Technical Report

ONTAP AFF All SAN Array Systems

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Abstract

This technical report introduces NetApp® ONTAP® All SAN Array (ASA) systems and covers implementation and best practices recommendations for always-available, business-critical SAN configurations. This version of the technical report corresponds to ONTAP 9.7.

NetApp®

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1 ONTAP All SAN Array Systems Introduction

NetApp® ASA systems are built on NetApp AFF systems, which deliver industry-leading performance and reliability. AFF systems provide an enterprise-class SAN solution for customers who want to consolidate and to share storage resources for multiple workloads.

AFF SAN systems deliver:

- Industry-leading >99.9999% availability
- Massive scale clusters, which scale both up and out
- The best enterprise performance in the industry (based on audited SPC-1 results)
- Industry-leading storage efficiency
- Among the most complete cloud-enabled cloud connectivity available
- Cost-effective seamless data protection.

NetApp ASA systems build on the all-flash system to deliver continuous SAN availability for enterprises that run mission-critical applications. These systems provide uninterrupted access to data during a planned or unplanned storage failover and deliver streamlined implementation, configuration, and management through a solution that's dedicated only to running tier 1 SAN workloads.

NetApp recommends ASA configurations when your requirements include:

- Mission-critical workloads such as databases that must have symmetric active-active paths from hosts to storage. All paths between the host and storage are active and optimized across high-availability (HA) partners in this design.
- Preference for a dedicated system to isolate some or all SAN workloads from all others.

AFF systems remain the preferred choice for customers who:

- Need to scale out SAN clusters to up to 12 nodes.
- Need asymmetric access to storage from hosts that are matched with the application requirement.
- Prefer a cluster that supports unified protocols and mixed NAS and SAN workloads.

2 ONTAP ASA Systems Overview

This document is a detailed guide for storage architects who intend to run business-critical tier 1 workloads on NetApp ONTAP® ASAs. It details an ASA storage configuration that has been tested by NetApp to validate its ability to provide consistent low-latency performance, high throughput, uninterrupted availability, and resiliency. It also discusses best practices for configuring, installing, validating, deploying, and monitoring tier 1 modern SAN storage environments.

This document and its prescriptions are the product of extensive performance testing to identify and to qualify a baseline configuration for consistent performance. It describes this configuration and makes conservative recommendations that are designed to optimize consistent performance. The ASA systems were designed to eliminate All Paths Down (APD) client disruptions that result from a storage failover and to eliminate variability in storage latency and performance, even during storage failover transitions. ASA systems offer uninterrupted availability while maintaining the industry-leading performance of ONTAP. And by concentrating on SAN protocols and features and by excluding NAS protocols and NAS-only features, they also reduce complexity.

Every organization has its own preferences for allocating and for clustering workloads, and for segregating or for integrating their SAN and NAS estates. There's no one best solution; it depends entirely on each company's business objectives, skillset, and technology roadmap. This report presents requirements and recommendations that will enable your IT organization to build systems that maximize performance while maintaining consistent low-latency operations, even during storage disruptions like with controller takeovers and givebacks.

The ASA configuration is optimized for symmetric active-active access and for consistent high performance with low latency. For information about NetApp AFF top-end performance, review the [Storage Performance Council's SPC-1 results].

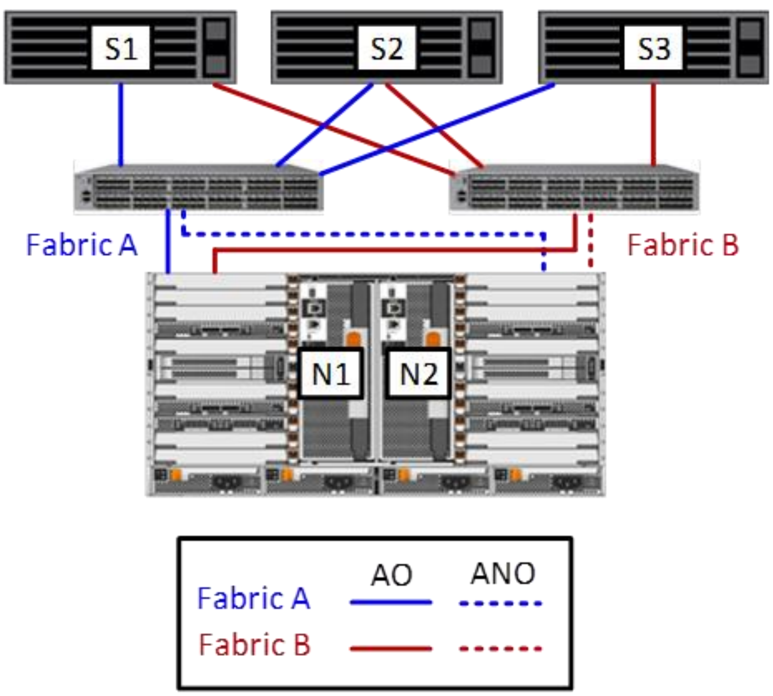
This document describes guidelines and requirements that are consistent with ONTAP 9.7. The guidelines, requirements, and sample results that are enumerated in this document are all products of extensive and continuous testing by NetApp's workload and performance characterization teams.

Note: In this technical report, we use the term "tier 1" to refer to mission-critical workloads that can't accept any loss of access to data. Some use the term "tier 0" to describe these same critical workloads.

3 Introducing ONTAP ASAs

Before the release of NetApp ONTAP 9.7, all ONTAP controllers featured the architecture that is shown in Figure 1. This architecture advertised routes directly to the controller that hosted the LUN as active-optimized (AO) paths, with all other paths (indirect paths) advertised as active-non-optimized (ANO) paths. Active non-optimized paths are not preferred and are not used unless no active optimized paths exist.

Figure 1) Unified ONTAP paths.



With ONTAP 9.7, NetApp introduced AFF ASA systems, which feature symmetric active-active topology, as shown in Figure 2. The ASA supports SAN (block protocols) only and is built on a single HA pair. It currently supports FC and iSCSI protocols, and support for NVMe protocols and larger clusters are expected in later releases.

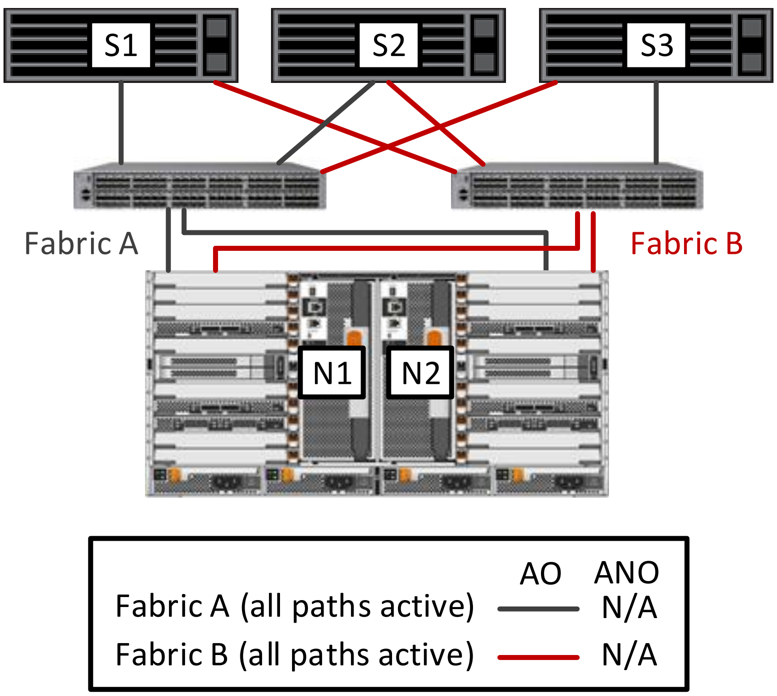
The defining features of ASA systems include:

- Symmetric active-active operations, which means that all paths are active "preferred" paths to all LUNs. ASA advertises all paths as AO, which means that there are always active paths to all LUNs, even if a storage failover (SFO, also called a takeover or giveback) occurs. The practical effect is that hosts always have active paths and don't need to query for new paths if an SFO occurs. This feature reduces the impact of an SFO to times that match those on frame-style arrays. Unified clusters advertise both AO and active-non-optimized (ANO) paths.

Note: Hosts that connect to a unified cluster see both AO paths (preferred) and ANO paths (not preferred). If the host loses all AO paths and doesn't receive updates that advertise new AO paths, it changes the ANO paths that it still has to a LUN to AO or preferred paths. However, this process can take some time for the host to make those adjustments to its storage map.

- A SAN-only experience that's simplified by the absence of any variables and options that are related to NAS (file) protocols. This feature reduces the skillset that you need to configure, to provision, and to manage the ASA.
- Support in ONTAP 9.7, which also includes a complete streamlined ONTAP System Manager (formerly OnCommand® System Manager) GUI. All aspects of provisioning, configuring, and managing of ONTAP SANs have been significantly simplified.

Figure 2) NetApp AFF A700 ASA active-active pathing.



4 ASA Compatibility Guidelines

An ASA that's provisioned to serve business-critical applications can grow with the data storage requirements of your applications. However, you should determine its initial size and configuration in accordance with NetApp's and the application publisher's best practices recommendations.

Applications and storage requirements that fit the following guidelines are an excellent fit for ASAs running current versions of NetApp ONTAP:

- Application architects should consider ONTAP ASA for workloads in which continuous availability and consistent low-latency performance are more important than attaining the maximum possible steady-state throughput. For a discussion about performance optimization and consistent low latency, review the section titled Steady-State Storage Utilization of this document.

- The ASA symmetric active-active architecture neutralizes the impact of planned and unplanned storage failovers or other component failures. In particular, because of the symmetric access that ASA provides to all LUNs, even with a path, fabric, network, or other failure, a well-designed and managed ASA still provides continuous, consistent, low-latency data access.
- All application components in the environment must be matched against a qualified configuration that's listed in the NetApp Interoperability Matrix Tool.

4.1 ASA Commitments and Service-Level Objectives

ASA service-level objectives (SLOs) are geared toward reducing failover times to an absolute minimum. By changing the ONTAP block architecture to "all paths active" and by using all controllers, ASA can offer symmetric active-active access to data with no client disruptions from APD. ASA also provides virtually instantaneous and nondisruptive failovers.

When comparing recovery times, measurement protocols matter. NetApp testing focuses on I/O resume times from the host's point of view (I/O resume time, or IORT). It is inadequate to measure recovery time by measuring transition times on the partner node. To really quantify the impact and disruption that an SFO causes, you must measure I/O resume time at the operating system (OS) or application level.

With ASA symmetric paths, we found no outages when storage failovers occurred, because hosts always have active paths to the LUNs to which they read and write data. With non-ASAs, testing showed variations in different host OS I/O stacks. The length of those disruption windows varied based on the OS, applications, and specific OS or application settings.

In fact, takeover and outage windows are primarily affected by the host OS. The takeover and pathing performance of many OSs can be improved to more quickly react to a loss of active paths by adjusting host I/O timeout thresholds—most of these tweaks were added to OS defaults on the most modern versions of those OSs. You can discover and review many of these configuration tweaks by reviewing the host utilities documentation associated with the OS you are interested in. To discover factors that contribute to OS initiator stack latency, NetApp interoperability teams are continuously studying IORT on host OSs and applications. These teams work with all major OS publishers to reduce or to remove latency and to improve error recovery.

5 ASA Configuration Requirements

This section details the requirements to implement and to maintain an ASA configuration. To validate an ASA configuration, you must fulfill the following requirements when you provision storage for applications.

You can check the configuration requirements and maximums by downloading and running NetApp Active IQ® Config Advisor. To confirm that the storage system continues to conform to ASA configuration requirements, you should run Config Advisor after initial setup and provisioning and whenever you make significant changes to the configuration and workloads. To maintain consistent performance and to meet storage SLOs, if Active IQ Config Advisor discovers any inconsistencies with the baseline configuration, you must remediate them. Config Advisor queries the configuration and maximums and identifies any nonconforming items so that you can remediate them to maintain the rapid failover times that are critical for ASA performance. The exception report also points to a NetApp Knowledgebase article that identifies all the configuration items and explains the impact of exceeding those configurations.

If NetApp AutoSupport® monitoring is configured along with Config Advisor, then the same checks are run against the collected AutoSupport data on at least a weekly basis. Those checks also generate an alert that identifies any exceptions and points to the same Knowledgebase article that lists configuration items and the impact of breaching those limits.

5.1 Required Hardware and Software Components for ASA Configurations

All ASA configurations have the following mandatory components:

- An AFF ASA HA pair (Table 1 shows current ASA-supported controllers)
- A qualified configuration, as confirmed by the NetApp Interoperability Matrix Tool (IMT)
- ONTAP 9.7
- Active IQ Unified Manager 9.7 (formerly OnCommand Unified Manager)
- Active IQ Config Advisor

Table 1) ONTAP ASA-qualified controllers.

Component	ASA AFF A220	ASA AFF A700
Form factor	2U	8U
CPU cores	12	36
Memory	64GB	1024GB
Maximum drives	144	480

5.2 NetApp Tools for ASA

This section describes multiple tools that you can use with ASA to greatly ease ASA management. Use these tools for the following functions:

- Confirm supported configurations
- Gather, parse, and display customer storage estate configuration details
- Manage thresholds, reporting, alerts, and performance

ASA administrators should add all the tools described in this section to their tool chests. These tools can greatly ease configuration, administration, and management of ASAs and unified ONTAP platforms. Three of the four tools are free to any NetApp customer or partner to use. The fourth tool, OnCommand Insight, does require a software license.

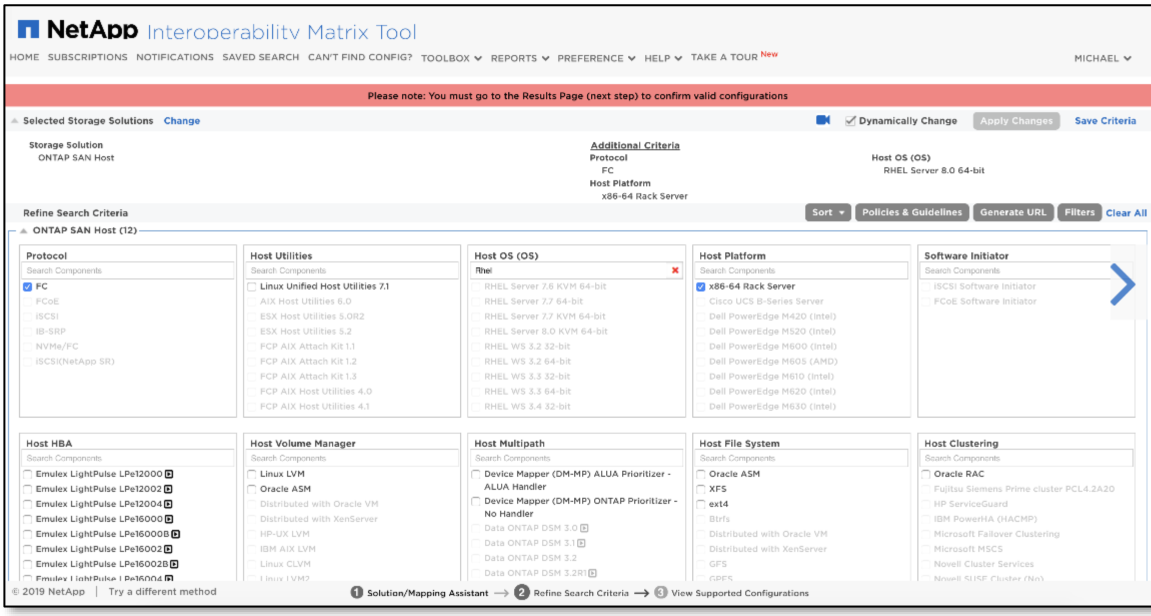
Note: For more information about OnCommand Insight, contact your NetApp account team for details about OnCommand Insight and how to acquire and onboard it.

NetApp Interoperability Matrix Tool

The NetApp IMT lists all the qualified configurations that have been tested and proven to fully interoperate. It is extremely important for storage managers to verify that their end-to-end storage configurations match the qualifications that are detailed in the IMT. A nonqualified configuration might work; however, NetApp can’t guarantee that it will work, or work optimally. If you need support, NetApp Support typically starts a support effort with a plan to get your system into a supported or qualified configuration.

The main way to confirm that you are in a qualified configuration is to use the IMT to verify that your configuration matches a qualified configuration. Figure 3 displays the results from an IMT search.

Figure 3) NetApp Interoperability Matrix Tool search results example.



Alternatively, you can use the NetApp OneCollect data collection tool to obtain your configuration details.

Active IQ OneCollect Data Collection Tool

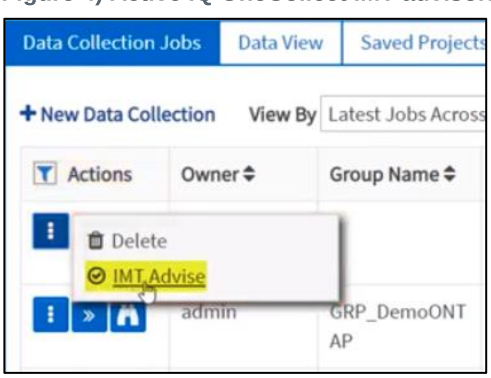
NetApp Active IQ OneCollect is a data collection tool that gathers data from storage, hosts, and switches. The collected data is used for troubleshooting, solution validation, migration, and upgrade assessments. NetApp Active IQ OneCollect is available to NetApp customers, channel partners, and internal users.

You can use the OneCollect tool to gather all the necessary data about an existing configuration. You can download it from the NetApp Support site and run it on various local hosts (Windows, Linux, Mac) or from a Docker image.

For more information about OneCollect, see the OneCollect tool page or the latest OneCollect Installation and Setup Guide.

As shown in Figure 4, you can use OneCollect to gather configuration data and then compare the collected data with the IMT to verify a qualified configuration. You can also create a gap list that your administrators can use to remediate any issues.

Figure 4) Active IQ OneCollect IMT advisor.



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OnCommand Insight

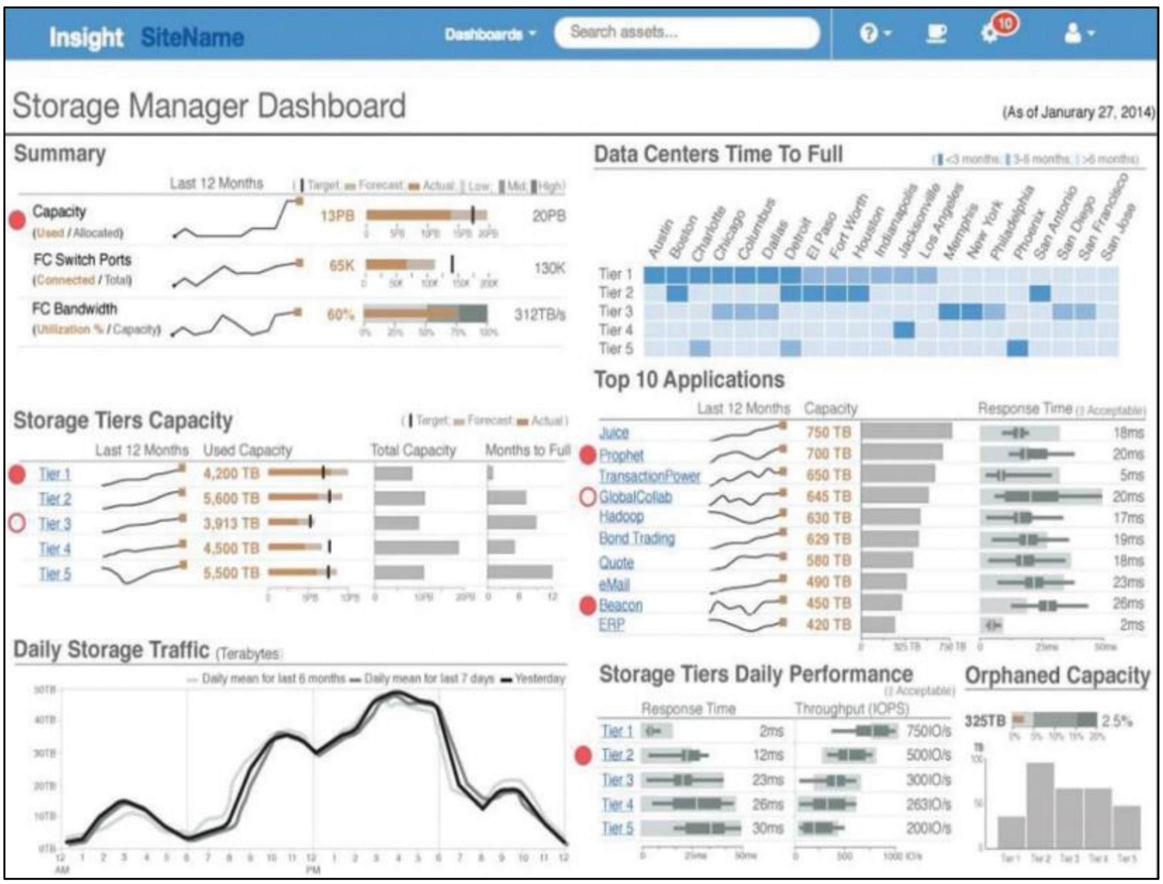
NetApp OnCommand Insight gathers and displays in-depth configuration and management information that provides insights, visualizations, and analysis that can be invaluable to storage administrators, managers, and architects. To view the OnCommand Insight dashboard, see Figure 5.

Note: Although it's not required, NetApp strongly recommends that you use OnCommand Insight 7.3.5 or later. OnCommand Insight discovers and analyzes:

- All storage arrays, regardless of make, model, or manufacturer
- All hosts, with granular enough data that it can report on host bus adapter (HBA) and unified target adapter (UTA) information
- All switches, including fabric information, in addition to more specific switch-centric data

For more information about OnCommand Insight, follow the links in the Where to Find Additional Information section of this technical report.

Figure 5) OnCommand Insight storage dashboard.



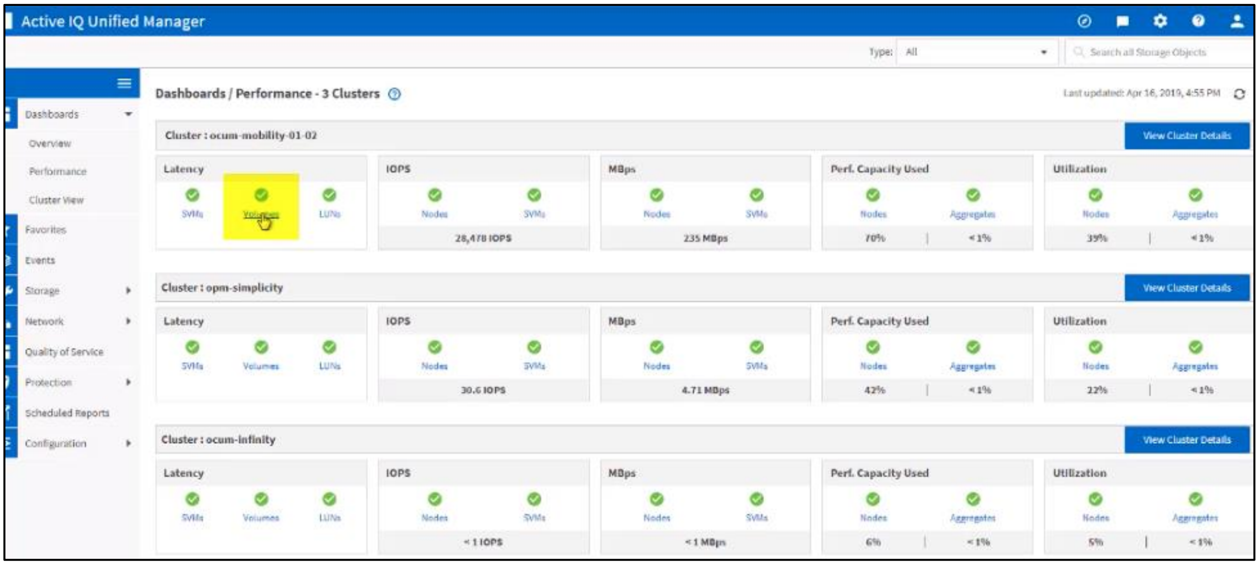
Active IQ Unified Manager

Active IQ Unified Manager enables:

- Health monitoring
- Performance monitoring and analysis
- Utilization and usage reporting
- Thresholding and alerting

Active IQ Unified Manager, shown in Figure 6, provides complete ONTAP estate monitoring for all ONTAP clusters from a single pane. It's available as a Windows or Linux installation or as a VMware-based virtual appliance.

Figure 6) Active IQ Unified Manager.



5.3 SAN Environmental Requirements

All ASA environments are assumed to have been architected to follow general SAN best practices: redundant fabrics and the use of dedicated high-speed storage networks that are segregated from general Ethernet communications networks. For details about best practices, see TR-4080: Best Practices for Modern SAN ONTAP 9.

5.4 Hardware Configuration

ONTAP ASA systems are introduced with ONTAP 9.7 as a single cluster that contains a single HA pair. This version of ASA cannot be expanded beyond that single HA pair.

5.5 Storage Controllers

Table 1 lists the NetApp storage controllers that support ASAs.

The baseline configuration was tested and qualified with a particular storage layout when running an AFF storage system. AFF nodes in a business-processing cluster must meet the storage subsystem hardware requirements that are described in Table 2.

Table 2) ONTAP ASA cluster limits.

Limits	AFF	Notes
Aggregate type	SSD only	All NetApp ASAs are AFF.
Advanced Disk Partitioning (ADP)	Yes	Advanced Disk Partitioning 2 (ADP2): one root, two data partitions. Each disk has three partitions, with a data partition per controller, up to the first 48 disks. The remaining disks are partitioned normally.
Maximum storage devices/node	240	–

Limits	AFF	Notes
Data aggregates	1–10	–
Drives/RAID group	11–28	–
Maximum volumes/node	200	–
Maximum LUNs/node	12,288	–
NetApp ONTAP Snapshot™ copies/volume	40	–
Data aggregate space utilization	>75%	–
Controller utilization	50% performance capacity	For CPU/disk utilization: Use the Active IQ Unified Manager headroom tool. CPU utilization of <=50% applies to steady-state only. In takeover, CPU utilization can go higher than 50% due to load from the other node.

5.6 Steady-State Storage Utilization

NetApp recommends that you size ASA nodes to less than 50% of performance capacity per node. This recommendation helps prevent an impact on performance if a failover occurs, where one controller hosts both controllers' workloads. NetApp sizing tools are tuned to size ASA systems based on this recommendation. This recommendation doesn't allow both controllers to optimize for steady-state operations, but it does ensure that there is no variability in performance if a failover occurs.

After the system is in operation, if workloads grow beyond the recommended maximum per node, NetApp suggests that ASA administrators balance these workloads back to below 50% per node. This rebalancing prevents performance impacts if a failover occurs. Neither ONTAP nor ASA specifically stops storage managers from provisioning beyond 50% performance capacity per node. The impact on takeover performance is correlated to the amount of performance capacity that is over 50%.

In previous technical reports, NetApp has recommended that storage administrators target the use of no more than 50% CPU and storage utilization to maintain consistent performance during a takeover. However, real-world experience has shown that some customers might find that this target utilization limit leaves potential capacity unused.

Therefore, going forward, NetApp recommends the use of performance capacity to optimize performance while maintaining consistently low latency. The section titled Steady-State Storage Utilization of this paper discusses utilization, capacity planning, and how performance capacity calculations work.

5.7 Software Configuration

The software configuration that's specific to a storage cluster running within the baseline configuration is meant to change over time as workloads and applications are added and removed. The software configuration section outlines the range of configuration values and settings that are included in the ASA configuration. To validate them automatically, you can use the Config Advisor tool. For more information about this tool and how to use it to validate a storage cluster's settings, see Validate the ASA Configuration.

5.8 Aggregate Full and Nearly Full Thresholds

You can set a fullness threshold for aggregates so that when the total percentage of used space in the aggregate exceeds the threshold, an event is generated. This event can then be forwarded to an SNMP-based monitoring tool.

To increase warning times and reaction windows, you should set the AFF ASA controllers' nearly full threshold to 70% and their full threshold to 75%. By lowering both thresholds, storage administrators have ample opportunity to act well before an aggregate is completely filled, despite the smaller storage space that is commonly available when compared with storage controllers that use spinning media.

5.9 Host OS Configuration and Settings

NetApp publishes host utilities for the following host OS families:

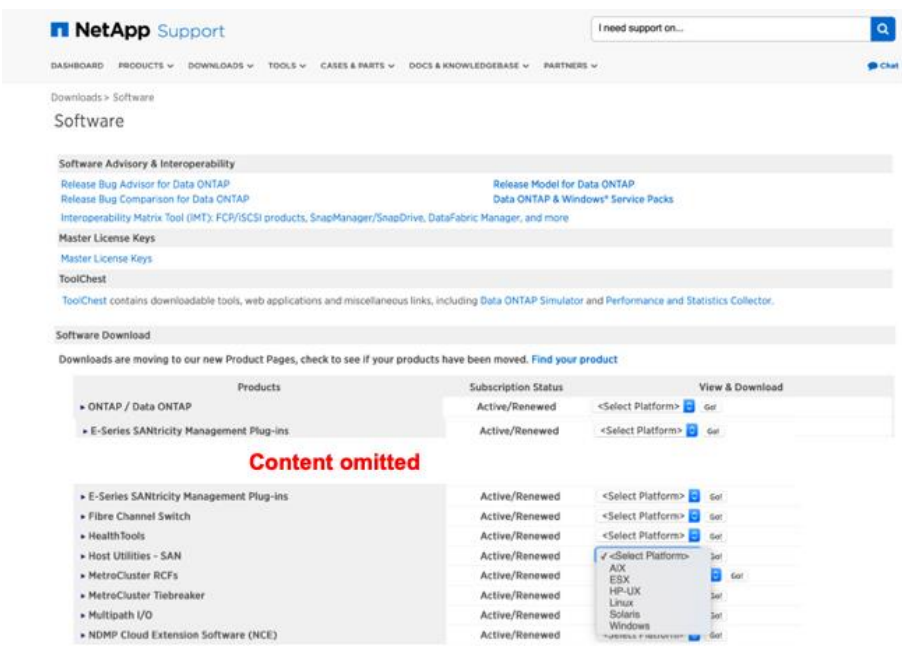
- IBM AIX
- Microsoft Windows
- Linux
- Oracle Solaris
- VMware ESX (for use with ESX 4.0 or earlier)

The host utilities software comes with:

- Documentation that's specific to the OS for which it's designed.
- Recommendations for configuration setting and tuning to optimize the OS for ONTAP SAN.
- The SANLUN utility, which provides several queries that are very helpful when documenting or troubleshooting host and ONTAP SAN interactions. These queries include listing paths, worldwide port name (WWPNs), iSCSI Qualified Names (IQNs), LUNs found, adapter settings, and so on.

  Note: There are no differences in the host OS settings between hosts that connect to ONTAP unified controllers versus ASA settings. Figure 7 shows the Host Utilities downloads page.

Figure 7) Host Utilities downloads.



5.10 ASA Specific Limits

To accelerate storage failover transition times, ASA configurations have lower maximum values for some parameters. Table 3 summarizes the differences between AFF systems and ASA systems at the time of their introduction. ASA limits will likely change over time as NetApp workload and performance engineering tests identify object limit maximums that enable the ASA to minimize failover transition times (takeover or giveback). For a full, current list of limits, always check the NetApp Hardware Universe.

The virtually instantaneous transition time causes no impact because there are still active paths to all LUNs. I/Os are fenced while controllers are actively transitioning, then they are responded to after the storage transition is complete.

Table 3) AFF versus ASA maximums.

Objects per Node	AFF Cluster Maximums	ASA Cluster Maximums
Maximum volumes	1,000	200
Data Protection Optimized (DPO) volumes	1,000	Not applicable; NetApp does not recommend DPO volumes on ASA
LUNs: AFF A220 AFF A700	8,192 12,288	8,192 12,288

5.11 Protocol Support

ASA supports block protocols exclusively and currently supports both FC and iSCSI. NetApp expects to add NVMe over Fabrics (NVMe-oF) protocols in later ASA releases. Neither NAS protocols nor NAS-only features are supported on ASA.

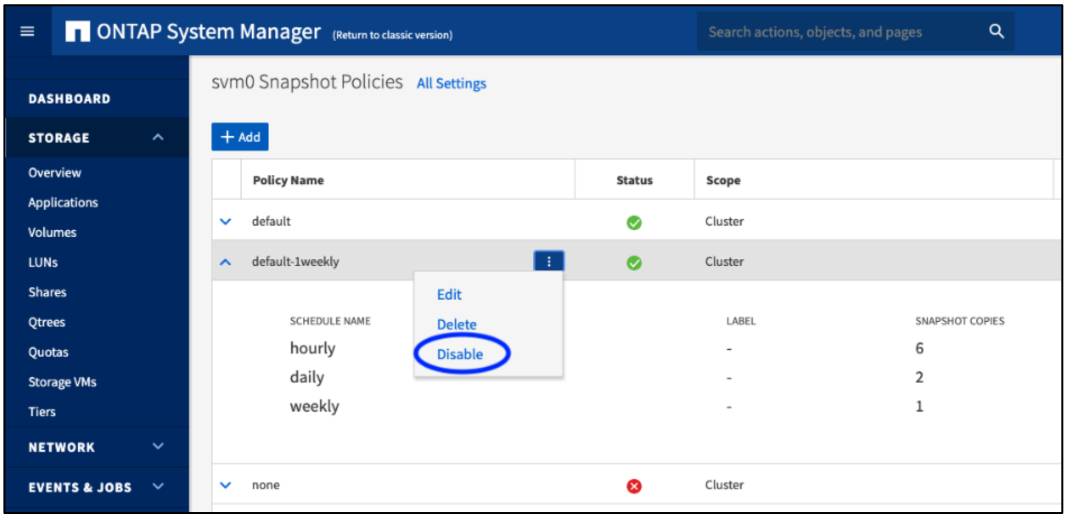
5.12 Snapshot Scheduling and Policy

Although Snapshot copies are supported on ASA systems, in most cases, NetApp recommends that you disable Snapshot policies. There are two reasons to disable Snapshot copies:

- Snapshot copies should be managed by a storage management tool, for instance, a member of the NetApp SnapCenter® suite of products, or should be application initiated to validate that they are application consistent.
- By disabling the Snapshot policy, your storage managers can also better manage the number of Snapshot copies and the amount of space that’s consumed.

Use ONTAP System Manager to edit, to delete, or to disable Snapshot policies. See Figure 8.

Figure 8) Use ONTAP System Manager to manage Snapshot policies.



5.13 Thin Provisioning

ONTAP uses the NetApp WAFL® file system, which does not preallocate storage on disk before consuming it. This storage allocation policy is known as thin provisioning or dynamic provisioning. You can set space reserves to subtract free space from a volume, an aggregate, or a LUN and to hold it in reserve for future write operations. This approach is called thick provisioning. When space reserves are turned off and LUNs are created that, when fully written, could consume more space than is immediately available in a volume or an aggregate, the policy is known as storage overcommitment.

Storage overcommitment requires that free space be continuously monitored to meet the needs of hosted applications. This policy also requires an action plan for increasing the free space that's available (either through nondisruptive data mobility operations or by expanding aggregate sizes). Therefore, the most conservative option is to fully provision storage, but at the cost of additional storage capacity that might not be required.

If you use thin provisioning, a strategy or action plan must be documented and in place to mitigate low-space scenarios. It is also a best practice to leave >25% free space in the hosting aggregate and to adjust free space thresholds for those aggregates. This recommendation is made to give storage managers enough time to react to low-space situations. For more information, see section 5.12, Aggregate Full and Nearly Full Thresholds.

5.14 LUN Space Allocation

The space allocation option on LUNs is disabled by default; you should not enable it. The space allocation setting determines whether a LUN supports SCSI unmap/space reclamation.

5.15 Space Reclamation (T10 Hole Punching/Unmap)

Space reclamation can be extremely processor intensive and potentially long-running and is therefore not supported in ASA. If any LUN that has this option enabled is replicated or migrated into the ASA, you should disable the option before allowing the LUN to be discovered by a host system. Not disabling this option could lead to potentially long-running performance impacts while unmapping scans are running on hosts and then communicated back to the ASA. This hole-punching is triggered by low-space or number-of-deleted-block thresholds that can be triggered during peak production times.

5.16 Validate the ASA Configuration

You can validate the ASA configuration with the Active IQ Config Advisor tool, as shown in Figure 9. Config Advisor examines an ASA cluster's current configuration and compares it with the baseline configuration, as detailed in this document. Table 4 contains a list of the checks performed by Config Advisor. NetApp recommends that you keep the resulting list of warnings for archival purposes and use it as a list of items to be remediated (see Figure 10).

The resulting output details any areas where the storage cluster's current configuration differs from the baseline configuration. You should schedule remediation actions to reestablish compliance for any configuration details that do not conform to the baseline configuration.

Figure 9) Config Advisor with Managed ONTAP SAN plug-in.

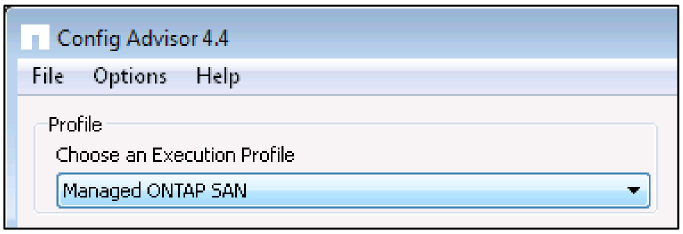


Figure 10) Configuration verification by Config Advisor with Managed ONTAP SAN plug-in.

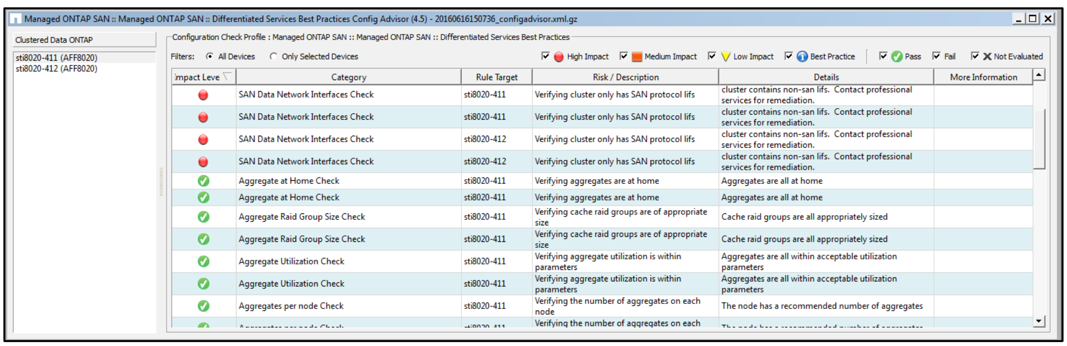


Table 4) Configuration checks performed by Active IQ Config Advisor.

Check Name	Description
Node health check	Verifies that nodes are healthy and can be queried for information
Model check	Verifies that all nodes are ASA supported controllers
Network interfaces check	Verifies that only SAN LIFs exist on the cluster
Aggregates per node check	Verifies that from 1 through 10 data aggregates are on each node
Aggregates at home check	Verifies that all aggregates are currently being serviced by their owning node
Aggregates utilization check	Verifies that no aggregates exceed 75% utilization
Volumes per node check	Verifies that no nodes own more than 200 volumes
Snapshot copies per volume check	Verifies that no volumes have more than 40 Snapshot copies

Check Name	Description
SFO check	Verifies that all nodes have SFO enabled
SAN SVM (formerly Vserver) quality of service (QoS) check	Verifies that QoS is enabled on all storage virtual machines (SVMs)
LUN space allocation check	Verifies that space allocation is disabled for all LUNs

6 Performance Capacity, CPU Utilization, Storage Utilization, and Performance Capacity Planning

To determine optimal solution sizing, solutions engineers from NetApp or a qualified channel partner should perform the initial sizing by using NetApp, OS, and application vendor best practices and NetApp internally available tools. After the initial sizing, NetApp recommends that you base all incremental performance sizing, monitoring, capacity planning, and workload placement on the Active IQ Unified Manager performance capacity determination. This approach is a departure from NetApp's previous recommendation, which was to size workloads to use less than 50% CPU utilization.

NetApp best practice for sizing ASA systems is to use performance capacity to size each node to less than 50% of the performance capacity on each controller. By sizing this way, you can maintain acceptable low latency if a takeover occurs. The cost of this approach is that you sacrifice a little of the steady-state top-line performance.

For a full discussion of performance capacity and how to use Active IQ Unified Manager to measure controller utilization to make placement decisions, review section 4 of TR-4211: Storage Performance Primer.

7 ASA Service Offering Lifecycle

The ASA service lifecycle describes how to size, configure, and validate an ASA implementation. It includes a number of checklists and task lists that should be performed to put a new ASA into production.

7.1 Size an ASA Cluster

Most ASA clusters need to grow over time. NetApp or certified partner solutions engineers or architects must determine the cluster's initial controller models, disks, and shelves. This determination can be made with NetApp OS and application vendor sizing tools, or with the deployment guide that's associated with the applications that the cluster hosts. For other sizing guides that are appropriate to particular applications, see Where to Find Additional Information and section 5.10, Steady-State Storage Utilization, in this technical report. Storage managers need to manage additional workload growth by rebalancing it across the ASA and even possibly between the current and additional ASAs.

7.2 Initial Setup and Prevalidation

Before you begin qualification and acceptance testing of a new ASA system, you should perform several steps after basic hardware installation of the cluster nodes. These steps are shown in the following checklists and validation guidelines.

7.3 Initial Hardware Setup Checklist

Install all the cluster nodes, including shelves, cluster network switches, and cabling, according to their installation guides. Table 5 shows the checklist items.

Table 5) Hardware setup checklist.

	Checklist Item
	All the ASA cluster's hardware components are operational.
	The cluster's data center environment falls within the parameters that are specified in the Hardware Universe.
	Neither node nor network switches have fault indicators.
	All power supply units and system fans are operational.
	No shelf modules or SSDs display faults.
	The FCP and iSCSI licenses are enabled, as appropriate.
	The cluster's disks, cluster network, and HA failover cabling are correct and have been validated by the Config Advisor tool.

7.4 Initial Hardware Setup Validation

To validate the initial hardware setup checklist that is shown in Table 5, use the validation method from the corresponding checklist item in Table 6.

Table 6) Hardware checklist validation methods.

	Checklist Validation Method
	Validate according to data center policies and guidelines: • Visually inspect cluster hardware for fault lights or other indicators. • Review storage controller environmental sensor readouts. • Review the cluster dashboard by using ONTAP System Manager.
	Review disk and shelf status values by using ONTAP System Manager. Under the cluster menu, review the overview and disks menu. The dashboard also has alerts for any problem components.
	Review Config Advisor output.
	Review the licenses that are currently installed by reviewing ONTAP System Manager, Cluster > Settings. The License tile displays licensed protocols and features; you can also enable any additional licenses that are supported on the ASA from that tile.

7.5 Configuration Tool Setup Checklist

For the list of configuration tools that are part of an ASA environment, see Table 7.

Table 7) ASA configuration tools.

Configuration Tool	Version	Schedule	Functionality
OneCollect	Latest	When configuration changes	Checks and preserves end-to-end configuration details
Config Advisor	Latest	When cluster configuration changes	Checks cabling and HA properties of storage systems

7.6 OnCommand Insight Report Checklist

Although OnCommand Insight is an optional component of a NetApp ASA configuration, this section showcases just how valuable a monitoring tool OnCommand Insight can be. Storage administration and application stakeholders negotiate which storage performance, availability, and utilization reports to deliver, along with the report format and schedule. The reports take the form of dashboard views of the ASA cluster storage from both application and total storage utilization viewpoints, as shown in Table 8 and Table 9.

Table 8) OnCommand Insight per-application reports.

Per-Application Report	Description	Suggested Schedules
End-to-end latency	~5-minute average latency of all objects that are associated with a given application, including storage volumes, fabric switches and ports, hosts, and VMs	Daily, weekly, monthly
End-to-end throughput	~5-minute average throughput of all objects that are associated with a given application, as noted earlier	Daily, weekly, monthly
Fabric redundancy/path-count violations	Times at which violations occurred and were resolved, correlated with latency and throughput reports	Daily, weekly, monthly
Storage growth delta	Growth of storage that's required by application over time, along with chargeback value (if any)	Weekly, monthly

Table 9) OnCommand Insight storage environment reports.

Storage Environment Report	Description	Suggested Schedules
Storage volume latency	~5-minute average latency of all storage volumes on a per-node basis, along with "top volumes"	Daily, weekly, monthly
Storage volume throughput	~5-minute average throughput of all storage volumes on a per-node basis, along with "top volumes"	Daily, weekly, monthly
Overall aggregate capacity	Time at which violations occurred and were resolved, correlated with latency and throughput reports	Daily, weekly, monthly
Storage growth delta	Graph of used versus total capacity for the entire storage environment, along with return-on-investment (ROI) calculations	Weekly, monthly

Note: You should add any existing ASAs to NetApp OnCommand Insight as a point of comparison and validation that the ASA is meeting application latency and availability requirements.

7.7 Predeployment Validation Tasks

Table 10 provides a checklist of predeployment validation tasks.

Table 10) Predeployment validation task checklist.

	Prevalidation Task	Desired Result
	Identify the hosts, fabrics, and networks that connect to the ASA, including hosts used during validation phases and when the ASA is serving applications in a production role.	You have validated the hardware and software in your environment are supported in an ASA environment, including hosts, networks, and fabrics.
	Gather configuration details by using the OneCollect tool and use the OneCollect IMT advisor to verify qualified configurations.	The OneCollect IMT advisor validates that the full environment is IMT compliant.
	Connect hosts to the ASA cluster by using the iSCSI or FC Protocol.	LUNs provided by the ASA cluster that are suitable for testing are mounted on hosts in the ASA application environment.

For a description of SAN topologies and host setup details, see the ONTAP SAN Configuration Guide.

7.8 Validation Testing

OnCommand Insight monitoring and reporting capabilities help the ASA keep serving data with consistent performance during the testing scenarios that are listed in Table 11. If you are not using OnCommand Insight, then you must develop other procedures for monitoring and testing your ASA configuration.

Table 11) Application validation test items.

Number	Validation Test	Desired Result
1	Cable pull and port shutdown to cause path failure: • From the storage controller to the fabric or Ethernet switch • From the host to the fabric or Ethernet switch	Path faults are detected by OnCommand Insight or by Active IQ Unified Manager; storage volume performance is still within ASA parameters.
2	Planned takeover and giveback of storage controllers	Storage I/O is not disrupted; storage performance is unaffected; alerts are sent out by using Active IQ Unified Manager and AutoSupport.
3	Unplanned takeover and giveback of storage controllers	Storage I/O is not disrupted; storage performance is unaffected; alerts are sent out by using Active IQ Unified Manager and AutoSupport.

7.9 Manage and Schedule Operations That Help Increase System Utilization

There are several operations that a storage administrator can run that can increase processor and disk utilization temporarily while the operations are being run.

Some of these operations include non-Disruptive volume and LUN move operations, such as a volume move or LUN move, large Snapshot deletes, and NetApp SnapMirror® initializations or re-baselines. As commonsense guidance, NetApp recommends that, where possible, you schedule these operations during nonpeak or lower-utilization periods.

NetApp also recommends that you reduce the number of concurrent operations that you run. For example, don't perform 20 volume moves at a time; such operations will reduce performance. By following these guidelines, you can achieve higher performance. In addition, operations such as volume moves complete more rapidly, which has the added benefit of reducing the amount of time that your controllers are subject to the utilization costs of these types of operations.

Appendix A: Configure Active Directory Domain Controller Access

Before an Active Directory account can access the SVM, you must configure Active Directory domain controller access to the cluster or SVM. Because a CIFs volume is not present on the ASA, you can create a computer account for the SVM on the Active Directory domain.

You have two options for configuring Active Directory domain controller authentication:

- **Configure an authentication tunnel.** If you have already configured a CIFS server for a data SVM, you can use the `security login domain-tunnel create` command to configure the SVM as a gateway, or tunnel, for Active Directory access to the cluster.
- **Create an SVM computer account on the domain.** If you have not configured a CIFS server for a data SVM, you can use the `vserver active-directory create` command to create a computer account for the SVM on the domain.

For more information, see the related NetApp Knowledgebase article.

Where to Find Additional Information

To learn more about the information that is described in this document, review the following documents and/or websites:

- Active IQ OneCollect 1.8 Installation and Setup Guide
  https://library.netapp.com/ecm/ecm_get_file/ECMLP2672457
- All SAN Array Documentation Resources
  https://www.netapp.com/us/documentation/all-san-array.aspx
- All SAN Array Documentation Center
  http://docs.netapp.com/allsan/index.jsp
- NetApp Active IQ Config Advisor
  http://mysupport.netapp.com/NOW/download/tools/config_advisor/
- NetApp Hardware Universe
  https://hwu.netapp.com/
- NetApp Support offerings and descriptions
  http://www.netapp.com/us/services-support/services/operations/services-descriptions.aspx
- OnCommand Insight
  https://www.netapp.com/us/products/data-infrastructure-management/oncommand-insight.aspx
- ONTAP 9 Documentation Center
  https://docs.netapp.com/ontap-9/index.jsp
- TR-4080: Best Practices for Scalable SAN in ONTAP 9
  http://www.netapp.com/us/media/tr-4080.pdf
- TR-4380: SAN Migration Using Foreign LUN Import
  http://www.netapp.com/us/media/tr-4380.pdf
- NetApp Product Documentation
  https://www.netapp.com/us/documentation/index.aspx

Version History

Version	Date	Document Version History
Version 1.0	August 2016	Initial version
Version 2.0	October 2018	Minor version updates
Version 2.1	December 2018	Minor version updates
Version 2.2	April 2019	Minor version updates, TR name change
Version 3.0	November 2019	Major update; added ASA
Version 3.1	February 2020	Minor update for link updates

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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