to your maintenance checklists.

Recommended preventive maintenance checklist

- ✓ Replace failed components as soon as possible.
- ✓ View weekly AutoSupport and health checks in Active IQ on the NetApp Support site.
- ✓ Run Config Advisor once each month to detect cabling issues.
- ✓ Read the release notes for new versions of ONTAP software to determine whether you can benefit from new features or bug fixes.
- ✓ Twice each year, verify Return Material Authorization (RMA) contact information and the expiration date of the support contracts.
- ✓ Change the Cluster and SVM Admin passwords at least twice each year.

Knowledge check

Module 10: Cluster maintenance

Knowledge check

Where do you find the Upgrade Advisor tool to plan an ONTAP upgrade?

a. System Manager

b. in the Tools page on the NetApp Support site

c. on the Downloads page at upgradeontap.netapp.com

d. in the Active IQ page on the NetApp Support site

Knowledge check

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Knowledge check

Which three intervals does ONTAP follow when creating cluster configuration backup files? (Choose three.)

a. every hour

b. every 8 hours

c. every 12 hours

d. daily

e. weekly

f. monthly

Knowledge check

Which three intervals does ONTAP follow when creating cluster configuration backup files? (Choose three.)

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b. every 8 hours

c. every 12 hours

d. daily

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f. monthly

Additional learning resources

- OnCommand WFA blog: http://www.wfaguy.com/
- OneCollect demonstration: https://www.youtube.com/watch?v=dTcF-nFRkQQ
- Storage Networking Industry Association (SNIA): https://www.snia.org/
- SAN Storage blog: http://www.sanadmin.net/
- Enterprise Storage website: http://www.enterprisestorageforum.com/
- Justin Parisi's blog: https://whyistheinternetbroken.wordpress.com
- Book: The Practice of System and Network Administration

References

- NetApp Hardware Universe
  http://hwu.netapp.com

- ONTAP 9 Documentation Center
  http://docs.netapp.com/ontap-9/index.jsp
  - *System Administration Reference*
  - *Upgrade Express Guide*
  - *Upgrade and Revert/Downgrade Guide*
  - *Performance Monitoring Express Guide*
  - *Performance Management Power Guide*

- Workflow Automation Documentation Center

- TR-4211: Storage Performance Primer ONTAP 9.2
  https://www.netapp.com/us/media/tr-4211.pdf

Module summary

This module focused on enabling you to do the following:

- Navigate the Active IQ customer dashboard
- Plan for ONTAP software upgrades
- Follow recommended practices for peak performance
- Configure event notifications and alerts
- Prepare to engage NetApp technical support
- Perform cluster maintenance

Complete an exercise

Module 10
Cluster maintenance

Installing and configuring Config Advisor

- Access your lab equipment.
- Open your Exercise Guide, Module 10.
- Complete Exercise 1.
- Share your results.

This exercise requires approximately **20 minutes**.

Addendum
ONTAP software upgrades

Stages of an automated upgrade

Stage 1
Select

Select the ONTAP software image:

- Display the current cluster version.
- Select a software image:
  - Select an available image.
  - Download an image from the NetApp Support site.

Stage 2
Validate

View and validate the cluster:

- Validate cluster update readiness.
- Display validation errors and warnings with corrective action.
- Update when the validation is completed successfully.
- Enable the update with warnings.

Stage 3
Update

Update the cluster:

- Update all the nodes in the cluster or update an HA pair in the cluster.
- Support a rolling update or a batch update. (The default update type depends on the number of nodes in the cluster.)

USB port use cases

Scenario	Prerequisites	Command
Perform boot device recovery from the LOADER prompt.	• The USB 2.0 device is formatted to FAT32 with the correct ONTAP image.tgz file. • The device is not hot-pluggable. After you insert the USB device, you must boot to the LOADER prompt.	• At the LOADER prompt, use **`boot_recovery`** by using the netboot image. • At the boot menu, select the appropriate ONTAP image.
Copy ONTAP software for installation.	The USB 2.0 device is formatted to FAT32 with the correct ONTAP image.	• Use the **`system node image update/get`** command. • From the additional options for the command, copy ONTAP software from the USB device.
Copy service images for firmware update.	The USB 2.0 device is formatted to FAT32 with the correct service image.	• Use the **`system node firmware download`** command. • From the additional options for the command, copy ONTAP software from the USB device.

