



Strategy | Technology | Results

200 Association Drive
Charleston, WV 25311
304 768-1645
304 768-1671 (fax)

RECEIVED
2020 MAY 13 PM 2:42
WV PURCHASING
DIVISION



Mr. Guy Nisbet
Department of Administration
Purchasing Division
2019 Washington Street, East
Charleston, WV 25305

May 14, 2020

Dear Mr. Nisbet,

Please find attached the SIS response to CRFQ 0313 DEP20000000022 due May 14, 2020. SIS agrees with the requirements of the RFQ and is submitting a response offering NetApp Storage for Production and DR with Cisco Switches. This response meets or exceeds the mandatory requirements of the RFQ for both the Production and Disaster Recovery sites. All Professional Services and Training and Knowledge Transfer as specified is included.

Thank you for the opportunity to submit this response and we look forward to further discussions.

Sincerely,

Charles D. Arnett
Senior Client Executive
carnett@thinksis.com

Enclosures



Purchasing Division
 2019 Washington Street East
 Post Office Box 50130
 Charleston, WV 25305-0130

State of West Virginia
 Request for Quotation
 21 - Info Technology

Proc Folder: 689579

Doc Description: Addendum 3 - Storage Area Network Hardware and Services

Proc Type: Central Contract - Fixed Amt

Date Issued	Solicitation Closes	Solicitation No	Version
2020-04-28	2020-05-14 13:30:00	CRFQ 0313 DEP2000000022	4

BID RECEIVING LOCATION

BID CLERK
 DEPARTMENT OF ADMINISTRATION
 PURCHASING DIVISION
 2019 WASHINGTON ST E
 CHARLESTON WV 25305
 US

VENDOR

Vendor Name, Address and Telephone Number:

Software Information Systems, LLC
 200 Association Drive, Suite 210
 Charleston, WV 25311
 304 768-1645

Total Bid: \$440,907.23

FOR INFORMATION CONTACT THE BUYER

Guy Nisbet
 (304) 558-2596
 guy.l.nisbet@wv.gov

Signature X

FEIN #

611371685

DATE

5-14-2020

All offers subject to all terms and conditions contained in this solicitation

Charles D. Arnott

ADDITIONAL INFORMATION:

Addendum

Addendum No.03 issued to publish and distribute the attached information to the vendor community.

Request for Quotation
(WV DEP Storage area Network Hardware and Services Project)

In accordance with WV Code 5A-3 The West Virginia Purchasing Division is soliciting bids on behalf of West Virginia Department of Environmental Protection to establish a contract for Storage Area Network Hardware and Services.

The WVDEP has existing production storage and integrated network infrastructure at its Kanawha City Building in Charleston, WV. New storage will be at both Charleston, WV for (production) and Logan, WV for (offsite backup). The Charleston address is 601 57th Street SE Charleston WV 25304. The address of the Logan site is 1101 George Kostas Dr. Logan, WV 25601 per the bid requirements, specifications, and terms and conditions as attached hereto.

INVOICE TO		SHIP TO	
ENVIRONMENTAL PROTECTION OFFICE OF ADMINISTRATION 601 57TH ST SE CHARLESTON WV25304 US		ENVIRONMENTAL PROTECTION 601 57TH ST CHARLESTON WV 25304 US	

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	Storage Area Network Hardware and Services			\$ 440,907.23	\$ 440,907.23

Comm Code	Manufacturer	Specification	Model #
43212200			

Extended Description :

Storage Area Network Hardware and Services for Storage Array's for Charleston and Logan. All professional services related to this solicitation (hardware installation, configuration and updating, software installation, software licensing, migration services and any additional equipment needed to complete with this solicitation) must be bid as a lump sum. Storage Area Network Hardware, and first (1) year Licenses and Support Services.

INVOICE TO		SHIP TO	
ENVIRONMENTAL PROTECTION OFFICE OF ADMINISTRATION 601 57TH ST SE CHARLESTON WV25304 US		ENVIRONMENTAL PROTECTION 601 57TH ST CHARLESTON WV 25304 US	

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
2	Support for storage array - renewal for year two (2) support			included	

Comm Code	Manufacturer	Specification	Model #
56112005			

Extended Description :

Support for storage array, 24x7 remote and on-site support renewal for year two (2) support

INVOICE TO		SHIP TO	
ENVIRONMENTAL PROTECTION OFFICE OF ADMINISTRATION 601 57TH ST SE CHARLESTON WV25304 US		ENVIRONMENTAL PROTECTION 601 57TH ST CHARLESTON WV 25304 US	

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
3	Support for storage array-renewal for year three (3) support			<i>included</i>	

Comm Code	Manufacturer	Specification	Model #
56112005			

Extended Description :

Support for storage array, 24x7 remote and on-site support renewal for year three (3) support

INVOICE TO		SHIP TO	
ENVIRONMENTAL PROTECTION OFFICE OF ADMINISTRATION 601 57TH ST SE CHARLESTON WV25304 US		ENVIRONMENTAL PROTECTION 601 57TH ST CHARLESTON WV 25304 US	

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
4	Support for storage array- renewal for year four (4) support			<i>included</i>	

Comm Code	Manufacturer	Specification	Model #
56112005			

Extended Description :

Support for storage array, 24x7 remote and on-site support renewal for year four (4) support

REQUEST FOR QUOTATION
Storage Area Network Hardware and Services

11. MISCELLANEOUS:

11.1. **Contract Manager:** During its performance of this Contract, Vendor must designate and maintain a primary contract manager responsible for overseeing Vendor's responsibilities under this Contract. The Contract manager must be available during normal business hours to address any customer service or other issues related to this Contract. Vendor should list its Contract manager and his or her contact information below.

Contract Manager: Charles D. Arnett

Telephone Number: 304 768-1645

Fax Number: 304 768-1671

Email Address: carnett@thinksis.com

DESIGNATED CONTACT: Vendor appoints the individual identified in this Section as the Contract Administrator and the initial point of contact for matters relating to this Contract.

Charles D. Arnett, Sr. Client Executive
(Name, Title)

(Printed Name and Title)

200 Association Dr. Charles, WV 25311
(Address)

304 768-1645 Fax 304 768-1671
(Phone Number) / (Fax Number)

charnett@thinksis.com
(email address)

CERTIFICATION AND SIGNATURE: By signing below, or submitting documentation through wvOASIS, I certify that I have reviewed this Solicitation in its entirety; that I understand the requirements, terms and conditions, and other information contained herein; that this bid, offer or proposal constitutes an offer to the State that cannot be unilaterally withdrawn; that the product or service proposed meets the mandatory requirements contained in the Solicitation for that product or service, unless otherwise stated herein; that the Vendor accepts the terms and conditions contained in the Solicitation, unless otherwise stated herein; that I am submitting this bid, offer or proposal for review and consideration; that I am authorized by the vendor to execute and submit this bid, offer, or proposal, or any documents related thereto on vendor's behalf; that I am authorized to bind the vendor in a contractual relationship; and that to the best of my knowledge, the vendor has properly registered with any State agency that may require registration.

Software Intermediary Systems LLC
(Company)

[Signature] Charles D. Arnett Sr. Client Executive
(Authorized Signature) (Representative Name, Title)

Charles D. Arnett Sr. Client Executive
(Printed Name and Title of Authorized Representative)

5-14-2020
(Date)

304 768-1645 Fax 304 768-1671
(Phone Number) (Fax Number)

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: _____

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:

(Check the box next to each addendum received)

- | | |
|--|--|
| <input checked="" type="checkbox"/> Addendum No. 1 | <input type="checkbox"/> Addendum No. 6 |
| <input checked="" type="checkbox"/> Addendum No. 2 | <input type="checkbox"/> Addendum No. 7 |
| <input checked="" type="checkbox"/> Addendum No. 3 | <input type="checkbox"/> Addendum No. 8 |
| <input type="checkbox"/> Addendum No. 4 | <input type="checkbox"/> Addendum No. 9 |
| <input type="checkbox"/> Addendum No. 5 | <input type="checkbox"/> Addendum No. 10 |

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Software-Intermatic Systems LLC
Company

[Signature]
Authorized Signature

5-14-2020
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.
Revised 6/8/2012

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

CONSTRUCTION CONTRACTS: Under W. Va. Code § 5-22-1(i), the contracting public entity shall not award a construction contract to any bidder that is known to be in default on any monetary obligation owed to the state or a political subdivision of the state, including, but not limited to, obligations related to payroll taxes, property taxes, sales and use taxes, fire service fees, or other fines or fees.

ALL CONTRACTS: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

"Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceeds five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (W. Va. Code §61-5-3) that: (1) for construction contracts, the vendor is not in default on any monetary obligation owed to the state or a political subdivision of the state, and (2) for all other contracts, that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: Software Technology Systems LLC

Authorized Signature: [Signature] Date: 5-11-2020

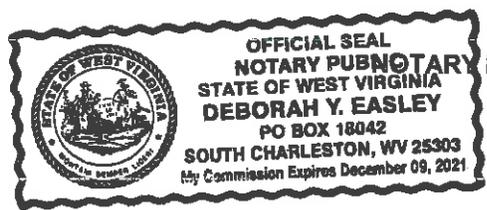
State of West Virginia

County of Kanawha to-wit:

Taken, subscribed, and sworn to before me this 11 day of May, 2020

My Commission expires Dec 9, 2021

AFFIX SEAL HERE



[Signature]

4. MANDATORY REQUIREMENTS:

4.1 Mandatory Contract Services Requirements and Deliverables: Contract Services must meet or exceed the mandatory requirements listed below.

4.1.1 Professional Services:

4.1.1.1 All professional services related to this solicitation (hardware installation, configuration and updating, software installation, software licensing, migration services and any additional equipment needed to complete this solicitation) must be bid as a lump sum price.

4.1.1.2 Project planning meetings may be held via conference call, in person or web conferencing sessions. A minimum of three (3) meetings prior to commencement of installation.

4.1.1.3 Any required/included project management functions can be performed offsite/remotely.

4.1.1.4 The professional services price must be all inclusive; no separate fees will be allowed.

4.1.1.5 Implementation/Migration Services Phase: This section outlines the minimum tasks that the successful vendor will be required to perform as part of the Implementation/Migration Phase of the project at both the Charleston and Logan WV sites.

4.1.1.5.1 Assist the WVDEP in connecting and configuring the network switching hardware to the existing WVDEP core router(s) at both data centers.

4.1.1.5.2 Work with the WVDEP to configure the storage array at both Charleston and Logan locations to meet the needs of the WVDEP. This configuration will closely mirror the configuration of the existing storage arrays and should consist of the following:

4.1.1.5.2.1 The vendor must perform the set-up of a single storage pool on the production array providing the total useable capacity of the hard disk drives in the storage array at the production data center including performance

acceleration provided by the flash drives included in the production array.

- 4.1.1.5.2.2** The vendor must perform the set-up of a primary storage pool on the Logan site backup array providing the same useable capacity as the storage pool configured on the production array.
- 4.1.1.5.2.3** The vendor must perform the set-up of a secondary storage pool on the Logan site backup array providing the remaining useable capacity of the drives in the offsite backup array for use as backup storage.
- 4.1.1.5.2.4** The vendor must perform configuration of asynchronous replication between the existing production array and the new production array for NAS (File) storage to prepare for cutover of file share access to the new production array.
- 4.1.1.5.2.5** The vendor must perform configuration of replication of one SAN (Block) storage volume from the existing production array to the new production array.
- 4.1.1.5.2.6** The vendor must perform configuration of replication between the new production array and new Logan site backup array for NAS (File) storage.
- 4.1.1.5.2.7** The vendor must perform configuration of the storage arrays and the switching hardware to allow new compute resources (servers) at both locations to access the storage arrays at the same location.
- 4.1.1.6** Assist the WVDEP with the migration of the NAS (File) storage and file share access, approximately sixty (60) terabytes, from the old production array to the new production array. This process should be as seamless to the end user as possible and done with no (or very minimal) downtime.
Downtime restricted to the hours of 6:00pm ET to 7:00am ET, Monday through Friday and any time on the weekend.

REQUEST FOR QUOTATION
Storage Area Network Hardware and Services

4.1.1.7 Assist the WVDEP with the installation of the hypervisor software (Red Hat Virtualization Hypervisors and Xen Hypervisors and management systems) on the server hardware at each location. Configuration must include clustering, configuration of converged networking, attaching and configuring LUNs/volumes from the storage array to the servers and the installation and configuration of management tools (Red Hat Virtualization Hypervisors and Xen Hypervisors and management systems). The clusters will be configured as follows:

4.1.1.7.1 One (1) 3-node cluster at the production site to run production workloads.

4.1.1.7.2 One (1) 2-node cluster at the production site to run development/test workloads.

4.1.1.7.3 One (1) 3-node cluster at the Logan site to run production workloads that reside at the Logan backup site and serve as the replication target for the production cluster.

4.1.1.8 The hardware installation and the commencement of the data migration must be completed within sixty (60) days after the solicitation is awarded.

4.1.2 Storage Array Solution for both, Charleston and Logan WV sites: Prior to award, vendors that are providing "or equal" equipment must provide a listing of all equipment proposed to complete this solicitation for evaluation to determine if the bid meets specifications.

4.1.2.1 The following minimum requirements are based on a NetApp storage array or equal. The technical aspects listed below are required to fulfill the current needs of the WVDEP.

4.1.2.1.1 Must provide dual storage controllers that function as a highly available clustered pair and they must have the following minimum specifications.

4.1.2.1.1.1 64 GB of RAM.

4.1.2.1.1.2 8GB of NVRAM.

4.1.2.1.1.3 1 x RJ45 10gb Ethernet ports.

4.1.2.1.1.4 2 x SFP+ 10gb Ethernet ports.

4.1.2.1.1.5 2 x 12gb SAS ports.

REQUEST FOR QUOTATION
Storage Area Network Hardware and Services

regarding the removed item which shall include item name, serial number and/or WVDEP property tag (if applicable).

4.1.7 Knowledge Transfer and Training: This section will outline any training or knowledge transfer required as part of this solicitation. Requirements may vary, based on whether NetApp storage arrays or equal are being provided.

4.1.7.1 All implementation work being performed will be done alongside WVDEP staff and will provide knowledge transfer on all work being performed, no additional knowledge transfer should be required.

4.1.8 Software license and additional equipment:

4.1.8.1 Vendor must include any additional software licenses needed for the process in their bid response. The NetApp storage arrays on which the storage requirements were based provides native replication tools for this functionality.

4.1.8.2 All software and software licenses needed for this solicitation must be included with vendors bid. Software licenses will be retained by WVDEP.

4.1.8.3 All cables and connectors to connect all equipment must work together at full speed and with redundancy. The power cables will need to have a C20 end to fit our existing PDUs.

4.1.9. Acceptance: Acceptance shall be defined as successful demonstration and testing of all system requirements, including training, with the ability for all users to navigate and utilize the system to perform their defined roles. The Agency with the Vendor's acceptance will issue a written letter and Change Order request to WV Purchasing Division as formal acceptance of the system. Upon mutual agreement of acceptance by both the Agency and the Vendor the Change Order issued by WV Purchasing Division will start, the first year's maintenance and support,

4.1.10 Maintenance and Support: The second, third, and fourth year's support/maintenance will also be added by subsequent formal change order, upon contract renewal at the end of the prior year's contract period for support/maintenance.

Production Hardware with 48 Months Support

Part Number	Product Description	Qty
FAS8200A-002	FAS8200 HA System,Premium Bundle	2
	Message: Includes All Protocols, SnapRestore, SnapMirror, SnapMirror Synchronous, SnapVault, FlexClone, SnapManager Suite, SnapCenter Foundation.	
X6566B-05-R6-C	Cable,Direct Attach CU SFP+ 10G,0.5M,-C	2
X66250-5-C	Cable,L,C-LC,OM4,5m,-C	8
X66031A-C	Cable,12Gb,Mini SAS HD,1m,-C	8
X6235-C	Chassis,FAS8200,AFF-A300,AC PS,-C	1
DOC-8200-C	Documents,8200,-C	1
DATA-AT-REST-ENCRYPTION	Data at Rest Encryption Capable Operating Sys	2
X1558A-R6-C	Power Cable,In-Cabinet,48-IN,C13-C14,-C	6
X-02657-00-C	Rail Kit,Thin,Rnd/Sq-Hole,4-Post,Adj,24-32,-C	2
X-02659-00-C	Rail Kit,4-Post,Rnd/Sq-Hole,Adj,24-32,-C	1
X6599A-R6-C	SFP+ Optical 10Gb Shortwave,-C	8
DS212C-07-4.0-12B-2P-C	Disk Shelf,12G,12x4TB,7.2K,2P,-C	2

Production Software with 48 Months Support

Part Number	Product Description	Qty
SW-2-CL-BASE	SW-2,Base,CL,Node	1
SW-2-8200A-NVE-C	SW,Data at Rest Encryption Enabled,8200A,-C	2
SW-2-8200A-TPM-C	SW,Trusted Platform Module Enabled,8200A,-C	2
OS-ONTAP1-CAP1-PREM-2P-C	ONTAP,Per-0.1TB,PREMBNDL,Capacity,2P,-C	960

DR Hardware with 48 Months Support

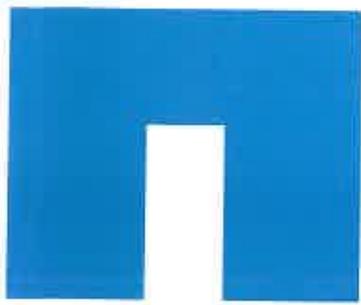
Part Number	Product Description	Qty
AFF-A300A-001	AFF A300 HA System,FlashBundle	2
	Message: Includes All Protocols, SnapRestore, SnapMirror, SnapMirror Synchronous, SnapVault, FlexClone, SnapManager Suite, SnapCenter Foundation.	
X6566B-05-R6-C	Cable,Direct Attach CU SFP+ 10G,0.5M,-C	2
X66250-5-C	Cable,LC-LC,OM4,5m,-C	8
X66031A-C	Cable,12Gb,Mini SAS HD,1m,-C	4
X6235-C	Chassis,FAS8200,AFF-A300,AC PS,-C	1
DOC-AFF-A300-C	Documents,AFF-A300,-C	1
X6599A-R6-C	SFP+ Optical 10Gb Shortwave,-C	8
X-02659-00-C	Rail Kit,4-Post,Rnd/Sq-Hole,Adj,24-32,-C	2
X1558A-R6-C	Power Cable,In-Cabinet,48-IN,C13-C14,-C	4
DATA-AT-REST-ENCRYPTION	Data at Rest Encryption Capable Operating Sys	2
DS224C-SL-3.8-24S-2P-C	SSD Shelf,12G,24x3.8TB,2P,-C	1

DR Software with 48 Monts Support

Part Number	Product Description	Qty
SW-2-CL-BASE	SW-2,Base,CL,Node	1
SW-2-A300A-NVE-C	SW,Data at Rest Encryption Enabled,A300A,-C	2
SW-2-A300A-TPM-C	SW,Trusted Platform Module Enabled,A300A,-C	2
SW-FLASH-BUNDLE-2P-C	ONTAP,Per-0.1TB,FlashBundle,Uit-Perf,2P,-C	912

Cisco Switches

Line No.	Qty	Part Number	Description
1	2	N3K-C3524P-XL	NEXUS 3524-XL 24 SFP+ PORTS,
2	2	CON-SNTP-3524PXL	SNTP-24X7X4 NEXUS 3524-XL 24 SFP+
3	2	N3548-24P-LIC	NEXUS 3524 FACTORY INSTALLED 24
4	2	N3K-C3064-ACC-KIT	NEXUS 3K/9K FIXED ACCESSORY KIT
5	8	NXA-FAN-30CFM-B	NEXUS 2K/3K/9K SINGLE FAN, PORT
6	2	N3548-BAS1K9	NEXUS 3500 BASE LICENSE
7	4	N2200-PAC-400W-B	NEXUS 2200 FEX POWER SUPPLY, BACK
8	4	CAB-9K12A-NA	POWER CORD, 125VAC 13A NEMA 5-15
9	4	SFP-10G-SR	10GBASE-SR SFP MODULE
10	2	NXOS-9.3 3	NEXUS 9500, 9300, 3000 BASE NX-OS



Datasheet

NetApp FAS8200 Hybrid Flash System

Quickly respond to changing storage needs across flash, disk, and cloud with industry-leading data management

Key Benefits

Simplify Your Storage Environment

Run SAN and NAS workloads with unified scale-out storage.

Accelerate Enterprise Applications

Reduce latency and speed operations with up to 50% higher performance than that of previous generation.

Maximize Uptime

Eliminate planned downtime to add, upgrade, or retire storage with no disruptions.

Consolidate Infrastructure

Scale up to 57PB, cluster with AFF all-flash systems, and integrate existing third-party storage arrays.

Optimize for the Hybrid Cloud

Easily implement a service-oriented IT architecture with leading cloud integration.

The Challenge

Enabling the data-driven business

As the role of technology has expanded to cover key business operations as well as back-office functions, IT leaders have had to rethink the way they architect storage. Traditional requirements such as storage uptime, scalability, and cost efficiency are still critical, but so are factors such as flash acceleration, cloud integration, unified support for SAN and NAS, and simplified data mining for competitive advantage.

Many enterprises struggle, held back by structural limitations in legacy storage and data architectures. Traditional storage arrays might deliver on basic needs, but are divided into separate silos or are incapable of meeting advanced service requirements and leveraging the cloud.

The Solution

Accelerate business operations with unified scale-out storage

The demands of a data-driven business require a new approach to storage with an integrated combination of high-performance hardware; leading cloud connectivity; and adaptive, scalable storage software. It needs to support existing workloads as well as adapt and scale quickly to address new applications and evolving IT models.

FAS8200 hybrid storage systems are engineered specifically to address these needs. Powered by NetApp® ONTAP® data management software, the FAS8200 unifies your SAN and NAS storage infrastructure. When FAS8200 systems are clustered with NetApp AFF all-flash arrays and integrated with the cloud, you have the control to easily move your data to where it's needed for your business and place it in the storage environment that delivers the best combination of flash performance, storage capacity, and cost efficiency. With proven agility and data management capabilities, the FAS8200 has the flexibility to keep up with changing business needs while delivering on core IT requirements.

Unlock the power of flash

Flash-accelerated FAS8200 hybrid storage systems deliver up to 50% more performance than our previous generation FAS storage, boosting throughput, lowering latency, and meeting stringent service levels. The base configuration of each HA pair includes 2TB of onboard Flash Cache™ based on NVMe technology, which can be expanded up to 4TB of integrated Flash Cache and up to 72TB of total flash per HA pair when leveraging Flash Pool™ intelligent data caching. Hot data is automatically promoted to flash in real time, so you get the full benefit of flash performance.

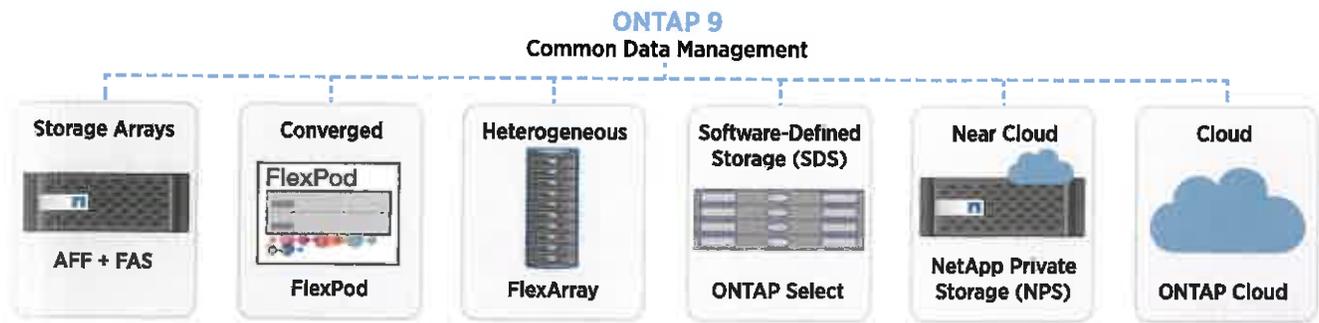


Figure 1) Standardize data management across architectures with a rich set of enterprise data services.

Scale and adapt to meet changing needs

Optimize and accelerate your storage environment as performance and capacity requirements change. Scale up by adding capacity, adding more flash acceleration, and upgrading controllers. Scale out by growing from 2 nodes up to a 24-node cluster with 57PB of capacity, including combinations of different FAS and AFF models.

FAS8200 systems also support massive NAS containers, which are easy to manage. With the NetApp FlexGroup feature of ONTAP 9, a single namespace can grow to 20PB and 400 billion files while maintaining consistent high performance and resiliency.

With nondisruptive addition and replacement of storage systems and components, scaling occurs without maintenance windows or the challenge of coordinating downtime across teams. Perform your updates during regular work hours.

Achieve unparalleled availability and nondisruptive operations

FAS8200 enterprise storage is engineered to meet demanding availability requirements. All models are designed to deliver 99.9999% availability or greater through a comprehensive approach that combines highly reliable hardware, innovative software, and sophisticated service analytics.

Software and firmware updates, hardware repair and replacement, load balancing, and tech refresh happen without planned downtime. Plus, NetApp Integrated Data Protection technologies protect your data, accelerate recovery, and integrate with leading backup applications for easier management.

Optimize your data infrastructure with the cloud-based predictive analytics and proactive support of NetApp Active IQ*. Prevent problems, save time, and gain insight by leveraging machine learning to get real-time predictions and recommendations based on community wisdom from NetApp's massive user base.

NetApp MetroCluster™ expands data protection to eliminate risk of data loss by synchronously mirroring data between locations for continuous availability of information. A MetroCluster storage array can exist in a single data center or in two different data centers that are located across a campus, across a metropolitan area, or in different cities. No matter what happens, your data can be protected from loss and is continuously available to meet the most business-critical needs. Plus, MetroCluster solutions

based on the FAS8200 offer enhanced configuration flexibility from the new controller architecture, which moves Flash Cache intelligent data caching from the PCIe slots to the motherboard and adds FCVI connectivity to the onboard UTA2 ports.

Get more from existing storage array investments

Simplify your IT operations and deliver more value from existing third-party arrays by using them as additional storage capacity behind FAS8200 systems. FlexArray® virtualization software running on the FAS8200 extends ONTAP to include storage capacity from EMC, Hitachi, HPE, IBM, and NetApp E-Series arrays. Consolidate management of your existing storage to increase efficiency, add support for SAN and NAS workloads, and provide superior data management functionality.

Optimize hybrid cloud deployment

Organizations today are focusing on service-oriented IT architectures where cloud IT models are leveraged to enhance return on investment and assets. The FAS8200 running ONTAP is optimized for private and hybrid cloud with secure multitenancy, adaptive quality of service (QoS), nondisruptive operations, and easily defined tiers of service.

Easily burst analytics and DevOps workloads to the cloud by connecting your FAS8200 to NetApp Cloud Volumes, the first enterprise-class native file service available in major hyperscalers.

For advanced data services that are common between your on-premises and cloud environments, leverage ONTAP Cloud, a version of ONTAP software that runs in Amazon Web Services (AWS) and Azure. Providing the storage efficiency, availability, and scalability of ONTAP, it allows easy movement of data between your on-premises FAS8200 and AWS or Azure environment with NetApp SnapMirror™ data replication software.

For organizations that need an enterprise-class hybrid cloud with data governance and security, the FAS8200 can be used in a NetApp Private Storage (NPS) for Cloud solution. With NPS for Cloud, you can directly connect to multiple clouds using a private, high-bandwidth, low-latency connection. Connect to industry-leading clouds such as AWS, Microsoft Azure, or IBM Cloud and switch between them at any time, all while maintaining complete control of your data on your dedicated, private FAS8200.

Build the right long-term platform

When it comes to long-term storage infrastructure investments, it is critical to focus on flexibility for adapting to future requirements, simplification of your storage environment, and total cost of ownership. The FAS8200 provides a significant price-performance benefit. Plus it delivers industry-leading storage efficiency technologies such as inline deduplication, inline compression, inline compaction, thin provisioning, and space-efficient Snapshot™ copies to reduce your cost per effective gigabyte of storage.

It is also critical to look at the security of your data environment. With the NetApp Volume Encryption feature of ONTAP, you can easily and efficiently protect your at-rest data by encrypting any volume on FAS (and AFF) systems. No special encrypting disks required. Plus, optional external key management can further increase security.

In a data-driven business, you also need the ability to leverage data for competitive advantage and to assign resources dynamically for more effective operations. The NetApp OnCommand® suite of management and optimization software is composed of a range of products for use with the FAS8200, including automation, integration, device-level management, and enterprise storage resource management.

Get It Right from the Start Using NetApp Expertise

Whether you're planning your next-generation data center, need specialized know-how for a hybrid cloud environment, or want to optimize the operational efficiency of your existing infrastructure, we have the expertise. NetApp Services and our certified partners can help you navigate your digital transformation to successfully create, deliver, and consume data services that power your business. [Learn more at netapp.com/services](http://netapp.com/services).

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of applications and data across cloud and on-premises environments to accelerate digital transformation. Together with our partners, we empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize their operations. For more information, visit www.netapp.com. #DataDriven

Table 1) FAS8200 technical specifications

Scale-Out

	FAS8200
NAS Scale-Out: 1-24 Nodes (12 HA Pairs)	
Maximum drives (HDD/SSD)	5,760/2,880
Maximum raw capacity	57PB
Maximum onboard Flash Cache based on NVMe technology	48TB
Maximum Flash Pool	864TB
Maximum memory	3072GB
SAN Scale-Out: 1-12 Nodes (6 HA Pairs)	
Maximum drives (HDD/SSD)	2,880/1,440
Maximum raw capacity	28PB
Maximum onboard Flash Cache based on NVMe technology	24TB
Maximum Flash Pool	288TB
Maximum memory	1536GB
Cluster interconnect	2 10GbE

Per HA Pair Specifications (Active-Active Dual Controller)

	FAS8200
Maximum drives (HDD/SSD)	480/480
Maximum raw capacity	4800TB
Maximum onboard Flash Cache based on NVMe technology	4TB
Maximum Flash Pool	72TB
Controller form factor	3U
ECC memory	256GB
NVRAM	16GB
PCIe expansion slots	4
Onboard I/O: UTA 2 (8Gb/16Gb FC, GbE/10GbE, or FCvI ports [MetroCluster only])	8
Onboard I/O: 10GbE	4
Onboard I/O: 10GbE Base-T	4
Onboard I/O: 12Gb SAS	8

OS Version: ONTAP 9.1 RC1 and Later

Shelves and media	See the Shelves and Media page ¹ on NetApp.com for the most current information.
Storage protocols supported	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB
Host/client operating systems supported	Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Windows XP, Linux, Sun Solaris, AIX, HP-UX, Mac OS, VMware, ESX

¹ netapp.com/us/products/storage-systems/risk-shelves-and-storage-media/index.aspx

Table 2) NetApp FAS8200 series software

The ONTAP 9 Base Bundle includes a set of software products that deliver leading data management, storage efficiency, data protection, and high performance. The optional Premium Bundle and extended value software products provide advanced capabilities, including instant cloning, data replication, application-aware backup and recovery, volume encryption, and data retention.

Software included in ONTAP 9 Base Bundle

The Base Bundle includes the following NetApp technologies:

- Storage protocols: all supported data protocol licenses (FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB)
- Efficiency: NetApp FlexVol[®], deduplication, compression, compaction, and thin provisioning
- Availability: multipath I/O
- Data protection: RAID-TEC[™], RAID DP[®], and Snapshot
- Performance: adaptive QoS
- Scalable NAS container: FlexGroup
- Management: OnCommand System Manager and OnCommand Unified Manager

Software included in ONTAP 9 Premium Bundle (optional)

To add capabilities to the Base Bundle, the optional Premium Bundle includes the following NetApp technologies:

- **FlexClone[®]**: instant virtual copies with file and volume granularity
- **SnapMirror[®]**: integrated data replication technology for simple, efficient, flexible disaster recovery and backup use cases
- **SnapRestore[®]**: restore entire Snapshot copies in seconds
- **SnapCenter[®]**: unified, scalable software and plug-in suite for application-consistent data protection and clone management
- **SnapManager[®]** suite: application- and virtual machine-aware backup and cloning

See NetApp.com for information about additional software available from NetApp.

Extended value software (optional)

Separate optional software, beyond the Base Bundle and Premium Bundle, is also available:

- **OnCommand Insight[®]**: infrastructure analytics platform that provides optimization, troubleshooting, monitoring, and cost analysis of your IT infrastructure
- **SnapLock[®]**: compliance software for write once, read many (WORM)-protected file data
- **Volume Encryption[®]**: granular, volume-level data-at-rest encryption
- **FlexArray[®]**: virtualization of existing third-party storage arrays into an ONTAP environment to leverage the array storage capacity behind a NetApp FAS

All Flash FAS

NetApp® All Flash FAS (AFF) is an all-flash array that delivers high performance, flexibility, low latency, and superior data management without sacrificing enterprise capabilities. AFF enables a smooth transition to flash for your data center, built on NetApp ONTAP® data management software.

As businesses go through digital transformation, they must modernize their IT infrastructure to improve speed and responsiveness to support critical business operations. Although all-flash storage systems have been widely adopted to accelerate typical enterprise applications, newer workloads such as data analytics, artificial intelligence (AI), and deep learning—demand higher performance that first-generation flash systems cannot deliver.

In addition, as more organizations adopt a “cloud first” strategy, it is critical to offer enterprise-grade data management capabilities for a shared environment across on-premise data centers and the cloud. Many all-flash array solutions available today lack robust data management, integrated data protection, seamless scalability, new levels of performance, deep application, and cloud integration.

Cloud-Connected All-Flash Storage Powered by ONTAP

NetApp® All Flash FAS (AFF) is a robust scale-out platform built for virtualized environments, combining low-latency performance with comprehensive data management, built-in efficiencies, integrated data protection, multiprotocol support, and nondisruptive operations.

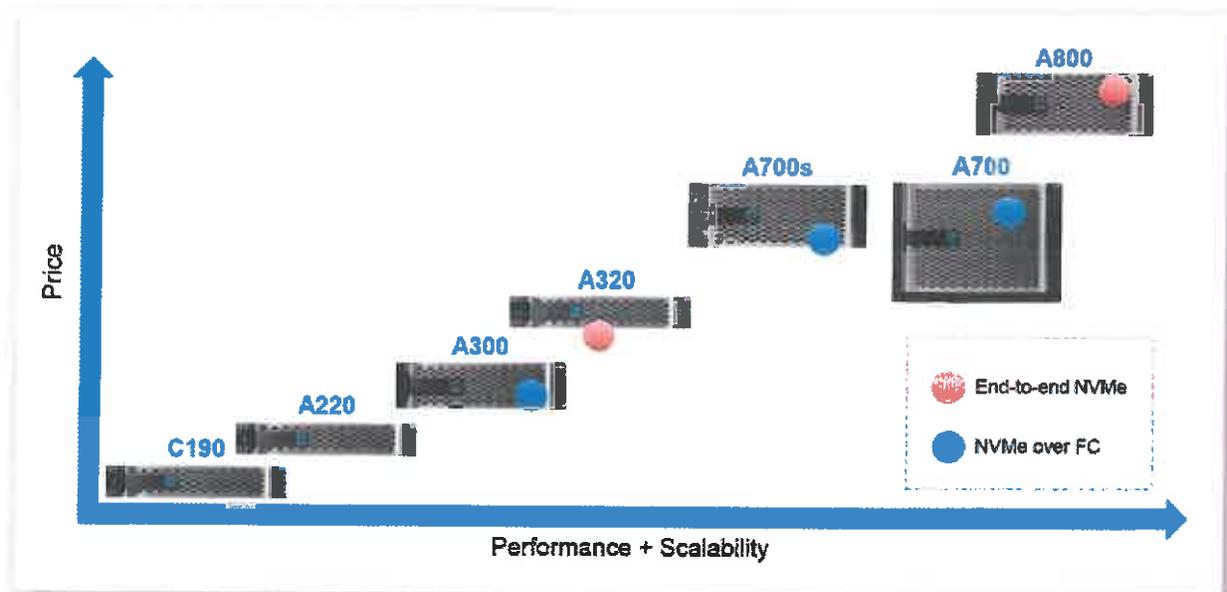


Figure 1: AFF portfolio – Modernize with cloud connected flash; provides solutions to modernize IT for small to large enterprises.

“We’re able to fit a whole lot more in a smaller amount of space and still provide more performance than we had before.”

— CI Engineer, financial services firm

NetApp AFF A-Series systems are designed to help businesses accelerate infrastructure transformation and fuel data-driven strategies. Powered by NetApp ONTAP® data management software, AFF systems accelerate, manage, and protect business-critical data and give you an easy and smooth transition to flash for your digital transformation in the hybrid cloud. With AFF systems, you can:

- Increase operational efficiency
- Accelerate applications and future-proof your infrastructure
- Keep business-critical data available, protected, and secure.

Increase Operational Efficiency

AFF offers the broadest application ecosystem integration for enterprise application, such as virtual desktop infrastructure (VDI), database, and server virtualization—supporting Oracle, Microsoft SQL Server, VMware, SAP, MySQL, and more. Infrastructure management tools simplify and automate common storage tasks so that you can:

- Provision and rebalance workloads by monitoring clusters and nodes
- Use one-click automation and self-service for provisioning and data protection
- Import LUNs from third-party storage arrays directly into an AFF system to seamlessly migrate data

In addition, with the NetApp Active IQ® intelligence engine you can optimize your NetApp systems with predictive analytics and proactive support tool, provide real-time insights and recommendations to prevent problems and optimize your data infrastructure.

“With the NetApp solution, we can slash the time needed to create an environment from 6 hours to 5 minutes regardless of scale, while provisioning additional environments simultaneously. That translates to a time savings of 70% for each product line.”

— Sandrine Kalk |Director of Global DevOps and Operations, Verint

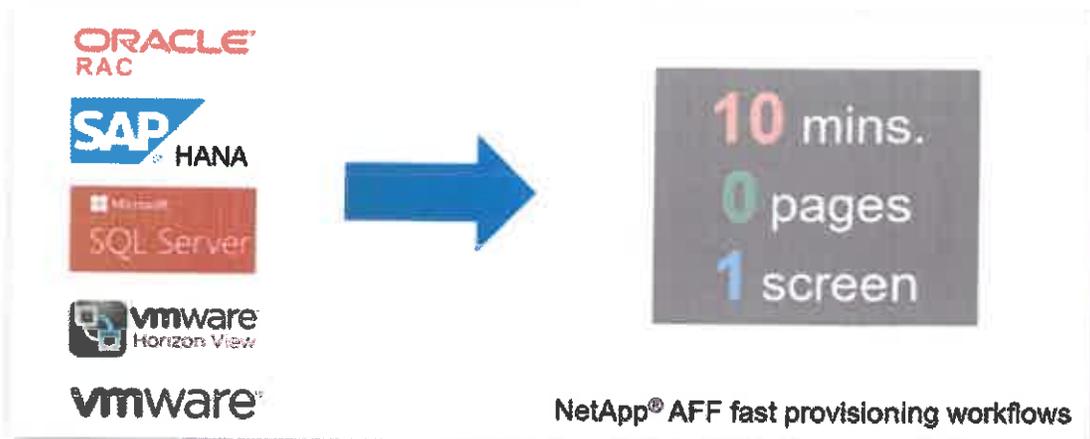


Figure 2: Application-aware data management – Deploy key workloads in less than 10 minutes with ONTAP System Manager.

Achieve Storage Savings, Backed by the Industry's Most Effective Guarantee

With AFF, reduce your data center costs with the best effective capacity for any workload, backed by the industry's most effective guarantee. We guarantee in writing:

- 3:1 guarantee across all workloads
- 4:1 for VVOL and 8:1 for VDI
- Use snapshots and get 10x higher efficiency

AFF system's support for solid state drives (SSDs) with multistream write technology, combined with advanced SSD partitioning, provides maximum usable capacity, regardless of the type of data that you store. Thin provisioning; NetApp Snapshot™ copies; and inline data reduction features, such as deduplication, compression, and compaction, provide additional space savings—without affecting performance—so you can purchase the least amount of storage capacity possible.

Build your Hybrid Cloud with Ease

The NetApp Data Fabric helps you simplify and integrate data management across cloud and on-premises to meet business demands and gain a competitive edge. With AFF, you connect to more clouds for more data services, data tiering, caching, and disaster recovery. FabricPool gives you the ability to move data automatically between AFF and the cloud storage tiers to maximize performance and reduce overall data management cost. Simplify hybrid cloud backup and recovery with cloud-resident NetApp Data Availability Services and accelerate read performance for data that is shared throughout your organization and across hybrid cloud deployments.

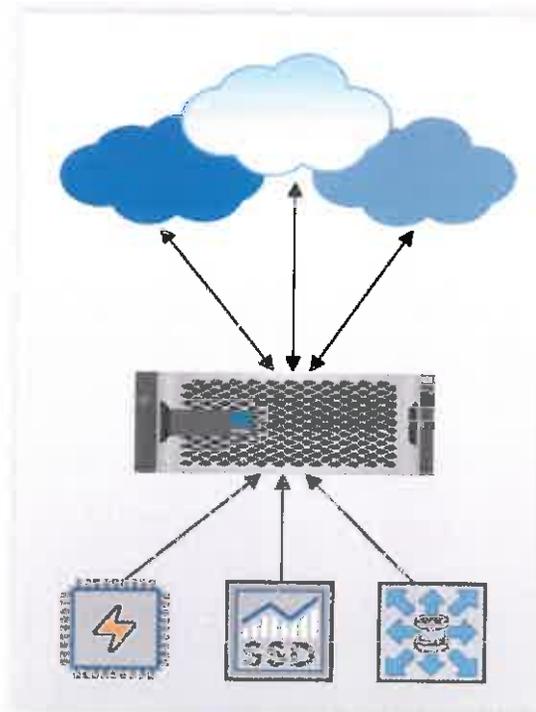


Figure 3: Future-proof your infrastructure with the most cloud-connected all-flash array –
Designed for the cloud era to connect to more clouds, in more ways, and to more services—to virtually any service provider or private cloud.

Accelerate Applications and Future-Proof Your Infrastructure

NetApp AFF systems deliver industry-leading performance proven by SPC-1¹ and SPEC SFS industry benchmarks, making them ideal for demanding, highly transactional applications such as Oracle, Microsoft SQL Server, MongoDB databases, VDI, and server virtualization. The AFF A800 system achieved:

- 2,401,000 SPC-1 IOPS at 0.590 SPC-1 IOPS Response Time in a new SPC-1v3 result
- Lowest latency and \$/GB among the top 5 results
- Predictable and consistent latency
 - ~0.4ms latency @ 80% load
 - 0.351ms SPC-1 Overall Response Time
- Highest storage capacity utilization
 - 66% versus ~30% from most others

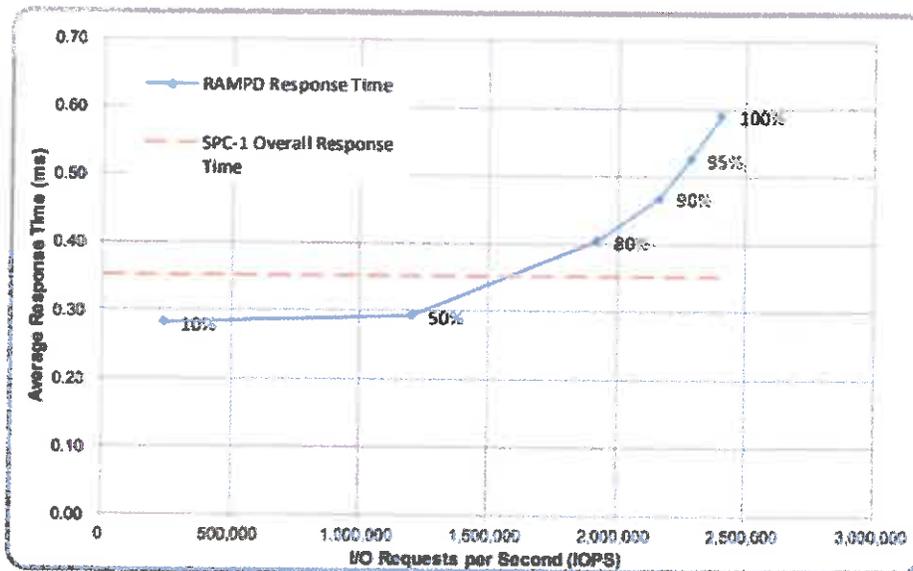


Figure 4: AFF A800 Places in the Top 4 of SPC-1v3 – Best performance and value among major vendors who publish benchmarks.

Accelerate Demanding Workloads

Accelerate the most demanding workloads with an AFF A800 and AFF A320 system. The AFF A800 combines NVMe SSDs and NVMe/FC connectivity to provide an ultrafast end-to-end data path to your applications. The midrange AFF A320 system supports NVMe/RoCE connectivity on the backend to the NVMe drive shelf and NVMe/FC on the front-end to the host. The AFF A320 leads the market with the best combination of NVMe-oF technologies.

Consolidate all workloads on AFF systems, which deliver up to 11.4 million IOPS at 1ms latency in a cluster with a truly unified scale-out architecture. You can manage a scalable NAS container of up to 20PB and 400 billion files with a single namespace by using NetApp FlexGroup volumes, while maintaining consistent high performance with adaptive quality of service (QoS) and resiliency. NetApp FlexCache® software improves the speed and productivity

¹ Link to SPC-1 report: <http://spcresults.org/benchmarks/results/spc1-spc1e#A32007>.

of collaboration across multiple locations and increases data throughput for read-intensive applications.

The NVMe-ready AFF A800s awarded the Product of the Year award for Enterprise Storage from CRN.

Modernize with Advanced NVMe

Designed specifically for flash, the AFF A-Series all-flash systems deliver industry-leading performance, capacity density, scalability, security, and network connectivity in dense form factors. AFF A-Series systems support NVMe/FC host connectivity, so you can gain twice the IOPS and cut application response time in half compared with traditional FC. These systems support a range of ecosystems, including VMware, Microsoft Windows 10, and Linux, with storage path failover. For most customers, integrating NVMe/FC into an existing SAN is a simple, nondisruptive software upgrade.

In addition, integrate new technologies and private or public cloud into your infrastructure nondisruptively. AFF is the only all-flash array where you can combine different controllers, SSD sizes, and new technologies—protecting your investment.

Keep Important Data Available, Protected, and Secure

Support backup and disaster recovery needs through our complete suite of integrated data protection and replication features. NetApp Integrated Data Protection technologies protect data and accelerate recovery; for easier management they integrate with leading backup applications. Benefit from features and capabilities such as NetApp Snapshot™ copies, cloning, encryption, and both synchronous and asynchronous replication for backup and disaster recovery. Key capabilities and benefits include:

- Reduced data management costs with native space efficiency with cloning and NetApp Snapshot copies. Up to 1,023 copies are supported.
- Unified, scalable platform and plug-in suite for application-consistent data protection and clone management with NetApp SnapCenter®.
- Reduced overall system costs with NetApp SnapMirror® replication software, which replicates to any type of FAS/AFF system: all-flash, hybrid, or HDD, on the premises or in the cloud.
- Synchronous replication with NetApp MetroCluster™ software, a capability in the all-flash-array market that delivers zero RPO and low to zero RTO for mission-critical workloads.
- Regulatory compliance with NetApp SnapLock® technology, which is enabled with Integrated Data Protection and storage efficiency.

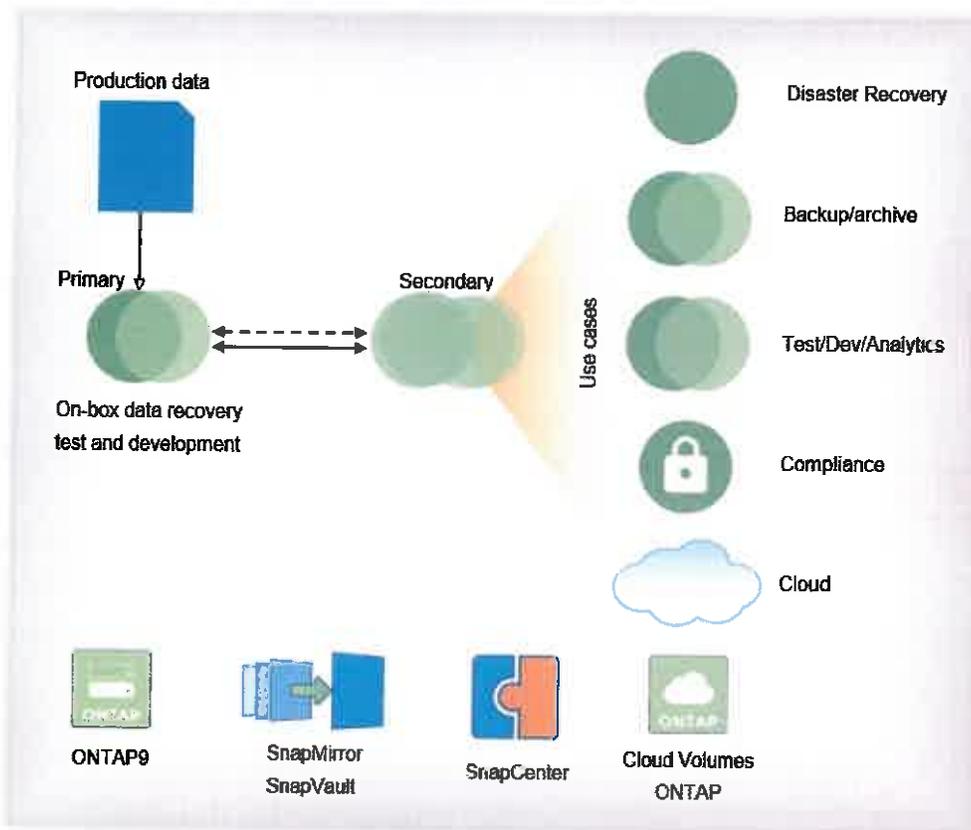


Figure 5: NetApp integrated data protection – Offers one data management flexible platform that provides data availability to keep applications running, mitigate risk, control costs, and improve data protection processes.

In addition, flexible encryption and key management help guard sensitive data on the premises, in the cloud, and in transit. With the simple and efficient security solutions, you can:

- Achieve FIPS 140-2 compliance (Level 1 and Level 2) with self-encrypting drives and use any type of drives with software-based encryption.
- Meet governance, risk, and compliance requirements with security features such as secure purge; logging and auditing monitors; and write once, read many (WORM) file locking.
- Protect against threats with multifactor authentication, role-based access control, secure multitenancy, and storage-level file security.

“NetApp’s multiprotocol capability was a major draw for our colleges. With NetApp, we can enable our colleges to retain their skillsets. They don’t have to learn something new or put in a mix of products just to accommodate their protocols.”

— Daniel Black |Director of Engineering, Technical College System of Georgia

Future-Proof Your Investment with Maximum Flexibility

NetApp solutions establish a seamless, well-integrated hybrid cloud architecture or Data Fabric that easily ties together private cloud, service providers, and hyperscale cloud providers along with their data management environments. This Data Fabric gives you the ability to implement the hybrid cloud on its own terms. Move data and applications to an AFF system, on commodity hardware with software-defined storage, or in the cloud. The Data Fabric offers a broad set of application ecosystem integration for database, VDI, and server virtualization.

With AFF, which is Data Fabric ready, your investment is protected as performance and capacity needs change or your cloud strategy evolves:

- AFF systems eliminate performance silos. Seamless integration with hybrid FAS systems means that workloads can transparently move between high-performance tiers and low-cost capacity tiers.
- Seamlessly adapt to changing needs with the only all-flash array that offers the ability to intermix different controllers, SSD sizes, and next-generation technologies.
- AFF is data fabric ready, with proven cloud connectivity. FabricPool enables you to move data automatically between AFF and the cloud storage tiers to maximize performance and reduce overall data management cost.
- Optimize data management for enterprise workload environments with leading application integration with Oracle, Microsoft, VMware, SAP, OpenStack, and many more.

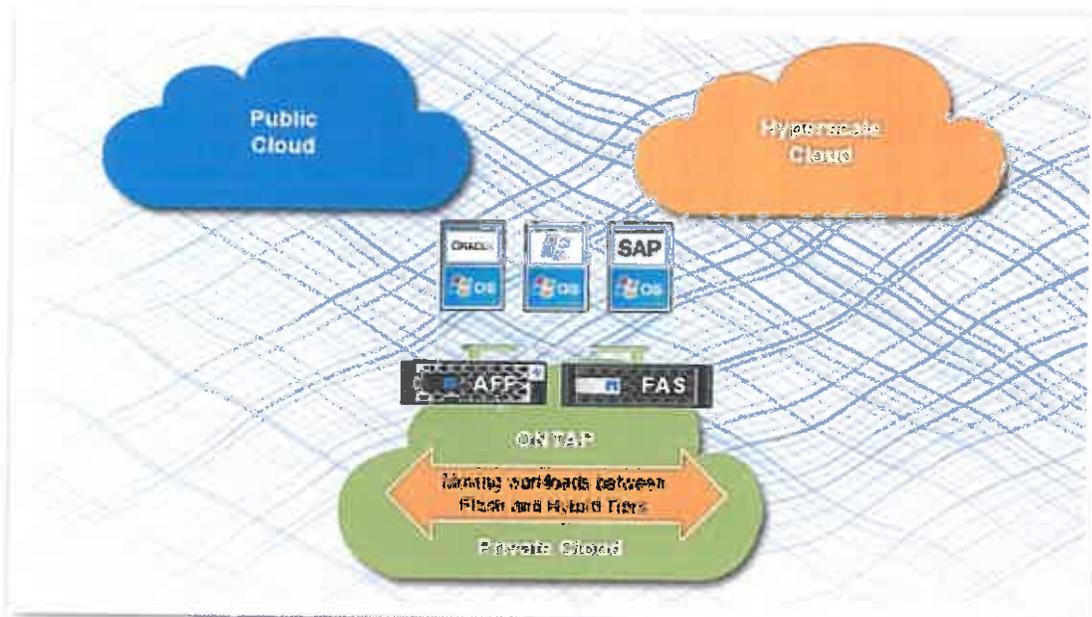


Figure 6: AFF is Data Fabric ready—moving data between tiers and different clouds.

“With NetApp All Flash FAS, we can improve the quality of healthcare in our own hospitals and others throughout the region by offering high-performing electronic patient records and virtual desktops to healthcare providers.”

— Reinoud Reynders, IT Manager, Infrastructure and Operations at UZ Leuven

All-Flash Performance Powered by End-to-End NVMe Technology

AFF systems are excellent for performance-demanding applications and mixed-workload environments that consist of, for example, Oracle, Microsoft SQL Server, MongoDB databases, VDI, and server virtualization. With NVMe-based AFF A800, AFF is also a great choice for AI and deep-learning environments:

- Combined with ONTAP cloud integration and software-defined capabilities, AFF enables the full range of the data pipeline that spans the edge, the core, and the cloud for AI and deep learning, leveraging the same ONTAP data management.
- The end-to-end NVMe-based AFF A800 delivers 1.3 million IOPS at below 500µs latency.
- Built-in adaptive QoS safeguards SLAs in multiworkload and multitenant environments. It optimizes performance control dynamically with superior scalability of up to 40,000 workloads per cluster at LUN, file, and VVol levels.
- With the latest ONTAP release, AFF delivers up to 90% performance increase for Microsoft SQL Server with multichannel SMB.

Storage Efficiency Technologies

NetApp is known for its superior storage efficiency technologies, such as inline deduplication, inline compression, thin provisioning, and space-efficient Snapshot copies. These technologies apply to AFF systems and further reduce your total cost of ownership by lowering cost per effective gigabyte of storage:

- Performance-efficient inline data reduction technologies provide an average of 5 to 10 times space savings for a typical use case.
- Space-saving inline data compaction technology places multiple logical data blocks from the same volume into a single 4KB block. Space savings as high as 67:1 from this feature have been observed when using inline data compaction and inline compression with an Oracle database.
- There is a near-zero performance impact with inline compression. Incompressible data detection eliminates wasted cycles.
- You can increase space savings by eliminating redundant blocks using inline deduplication—effective for operations such as VDI OS patches in which this deduplication can achieve 70:1 reduction rates.
- As the first all-flash array to support SSDs with MSW technology, and combined with advanced SSD partitioning in ONTAP, AFF further increases usable capacity by up to 42%.

NetApp Simplifies Management

NetApp management software provides automated tools to further simplify management of storage operations:

- Set up and configure AFF quick and easy with preconfigured systems for SAN and NAS deployments. It takes less than 10 minutes with ONTAP System Manager.
- OnCommand Workflow Automation automates common storage tasks such as provisioning and data protection. It provides fast one-click automation and self-service.

- To optimize storage for peak performance and to keep everything running smoothly, OnCommand Performance Manager provisions and rebalances workloads by monitoring clusters and nodes to assure performance headroom.
- Import LUNs from storage arrays that are not based on ONTAP software directly into an AFF system to seamlessly migrate data from older storage arrays.

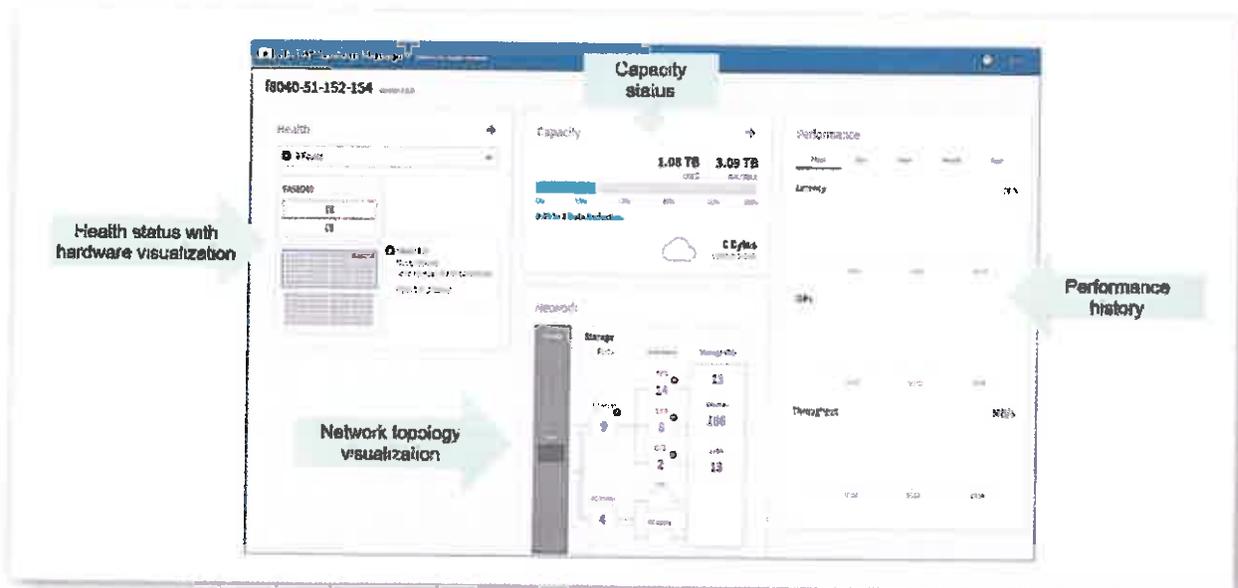


Figure 7: Intuitive ONTAP System Manager –Based on REST APIs, the new System Manager dashboard is more intuitive and displays richer information in a more actionable view.

Get More Business Value with Services

To help you fully realize the benefits of NetApp solutions, NetApp Services and our NetApp certified services partners will collaborate with you through a full portfolio of services that covers the company's IT lifecycle. NetApp offers:

- Assessment services to evaluate the performance and efficiency of workloads across heterogeneous environments
- Advisory services to determine the best workload candidates to move to flash
- Deploy and optimize services to prepare your environment and deliver continuous operation of AFF systems
- Managed upgrade services to secure your storage environment and to protect your investment by ensuring your ONTAP software is the most current version.

NetApp Support offerings, such as the NetApp Active IQ® cloud-based predictive cloud-based analytics and proactive support tool, provide real-time insights and recommendations to prevent problems and optimize your data infrastructure. Learn more at netapp.com/services.

AFF A-Series Systems

NetApp AFF systems help you meet your enterprise storage requirements with the following AFF A-Series Systems:

AFF A800

The AFF A800 is designed for the most demanding workloads requiring ultra-low latency and is the first flash array on the market to support NVMe SSDs and NVMe over Fabrics (NVMe-oF). It provides end-to-end NVMe connectivity between storage arrays and host servers for maximum bandwidth, high IOPS, and the lowest possible latency. Each 4U chassis accommodates dual controllers for high availability (HA) and includes 48 slots for NVMe SSDs. In addition to 32Gb and 16Gb FC, network options include the storage industry's first 100GbE connectivity, as well as 40GbE and 10GbE. An NVMe-powered SAN scale-out cluster supports up to 12 nodes (6 HA pairs) with 1,440 drives and nearly 160PB of effective capacity. NAS scale-out clusters support up to 24 nodes (12 HA pairs). The AFF A800 future-proofs your data infrastructure with NetApp ONTAP 9 the industry's leading data management software.

"NetApp once again hits it out of the park with the enterprise focused A800. The performance profile is very strong, taking its position at the top of the ONTAP family."

— *StorageReview Editors' Choice, May 2019*

AFF A700

The AFF A700 is a high-end NetApp storage controller designed for performance-driven workloads and data centers requiring a modular design. The AFF A700 can dramatically enhance performance and high-performance I/O density in a new 8U HA form factor and it includes options for 40GbE and 32Gb FC along with the latest in SAS connectivity, the SAS 3.0 standard with 12Gb speeds. This controller also provides the most versatile I/O interface available, the UTA2 connections that support 10GbE and 16Gb FC and that can be easily changed between these two protocols in the field. AFF A700 controllers support up to 12 nodes for SAN deployments and up to 24 nodes in NAS deployments.

AFF A700s

The AFF A700s is an integrated high-end all-flash array and best for performance-driven workloads and data centers requiring a small footprint. The AFF A700s comes in a compact form factor with dual controllers and 24 internal SSDs in a single 4U chassis. A700s provides data center efficiencies and excellent performance with reduced power and cooling. AFF A700s performance is comparable to that of AFF A700; however, they offer different connectivity and capacity options to address different solutions and customer requirements.

AFF A320

The AFF A320 midrange end-to-end NVMe NetApp AFF storage controller is a modern NVMe Flash storage system. It provides application performance improvements with lower latencies compared to the AFF A300. For enterprise applications that require the best performance at value, the AFF A320 includes dense 2U form factor with two HA controllers, extreme bandwidth with 16 onboard 100GbE ports and four expansion slots in an HA pair, adapter support includes 100GbE, 32Gb FC, 25GbE, and 10GbE support, NVDIMMs for persistent write cache of data received but not yet committed to flash media, and host-side NVMe/FC support for low-latency, high-performance remote direct memory access (RDMA) connectivity to the NVMe SSDs.

AFF A300

The A300 firmly targets enterprise applications that require best balance of performance and cost. It is more powerful than the AFA A220 for users that need additional capacity and performance. The AFF A300 is easy to set up and runs the latest version of ONTAP and supports SSDs up to 30TB. It requires just 12 SSDs to start but scales to over 140PB raw (560PB effective) in NAS config and 70PB raw (280PB effective) as SAN. The A300 supports 10GbE, 40GbE as well as Fibre Channel up to 32Gb and NVMe/FC with the 32Gb FC adapter.

The midrange AFF A300 recently won the Editor's Choice Award from StorageReview, which bestows this award for "performance in excess of competitive offerings, a feature set that is innovative and sets a new bar for competitive offerings or for defining a new category or space within enterprise IT". Through Storage Review's independent testing with Oracle, SQL, VDI workloads, AFF A300 stands out with its impressive performance and feature set.

— StorageReview Editors' Choice, November 2018

AFF A220

The AFF A220 is ideal for mid-size business and small enterprises that require simplicity and best value. With the AFF A220 you can accelerate business insights and demanding workloads. This 2U array enables enhanced storage efficiency based on the types of workloads. With a potential maximum raw capacity of up to 48.3 PB and maximum memory of 768 GB, NetApp ensures the effectiveness of its inline data reduction technologies, including compression, deduplication and data compaction. It offers 4x 10 GbE cluster interconnect channels for distribution of the processing across an array of nodes in the clusters, and high-data rate and low-latency communication between node processes.

"In addition to accelerating every application without disruption, the NetApp AFF A200 dramatically improves data center economics and enables data-driven enterprises to modernize their infrastructures with confidence. Editor's Choice award for the NetApp AFF A200 for phenomenal performance at sub-millisecond latencies."

— StorageReview Editors' Choice, November 2017

AFF C-Series Systems

NetApp AFF C-Series offers entry-level all-flash systems with enterprise-grade features.

AFF C190

The NetApp AFF C190 offers an enterprise-class flash system for an affordable price. It is designed for IT generalists to meet business requirements with comprehensive data services, seamless scalability, new levels of performance, and cloud integration. With the C190 you can effortlessly connect to public clouds and automatically tier cold data or back up to the cloud to reduce overall storage costs. It delivers industry-leading hybrid cloud integration, supporting all major public clouds including Google Cloud, Amazon Web Services (AWS), Microsoft Azure, IBM Cloud, and Alibaba Cloud.

Table 1: All Flash FAS A-Series Systems technical specifications.

AFF Technical Specifications						
	AFF A800	AFF A700s	AFF A700	AFF A320	AFF A300	AFF A220
Maximum scale-out	2–24 nodes (12 HA pairs)					
Maximum SSD	2,880	2,529	5,760	576	4,608	1,728
Max effective capacity ²	316.3PB	316.3PB	702.7PB	35PB	562.2PB	193.3PB
Per-System Specifications (Active-Active Dual Controller)						
Controller form factor	4U with 48 SSD slots	4U with 48 SSD slots	8U	2U	3U	2U with two 24 SSD slots

Table 2: AFF A-Series software.

AFF A-Series Software	
Features and software included with ONTAP software	<p>Efficiency: NetApp FlexVol[®], inline deduplication, inline compression, inline compaction, and thin provisioning</p> <p>Availability: Multipath I/O and active-active HA pair</p> <p>Data protection: NetApp RAID DP[®], NetApp RAID TEC[®], and Snapshot technology</p> <p>Whole cluster synchronous replication: MetroCluster</p> <p>Performance control: Adaptive QoS and balanced replacement</p> <p>Management: OnCommand Workflow Automation, ONTAP System Manager, and Active IQ Unified Manager</p> <p>Scalable NAS container: NetApp ONTAP FlexGroup</p> <p>Storage protocols supported: NVMe/FC, FC, FCoE, iSCSI, NFS, pNFS, and SMB</p>
Flash bundle	<p>NetApp SnapRestore[®] software: Restore entire Snapshot copies in seconds</p> <p>NetApp SnapMirror software: Simple, flexible backup and replication for disaster recovery</p> <p>NetApp FlexClone[®] technology: Instant virtual copies of files, LUNs, and volumes</p> <p>NetApp SnapCenter[®]: Unified, scalable platform and plug-in suite for application-consistent data protection and clone management</p> <p>NetApp SnapManager software: Application-consistent backup/recovery for enterprise applications</p> <p>Go to NetApp.com for information on additional software available from NetApp.</p>

² Effective capacity is based on 5:1 storage efficiency ratios with the maximum number of SSDs installed. The actual ratio can be higher depending on workloads and use cases.

AFF A-Series Software

Extended-value software (optional)

NetApp OnCommand Insight: Flexible, efficient resource management for heterogeneous environments

NetApp SnapLock: Compliance software for write once, read many (WORM) protected data

NetApp Volume Encryption (free license): Granular, volume-level, data-at-rest encryption

NetApp FabricPool feature: Automatic data tiering to the cloud

SnapMirror Synchronous: Synchronous data replication with zero recovery point objective

NetApp Data Availability Services: Cloud native backup solution for ONTAP storage

NetApp FlexCache: Acceleration for data access for single or multisite deployment

Table 3: All Flash FAS C-Series Systems technical specifications.

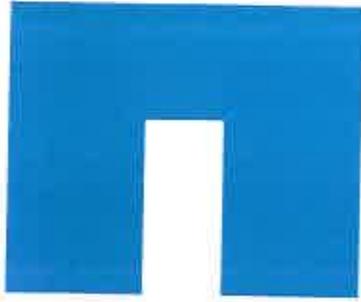
AFF C190 Technical Specifications for Active-Active Dual Controller		
Drives and Capacity	Connectivity	Protocols and Operating Systems
Max. effective capacity 50TiB ³	4 ports—12Gb/6Gb SAS	ONTAP 9.6 GA or later
Max. SSD 24 drives	1GbE management port, USB port	Protocols: FC, FCoE, iSCSI, NFS, pNFS, SMB
Drive type: 960GB SSD	8 ports—FC target (16Gb) 8 ports—FCoE target, UTA2 12 ports—10GbE ports, UTA2 12 ports—10GBASE-T	Host OS version: Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Linux, Oracle Solaris, AIX, HPE UX, macOS, VMware, ESX

³ Effective capacity is based on 3:1 storage efficiency ratios with the maximum number of SSDs installed. The actual ratio can be higher depending on workloads and use cases

Table 4: AFF C-Series software.

Software Included with AFF C190

Features and software included with ONTAP software	<p>Efficiency: NetApp FlexVol®, inline deduplication, inline compression, inline compaction, and thin provisioning</p> <p>Availability: High availability (HA) pair and multipath I/O</p> <p>Data protection: NetApp RAID DP®, NetApp RAID TEC®, and Snapshot technology</p> <p>SnapMirror Synchronous replication</p> <p>Performance acceleration: NetApp FlexCache® software</p> <p>Management: OnCommand Workflow Automation, ONTAP System Manager, and Active IQ Unified Manager</p> <p>Scalable NAS container: NetApp ONTAP FlexGroup</p> <p>Storage protocols supported: FC, FCoE, iSCSI, NFS, pNFS, and SMB</p> <p>NetApp SnapRestore® software: Restore entire Snapshot copies in seconds</p> <p>NetApp SnapMirror software: Simple, flexible backup and replication for disaster recovery</p> <p>NetApp FlexClone® technology: Instant virtual copies of files, LUNs, and volumes</p> <p>NetApp SnapCenter®: Unified, scalable platform and plug-in suite for application-consistent data protection and clone management</p> <p>NetApp SnapManager software: Application-consistent backup/recovery for enterprise applications</p>
Extended-value software (optional)	<p>NetApp OnCommand Insight: Flexible, efficient resource management for heterogeneous environments</p> <p>NetApp SnapLock®: Compliance software for write once, read many (WORM) protected data</p> <p>NetApp Volume Encryption (free license): Granular, volume-level, data-at-rest encryption</p> <p>NetApp FabricPool: Automatic data tiering to the cloud</p> <p>NetApp Data Availability Services: Cloud native backup solution for ONTAP storage</p>



Datasheet

ONTAP 9 Data Management Software

Simplify your hybrid cloud. Unify your data.

Key Benefits

Smart: Simplify Operations and Reduce Costs

- Minimize capex and opex with leading storage efficiency.
- Provision storage in minutes for Oracle, SAP, Microsoft SQL, VMware, and other business apps.
- Tier your cold data to the cloud. Automatically.

Powerful: Respond to Changing Business Requirements

- Accelerate critical workloads with industry-leading performance.
- Scale capacity and performance without disruption.
- Deploy enterprise applications on NetApp storage systems, commodity servers, or in the cloud.

Trusted: Protect and Secure Your Data Across the Hybrid Cloud

- Guard against data loss and accelerate recovery with integrated data protection.
- Eliminate business disruptions due to failures, maintenance, and site disasters.
- Protect your sensitive company and customer information with built-in data security.

The Challenge

Businesses today are under pressure to become more efficient, respond quickly to new opportunities, and improve customer experience. During their digital transformation to address these challenges, they must modernize their IT infrastructure and integrate new types and uses of data into their existing environment. They also need to effectively manage and protect their data wherever it resides—on premises and in the cloud—while reducing costs, increasing security, and operating with existing IT staff.

The Solution

Create a storage infrastructure that is smart, powerful, and trusted. Simplify how you manage your data that is spread across your hybrid cloud environment. NetApp® ONTAP® 9, the industry's leading enterprise data management software, combines new levels of simplicity, flexibility, and security with powerful data management capabilities, proven storage efficiencies, and leading cloud integration.

With ONTAP 9, you can build an intelligent hybrid cloud that is the foundation of a NetApp Data Fabric that spans flash, disk, and cloud. Flexibly deploy storage on your choice of architectures—hardware storage systems, software-defined storage (SDS), and the cloud—while unifying data management across all of them. Accelerate your enterprise applications with flash, without compromising on the essential data services that you need. And seamlessly manage your data as it flows to wherever you need it most to help you make the best possible decisions for your organization.

Smart: Simplify Operations and Reduce Costs

Get proven storage efficiency

With ONTAP, you get a comprehensive, industry-leading portfolio of storage efficiency capabilities. Inline data compression, deduplication, and compaction work together to reduce your storage costs and maximize the data you can store. Plus, you can multiply your savings with space-efficient NetApp Snapshot™ copies, thin provisioning, replication, and cloning technologies.

Deploy workloads in less than 10 minutes

Built-in application workflows enable you to quickly and confidently provision storage for key workloads in less than 10 minutes—from power-on to serving data. These workloads include Oracle, SAP, SQL Server, and virtual desktops and servers. Years of NetApp experience and best practices are integrated into the System Manager wizard and factory configurations, enabling you to quickly set up your new configuration just by answering a few questions.

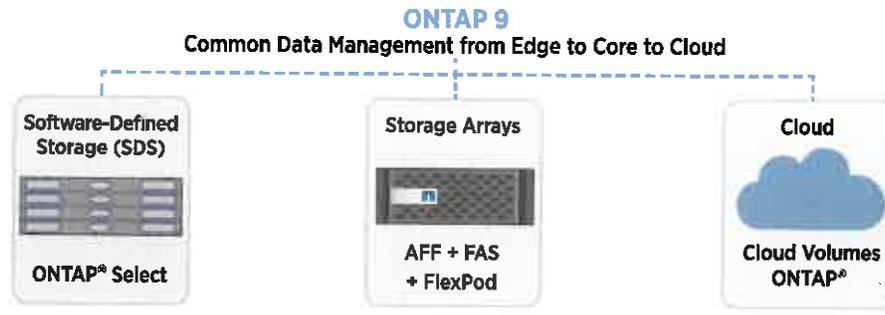


Figure 1) Standardize data management across architectures with a rich set of enterprise data services.

Trusted: Protect and Secure Your Data Across the Hybrid Cloud

Integrated data protection and nondisruptive operations
ONTAP provides NetApp integrated data protection (IDP) to safeguard your operations and keep them running smoothly. Meet your requirements for local backup with nearly instantaneous recovery by using space-efficient Snapshot copies. Achieve remote backup/recovery and disaster recovery with NetApp SnapMirror® asynchronous replication. Get zero data loss protection (RPO=0) with SnapMirror Synchronous replication.

NetApp MetroCluster™ technology delivers business continuity by synchronously mirroring between locations for continuous data availability. A MetroCluster storage array, using FC or IP connectivity, can be deployed at a single site, across a metropolitan area, or in different cities.

With ONTAP, you can service and update your infrastructure during regular work hours without disrupting your business. Dynamically assign, promote, and retire storage resources without downtime over the lifecycle of an application. Data can be moved between controllers without application interruption, so you can get the data on the node that delivers the optimal combination of speed, latency, capacity, and cost.

Robust security

The leading portfolio of security capabilities in ONTAP helps you integrate data security across your hybrid cloud and avoid unauthorized data access. With the NetApp Volume Encryption feature that is built in to ONTAP, you can easily and efficiently protect your at-rest data by encrypting any volume on an AFF or FAS system. No special encrypting disks are required. In-flight encryption for backup and replication protects your data in transit. Plus, other features such as multifactor authentication, role-based access control (RBAC), and onboard and external key management increase the security of your data.

Secure consolidation

You can save time and money by sharing the same consolidated infrastructure for workloads or tenants that have different performance, capacity, and security requirements. And with ONTAP, you don't have to worry that the activity in one tenant partition will affect another. With multitenancy, a storage cluster can be subdivided into secure partitions that are governed by rights and permissions.

Rigorous compliance

To meet your stringent compliance and data retention policies, NetApp SnapLock® software enables write once, read many (WORM) protected data for your ONTAP environment. NetApp also provides superior integration with enterprise backup vendors and leading applications. Our IDP solutions also include integrated and unified disk-to-disk backup and disaster recovery in a single process for VMware and Microsoft virtualization. In addition, cryptographic shredding enables General Data Protection Regulation (GDPR) compliance.

Make a Simple, Straightforward Transition to ONTAP 9

No matter what your starting point is, NetApp streamlines your move to ONTAP 9:

- Upgrade from ONTAP 8.3 with a simple update of your ONTAP software—no disruption and zero downtime.
- Make a smooth transition from NetApp Data ONTAP operating in 7-Mode with proven tools and best practices, including the 7-Mode Transition Tool (7MTT) and copy-free transition (CFT).
- Use straightforward import processes from third-party storage to ONTAP 9.

Consult our experts to plan and implement your transition and gain the latest ONTAP advantages from day one. You can use NetApp Services or NetApp Services Certified Partners, you can do it yourself by using our proven tools and processes, or you can combine these approaches.

Plus, when you're running ONTAP, you can use the Managed Upgrade Service to get the most from your investment by ensuring that your ONTAP software is always up to date.

Make your move to ONTAP 9.

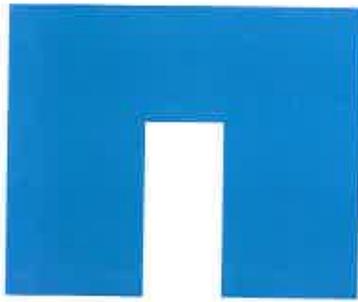
About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of applications and data across cloud and on-premises environments to accelerate digital transformation. Together with our partners, we empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize their operations. For more information, visit www.netapp.com. #DataDriven

NetApp Software and Features

Table 1) ONTAP 9 offers a robust set of standard and optional features.

	Function	Benefits
Data compaction	Packs more data into each storage block for greater data reduction	Works with compression to reduce the amount of storage that you need to purchase and operate
Data compression	Provides transparent inline and postprocess data compression for data reduction	Reduces the amount of storage that you need to purchase and maintain
Deduplication	Performs general-purpose deduplication for removal of redundant data	Reduces the amount of storage that you need to purchase and maintain
FabricPool	Automates data tiering to the cloud (public and private)	Decreases storage costs for cold data
Flash Pool™ Caching	Creates a mixed-media storage pool by using SSDs and HDDs	Increases the performance and efficiency of HDD pools with flash acceleration
FlexCache®	Caches actively read datasets within a cluster and at remote sites	Accelerates read performance for hot datasets by increasing data throughput within a cluster, and improves the speed and productivity of collaboration across multiple locations
FlexClone®	Instantaneously creates file, LUN, and volume clones without requiring additional storage	Saves you time in testing and development and increases your storage capacity
FlexGroup	Enables a single namespace to scale up to 20PB and 400 billion files	Supports compute-intensive workloads and data repositories that require a massive NAS container while maintaining consistent high performance and resiliency
FlexVol®	Creates flexibly sized volumes across a large pool of disks and one or more RAID groups	Enables storage systems to be used at maximum efficiency and reduces hardware investment
MetroCluster	Combines array-based clustering with synchronous mirroring to deliver continuous availability and zero data loss; up to 700km distance between nodes	Maintains business continuity for critical enterprise applications and workloads if a data center disaster occurs
Performance capacity	Provides visibility of performance capacity that is available for deploying new workloads on storage nodes	Simplifies management and enables more effective provisioning of new workloads to the optimal node
QoS (adaptive)	Simplifies setup of QoS policies and automatically allocates storage resources to respond to workload changes (number of terabytes of data, priority of the workload, and so on)	Simplifies operations and maintains consistent workload performance within your prescribed minimum and maximum IOPS boundaries
RAID-TEC™ and RAID DP® technologies	Provides triple parity or double-parity RAID 6 implementation that prevents data loss when three or two drives fail	Protect your data without the performance impact of other RAID implementations; reduce risks during long rebuilds of large-capacity HDDs
SnapCenter®	Provides host-based data management of NetApp storage for databases and business applications	Offers application-aware backup and clone management; automates error-free data restores
SnapLock	Provides WORM file-level locking	Supports regulatory compliance and organizational data retention requirements
SnapMirror	Provides integrated remote backup/recovery and disaster recovery with incremental asynchronous data replication; preserves storage efficiency savings during and after data transfer	Provides flexibility and efficiency when replicating data to support remote backup/recovery, disaster recovery, and data distribution
SnapMirror Synchronous	Delivers incremental, volume-granular, synchronous data replication; preserves storage efficiency savings during and after data transfer	Achieve zero data loss protection (RPO=0)
SnapRestore®	Rapidly restores single files, directories, or entire LUNs and volumes from any Snapshot copy	Instantaneously recovers files, databases, and complete volumes from your point-in-time Snapshot copy
Snapshot	Makes incremental data-in-place, point-in-time copies of a LUN or a volume with minimal performance impact	Enables you to create frequent space-efficient backups with no disruption to data traffic
NetApp Volume Encryption	Provides data-at-rest encryption that is built into ON-TAP	Lets you easily and efficiently protect your at-rest data by encrypting any volume on an AFF or FAS system; no special encrypting disks are required



Datasheet

NetApp AFF A-Series

Leading the future of flash

Key Benefits

Accelerate Applications

- Speed up your critical applications with the industry's fastest end-to-end NVMe enterprise all-flash array.
- Accelerate artificial intelligence and machine learning applications with lowest latency.
- Support 2 times more workloads and cut application response time in half with a modern NVMe-based SAN infrastructure.

Reduce Data Center Costs

- Minimize your data center footprint by storing up to 2PB of data in a 4U compact system.
- Save SSD storage by 5 to 10 times with inline data reduction technologies.
- Reduce power and cooling, rack space, and support costs dramatically.

Simplify IT Operations

- Unify data services across SAN and NAS environments, both on the premises and in the cloud.
- Set up and configure a complete system and serve data within 10 minutes.
- Safeguard your data with best-in-class integrated data protection and seamless cloud backup and recovery.

Data driven organizations require an agile and efficient IT infrastructure to meet the demand for fast, secure, and continuous data access. A fundamental first step in undertaking an IT transformation is to modernize your infrastructure with all-flash storage to improve speed and responsiveness for critical business applications. New workloads, such as data analytics, artificial intelligence (AI), and deep learning (DL), demand extreme performance that first-generation flash systems cannot deliver. Additionally, more and more organizations are adopting a "cloud first" strategy, driving the need for enterprise-grade data services for a shared environment across on-premises data centers and the cloud. As a result, modern all-flash arrays must provide robust data services, integrated data protection, seamless scalability, and new levels of performance—plus deep application and cloud integration.

Cloud-Connected All-Flash Storage Powered by ONTAP

IT departments need smart, powerful, trusted solutions that take advantage of modern cloud technologies. NetApp® AFF A-Series systems are designed to help organizations accelerate their infrastructure transformation and fuel data-driven strategies. Powered by NetApp ONTAP® data management software, AFF systems deliver the industry's highest performance, superior flexibility, and best-in-class data services and cloud integration to help you accelerate, manage, and protect your business-critical data in the hybrid cloud.

A wide range of customers, from enterprise to midsize businesses, rely on AFF to:

- Simplify operations with seamless data management, on the premises and in the cloud.
- Accelerate traditional and new-generation applications.
- Keep business-critical data available, protected, and secure.

AFF A-Series systems support end-to-end NVMe technologies, from NVMe-attached SSDs to front-end NVMe over Fibre Channel (NVMe/FC) host connectivity. These systems deliver the industry's lowest latency for an enterprise all-flash array, making them a superior choice for driving the most demanding workloads and AI/DL applications. With a simple software upgrade to the modern NVMe/FC SAN infrastructure, you can drive more workloads with faster response times, without disruption or data migration.

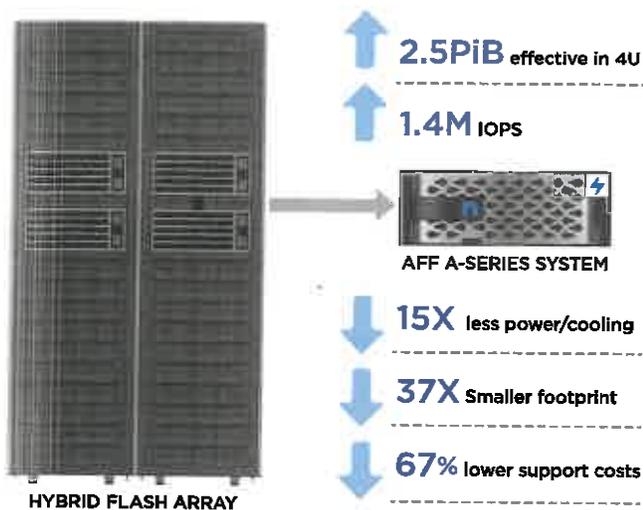


Figure 1) Benefits of Modernizing with All-Flash.

Increase Operational Efficiency for Your Business

IT departments are striving to make budgets go further and to allow IT staff to focus on new value-added projects rather than on day-to-day IT management.

Provision storage in minutes

NetApp AFF systems offer broad application ecosystem support and deep integration for enterprise applications, virtual desktop infrastructure (VDI), database, and server virtualization, supporting Oracle, Microsoft SQL Server, VMware, SAP, MySQL, and more. You can quickly provision storage in less than 10 minutes with NetApp ONTAP System Manager (formerly OnCommand® System Manager).

Infrastructure management tools simplify and automate common storage tasks so that you can:

- Easily provision and rebalance workloads by monitoring clusters and nodes.
- Use one-click automation and self-service for provisioning and data protection.
- Import LUNs from third-party storage arrays directly into an AFF system to seamlessly migrate data.

In addition, the NetApp Active IQ® intelligence engine enables you to optimize your NetApp systems with predictive analytics and proactive support. Fueled by NetApp's massive user base, AI and machine learning create actionable insights that help you prevent problems, optimize your configuration, save time, and make smarter decisions.

Achieve storage savings, backed by the industry's most effective guarantee

NetApp employs various capabilities to promote optimal capacity savings and to drive down your TCO. AFF system's support for solid-state drives (SSDs) with multistream write technology, combined with advanced SSD partitioning, provides maximum usable capacity, regardless of the type of data that you store. Thin provisioning; NetApp Snapshot™ copies; and inline data reduction features, such as deduplication, compression, and compaction, provide substantial additional space savings—without affecting performance—enabling you to purchase the least amount of storage capacity possible. With AFF, you can dramatically reduce your data center costs with the best effective capacity for any workload, backed by the industry's most effective guarantee.

Build your hybrid cloud with ease

The NetApp Data Fabric helps your organization simplify and integrate data management across cloud and on-premises to meet business demands and gain a competitive edge. With AFF, you can connect to more clouds for more data services, data tiering, caching, and disaster recovery. You can also:

- Maximize performance and reduce overall storage costs by automatically tiering cold data to the cloud with FabricPool.
- Greatly simplify hybrid cloud backup and recovery with cloud-resident NetApp Data Availability Services.
- Accelerate read performance for data that is shared widely throughout your organization and across hybrid cloud deployments.

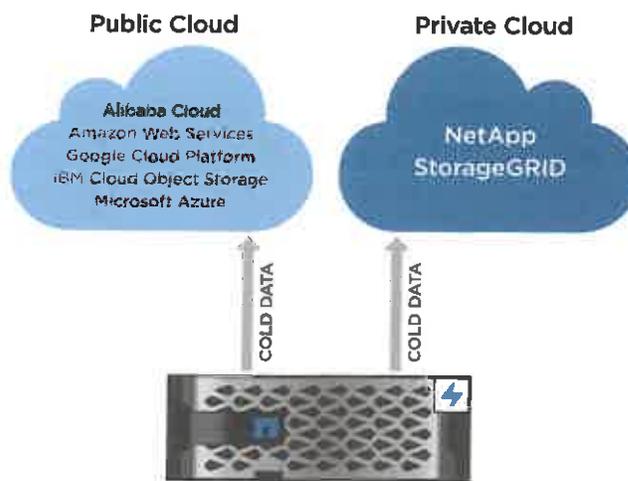


Figure 2) Automatic tiering to the cloud.

Accelerate Applications and Future-Proof Your Infrastructure

In the modern data center, IT is charged with driving maximum performance for business-critical workloads, scaling without disruption as the business grows, and enabling the business to take on new data-driven initiatives.

Get the best performance for your most demanding applications

NetApp AFF systems deliver industry-leading performance proven by SPC-1 and SPEC SFS industry benchmarks, making them ideal for demanding, highly transactional applications such as Oracle, Microsoft SQL Server, MongoDB databases, VDI, and server virtualization. With the power of front-end NVMe/FC host connectivity combined with back-end NVMe-attached SSDs, the AFF A800 and AFF A320 systems deliver latency as low as 100µs, making them an optimal fit for your most demanding workloads. The midrange AFF A320 system puts best performance within your budget. Supporting NVMe/RoCE connectivity on the back-end to the NVMe drive shelf and NVMe/FC on the front-end to the host, AFF A320 leads the market with the best combination of NVMe-oF technologies. You can also:

- Consolidate workloads on AFF systems, which can deliver up to 11.4 million IOPS at 1ms latency in a cluster with a truly unified scale-out architecture. You also get built-in adaptive quality of service (QoS) that safeguards SLAs in multiworkload and multitenant environments.
- Manage massively scalable NAS containers of up to 20PB and 400 billion files with a single namespace.
- Improve the speed and productivity of collaboration across multiple locations and increase data throughput for read-intensive applications with NetApp FlexCache® software.

Modernize with advanced NVMe

Designed specifically for flash, the AFF A-Series all-flash systems deliver industry-leading performance, density, scalability, security, and network connectivity. AFF A-Series systems support NVMe/FC host connectivity on all midrange and high-end systems, so you can get twice the IOPS and cut application response time in half compared with traditional FC. These systems support a range of ecosystems, including VMware, Microsoft Windows 10, and Linux, with storage path failover. For most customers, integrating NVMe/FC into an existing SAN is a simple, nondisruptive software upgrade.

Scale without disruption

You can integrate new technologies and private or public cloud into your infrastructure nondisruptively. AFF is the only all-flash array that enables you to combine different controllers, SSD sizes, and new technologies so that your investment is protected.

Keep Important Data Available, Protected, and Secure

As organizations become more data driven, the business impact of data loss can be increasingly dramatic—and costly. IT must protect data from both internal and external threats, ensure data availability, eliminate maintenance disruptions, and quickly recover from failures.

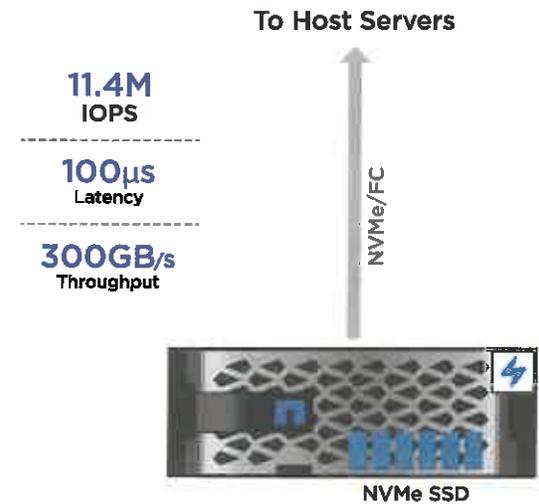


Figure 3) Industry-leading NVMe performance.

Integrated data protection

AFF systems come with a full suite of acclaimed NetApp integrated and application-consistent data protection software. Key capabilities include:

- Native space efficiency with cloning and NetApp Snapshot copies reduce storage costs and minimize performance impact. Up to 1,023 copies are supported.
- NetApp SnapCenter® software provides application-consistent data protection and clone management to simplify application management.
- NetApp SnapMirror® technology replicates to any NetApp FAS or AFF system on the premises or in the cloud, reducing overall system costs.

Business continuity and fast disaster recovery

With AFF, you can maintain constant data availability with zero data loss and zero downtime. NetApp MetroCluster™ software provides synchronous replication to protect your entire system, and NetApp SnapMirror Synchronous provides more granular replication of selected critical data.

Security everywhere

Flexible encryption and key management help guard your sensitive data on the premises, in the cloud, and in transit. With the simple and efficient security solutions, you can:

- Achieve FIPS 140-2 compliance (Level 1 and Level 2) with self-encrypting drives and use any type of drives with software-based encryption.
- Meet governance, risk, and compliance requirements with security features such as secure purge; logging and auditing monitors; and write once, read many (WORM) file locking.
- Protect against threats with multifactor authentication, role-based access control, secure multitenancy, and storage-level file security.

Get More Business Value with Services

NetApp Services and NetApp Services Certified Partners collaborate with you to enhance your IT capabilities through a full portfolio of services that cover your IT lifecycle. To help you get the most value from your flash technology investment, NetApp offers:

- Assessment services to help evaluate the performance and efficiency of workloads across your heterogeneous environments.
- Advisory services to help you determine the best workload candidates to move to flash.
- Deployment and optimization services to prepare your environment and to deliver continuous operation of your AFF systems.
- Managed upgrade services to secure your storage environment and to protect your investment by ensuring your ONTAP software is the most current version.

Learn more at netapp.com/services.

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of applications and data across cloud and on-premises environments to accelerate digital transformation. Together with our partners, we empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize their operations. For more information, visit www.netapp.com. #DataDriven

Table 1) AFF technical specifications.

	AFF A800	AFF A700s	AFF A700	AFF A320	AFF A300	AFF A220
Maximum scale-out	2-24 nodes (12 HA pairs)	2-24 nodes (12 HA pairs)	2-24 nodes (12 HA pairs)	2-24 nodes (12 HA pairs)	2-24 nodes (12 HA pairs)	2-24 nodes (12 HA pairs)
Maximum SSDs	2,880	2,592	5,760	576	4,608	1,728
Maximum effective capacity ^a	316.3PB	316.3PB	702.7PB	35PB	562.2PB	193.3PB
Per-System Specifications (Active-Active Dual Controller)						
	AFF A800	AFF A700s	AFF A700	AFF A320	AFF A300	AFF A220
Controller form factor	4U with 48 SSD slots	4U with 24 SSD slots	8U	2U	3U	2U with 24 SSD slots
PCIe expansion slots	8	8	20	4	4	n/a
FC target ports (32Gb autoranging)	32	8	64	16	8	n/a
FC target ports (16Gb autoranging)	32	16	64	16	24	8
FCoE target ports, UTA2	n/a	n/a	64	n/a	24	8
100GbE ports (40GbE autoranging)	20	n/a	n/a	24	n/a	n/a
40GbE ports (10GbE autoranging)	n/a	16	32	n/a	8	n/a
10GbE ports	32	n/a	64	16	20	12
10Gbase-T (1GbE autoranging)	n/a	n/a	64	16	12	n/a
12Gb/6Gb SAS ports	n/a	16	64	n/a	24	4
Storage networking supported	NVMe/FC, FC, iSCSI, NFS, pNFS, CIFS/SMB	NVMe/FC, FC, iSCSI, NFS, pNFS, CIFS/SMB	NVMe/FC, FC, FCoE, iSCSI, NFS, pNFS, SMB	NVMe/FC, FC, iSCSI, NFS, pNFS, CIFS/SMB	NVMe/FC, FC, FCoE, iSCSI, NFS, pNFS, SMB	FC, FCoE, iSCSI, NFS, pNFS, SMB
OS version	ONTAP 9.4 RC1 or later	ONTAP 9.1 GA or later	ONTAP 9.1 RC1 or later	ONTAP 9.6 or later	ONTAP 9.1 RC1 or later	ONTAP 9.4 RC1 or later
Shelves and media	NVMe drive packs DS224C (2U; 24 drives, 2.5" SFF); DS2246 (2U; 24 drives, 2.5" SFF)	DS224C (2U; 24 drives, 2.5" SFF); DS2246 (2U; 24 drives, 2.5" SFF)	DS224C (2U; 24 drives, 2.5" SFF); DS2246 (2U; 24 drives, 2.5" SFF)	NS224 (2U; 24 drives, 2.5" SFF NVMe)	DS224C (2U; 24 drives, 2.5" SFF); DS2246 (2U; 24 drives, 2.5" SFF)	DS224C (2U; 24 drives, 2.5" SFF); DS2246 (2U; 24 drives, 2.5" SFF)
Host/client OS supported	Microsoft Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Linux, Oracle Solaris, AIX, HP-UX, Mac OS, VMware, ESX					

^a Effective capacity is based on 5:1 storage efficiency ratios with the maximum number of SSDs installed. The actual ratio can be higher depending on workloads and use cases.

Table 2) AFF A Series Software

Features and software Included with ONTAP software	<p>Efficiency: NetApp FlexVol™ technology, inline deduplication, inline compression, inline compaction, and thin provisioning</p> <p>Availability: active-active HA pair and multipath I/O</p> <p>Data protection: NetApp RAID DP®, RAID-TEC™, and Snapshot technology</p> <p>Whole cluster synchronous replication: NetApp MetroCluster</p> <p>Performance control: adaptive QoS and balanced placement</p> <p>Management: NetApp OnCommand Workflow Automation, ONTAP System Manager, and Active IQ Unified Manager (formerly OnCommand Unified Manager)</p> <p>Scalable NAS container: NetApp ONTAP FlexGroup</p> <p>Storage protocols supported: NVMe/FC, FC, FCoE, iSCSI, NFS, pNFS, and SMB</p>
Flash bundle	<p>NetApp SnapRestore® software: restoration of entire Snapshot copies in seconds</p> <p>NetApp SnapMirror software: simple, flexible backup and replication for disaster recovery</p> <p>NetApp FlexClone® technology: instant virtual copies of files, LUNs, and volumes</p> <p>NetApp SnapCenter®: unified, scalable platform and plug-in suite for application-consistent data protection and clone management</p> <p>NetApp SnapManager® software: application-consistent backup and recovery for enterprise applications</p> <p>For information about additional software that is available from NetApp, visit netapp.com.</p>
Extended-value software (optional)	<p>NetApp OnCommand Insight: Flexible, efficient resource management for heterogeneous environments</p> <p>NetApp SnapLock® software: compliance software for WORM protected data</p> <p>NetApp Volume Encryption (free license): granular, volume-level, data-at-rest encryption</p> <p>FabricPool: automatic data tiering to the cloud (free when tiering to NetApp StorageGRID® object-based storage)</p> <p>NetApp SnapMirror Synchronous: synchronous data replication with zero recovery point objective</p> <p>NetApp Data Availability Services: cloud-native backup solution for NetApp ONTAP storage</p> <p>NetApp FlexCache: acceleration for data access for single or multisite deployment</p> <p>For information about additional software that is available from NetApp, visit netapp.com.</p>

ONTAP 9: Harness the Power of the Hybrid Cloud

NetApp ONTAP simplifies data management for any application, anywhere. Accelerate and protect data across the hybrid cloud; and future-proof your data infrastructure. The latest version, ONTAP 9.7, offers a number of enhancements, including a new management user interface and synchronous mirroring with MetroCluster.

The State of Est Virginia's transformation into a digital business brings with it pressures to be more efficient, respond quickly to new opportunities, and improve the customer experience. This might require modernizing your IT infrastructure, integrating new types and uses of data into your existing environment, and managing data on premises as well as in the cloud—yet operations must be simplified, costs reduced, and security increased.

NetApp® ONTAP 9® unifies data management across flash, disk, and cloud. It bridges current enterprise workloads and new emerging applications providing unmatched versatility, comprehensive data protection, and leading storage efficiency. NetApp ONTAP 9.7 is the latest generation of the leading data management software that delivers the performance, data resiliency, protection, and scalability that you need for your data infrastructure. ONTAP 9.7 continues to build the foundation for a modern data fabric. You can easily harness the power and agility of the hybrid cloud to get the most value from your data wherever you need it—at the edge, in the data center, or in the cloud. This latest release of ONTAP software is well suited for enterprise business applications and for artificial intelligence (AI) and real-time analytics.

Leverage ONTAP 9 to:

- Simplify operations and reduce cost
- Adapt to changing business needs
- Protect and secure data across the hybrid cloud

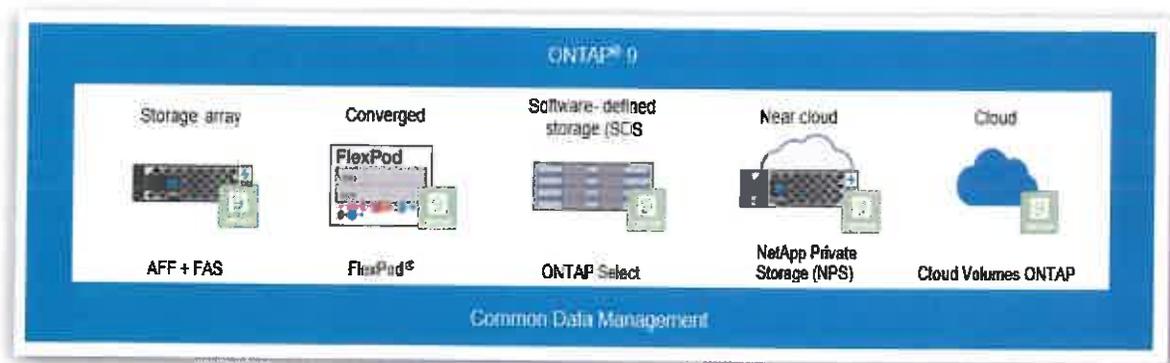


Figure 1: Standardize data management across architectures with a rich set of enterprise data services.

"Ease of use is the most valuable feature for us....With ONTAP we have more shelves, more disks, and aggregates."

— Peggy Baladera, Storage Tec, General Dynamics Mission Systems Inc.

Simplify Operations and Reduce Costs

Although storage might double in size, it no longer means there is twice as much work required. ONTAP has a common set of features across deployment architectures that simplify complex tasks so your staff can be more productive.

Receive Proven Storage Efficiency

With ONTAP, you can reduce costs with one of the most comprehensive storage efficiency offerings in the industry. You get NetApp Snapshot™ copies, thin provisioning, as well as replication and cloning technologies. You also get inline data compression, inline deduplication, and inline compaction that work together to reduce data management costs and maximize effective capacity. In addition, FabricPool automates the cost-efficient tiering of cold data to both public and private clouds.

Deploy Workloads in Less Than 10 Minutes

Fast provisioning workflows enable the deployment of key workloads such as Oracle, SQL Server, SAP HANA, VDI, and VMware in less than 10 minutes from power-on to serving data. Years of NetApp experience and best practices are integrated into the System Manager wizard and factory configurations, so you can quickly set up new configurations by answering a few questions. As new workloads are deployed, ONTAP 9 gives you the visibility to know which node has the most performance capacity available for optimal deployment.

Save Time with the New Management User Interface

ONTAP System Manager has been redesigned with new dashboard page views and simpler workflows that are based on REST APIs. The new management user interface gives you the ability to easily see the status of your cluster and to take quick actions to complete management tasks or mitigate risks before they become problems. ONTAP System Manager will save you time by showing key system information about capacity, hardware health, networking, and performance history with up to one year of data. Only one screen is needed for provisioning LUNs or NAS volumes.

Simplify Operations and Unify Data Management

Simplify your operations by unifying data management across a hybrid cloud that can span flash, disk, and cloud running SAN and NAS workloads. Increase the efficiency of your staff and easily move data between nodes to where it is most needed. ONTAP is the foundation for a data fabric that gives freedom, choice, and control across your storage environment.

Automatically Tier to Cloud

You can deliver high performance to your applications and reduce storage costs by automatically tiering cold data from the performance tier to a private or public cloud. FabricPool frees up space on your existing NetApp All Flash FAS (AFF) infrastructure, so you can consolidate more workloads.

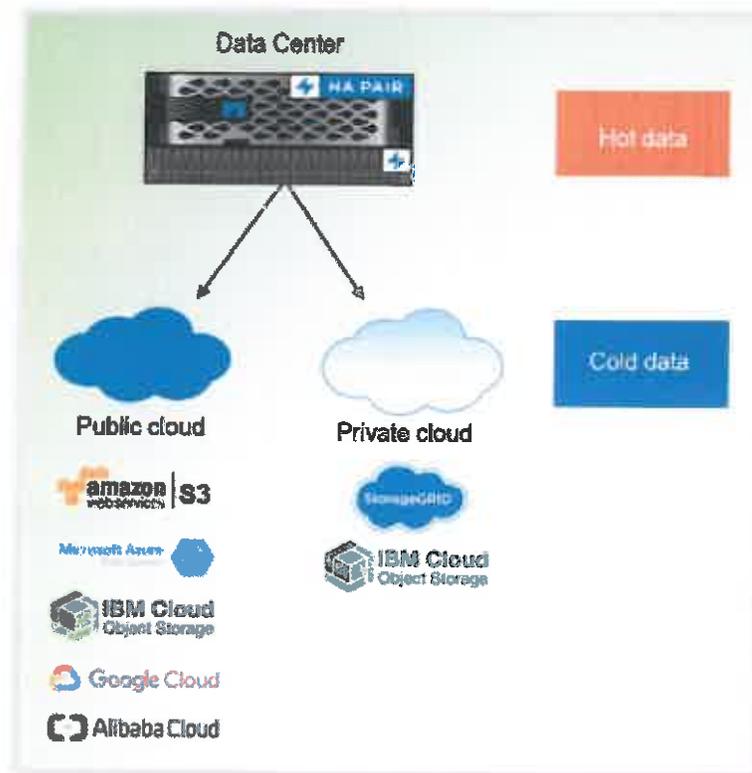


Figure 2: Automatic cloud tiering of cold data – ONTAP 9.7 enables mirroring of tiered, cold data to multiple cloud buckets, either in public clouds or in on the premises. This feature increases your flexibility to change cloud-tiering providers or locations and gives you an additional level of resiliency if one cloud tier location goes offline.

Maximize Investment Protection

ONTAP gives you the flexibility to create an integrated, scalable storage environment by clustering storage controllers from different families—AFF and FAS—as well as from different generations. Grow with the latest hardware and continue to use your older hardware. When it is time to retire a storage system, simply upgrade the controllers and keep data in place on the existing disk shelves.

Gain Simple, Powerful Management Capabilities

NetApp data management infrastructure software manages hybrid clouds. You can centrally monitor the health of your environment by viewing metrics on capacity utilization, performance, availability, and data protection. It can also help automate your storage processes and integrate them into your data center orchestration platform for end-to-end service delivery for your private and hybrid cloud services.

NetApp Active IQ® intelligence provides predictive analytics and actionable insights based on machine learning and artificial intelligence. This intelligence helps optimize your NetApp investment, simplify and automate operations, and achieve data center efficiencies.

“ONTAP has really reduced our costs because we learned that we could use our storage with fewer machines and drive down data center costs.”

— *Oliver Fuckner, Systems Administrator, Strato AG*

Adapt to Changing Business Needs

To support your critical applications, you need a storage environment that cost-effectively delivers high performance and availability that can also scale with business growth and protect your valuable data. ONTAP 9 delivers on all these requirements with highly efficient flash performance for scalable, nondisruptive operations.

Optimized for Flash

ONTAP 9 delivers the horsepower that critical applications require without compromising on rich data services. AFF systems running ONTAP 9 are optimized specifically for flash, including AFF systems with NVMe solid-state drives (SSDs) and NVMe over Fabrics, providing up to twice the performance compared to the same workloads running on prior ONTAP releases, while still delivering consistent submillisecond latency.

ONTAP 9 also enables FAS hybrid-flash systems to deliver flash-accelerated performance that is balanced with hard disk drives (HDD) economies. Hot data is automatically cached in flash to accelerate application performance.

Consistent Performance

Quality of service (QoS) workload management allows you to control the resources that each workload can consume, to better manage performance spikes and improve customer satisfaction. Adaptive QoS can be used to set both maximum and minimum resource levels, which is especially important for business-critical workloads, and it automatically adjusts storage resource levels to respond to changes in workloads and deliver consistent performance.

Seamless Scalability

Storage systems that run ONTAP can transparently scale from a few terabytes up to 176PB. You can scale up by adding capacity. Or scale out by adding additional storage controllers to seamlessly expand your cluster up to 24 nodes as your business needs grow. Rebalance capacity to improve service levels by redeploying workloads dynamically and avoiding hot spots. You can also isolate workloads and offer levels of service by using different controller technologies, storage tiers, and QoS policies.

In addition, ONTAP supports massive NAS containers that are easy to manage. With FlexGroup, a single namespace can grow to 20PB and 400 billion files while maintaining consistent high performance and resiliency.

Future-proof Your Data Infrastructure

ONTAP 9 provides the flexibility you need to design and deploy your storage environment across the widest range of architectures, so you can match the approach that is best for your evolving business needs:

- NetApp hardware systems: AFF all flash systems and FAS hybrid-flash systems
- Converged infrastructure: FlexPod®
- On commodity servers as software-defined storage (SDS): ONTAP Select
- Next to the cloud: NetApp Private Storage (NPS) for Cloud
- In the cloud: Cloud Volumes ONTAP

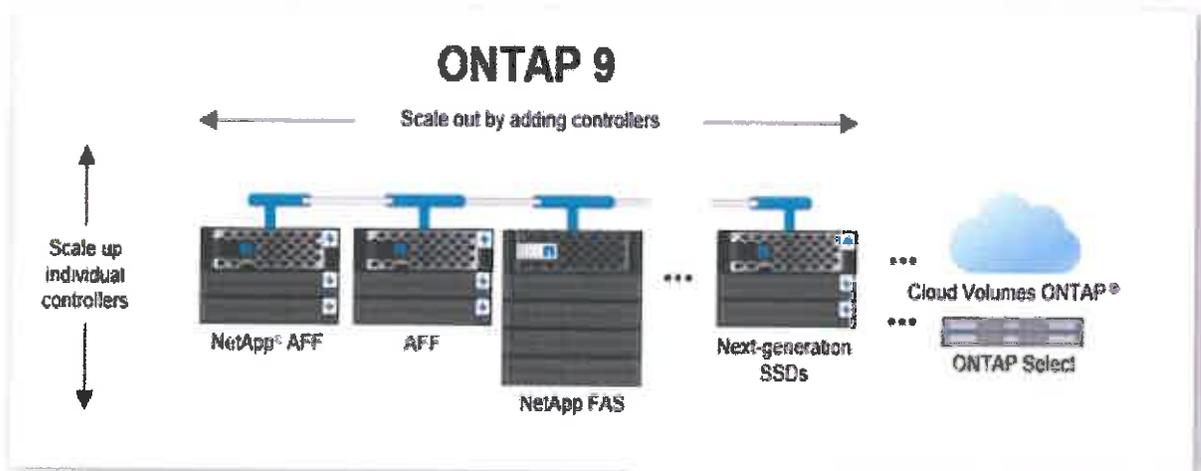


Figure 3: Scale seamlessly – Scale out by intermixing your choice of flash and hybrid-flash nodes, upgrade hardware/software or scale up without disrupting users, incorporate software-defined, cloud, and future-generation flash.

Flexibly consolidate both NAS and SAN workloads onto any ONTAP environment while delivering consistent data services. You can also seamlessly move your data between architectures to get your data onto the optimal environment for performance, capacity, and cost efficiency.

Protect and Secure Your Data Across the Hybrid Cloud

ONTAP provides comprehensive data protection so you can protect your data seamlessly across the hybrid cloud.

Integrated Data Protection and Nondisruptive Operations

NetApp offers a complete suite of Integrated Data Protection (IDP) to safeguard your operations and keep them running smoothly. You can:

- Meet your requirements for local backup with near-instant recovery by using space-efficient NetApp Snapshot copies. Application-created Snapshots that are used by third-party data protection software are replicated, as well as LUN clones.
- Achieve remote backup/recovery and disaster recovery with SnapMirror® asynchronous replication.
- Get zero data loss protection (RPO=0) for your NVMe environment with SnapMirror Synchronous replication.

NetApp MetroCluster™ technology delivers business continuity by synchronously mirroring between locations for continuous data availability. A MetroCluster storage array, leveraging FC or IP connectivity, can be deployed at a single site, across a metropolitan area, or in different cities. With the release of ONTAP 9.7, you can use your existing network infrastructure for synchronous mirroring with MetroCluster. Simultaneously mirror your tiered data out to multiple clouds. You get the flexibility to store your data at multiple cloud providers for added resiliency and it simplifies the process for changing cloud providers.

ONTAP gives you the ability to perform critical tasks without interrupting your business by dynamically assigning, promoting, and retiring storage resources without downtime over the lifecycle of an application. Data can be moved between controllers without application interruption, so you can get the data on the node that delivers the optimal combination of speed, latency, capacity, and cost.

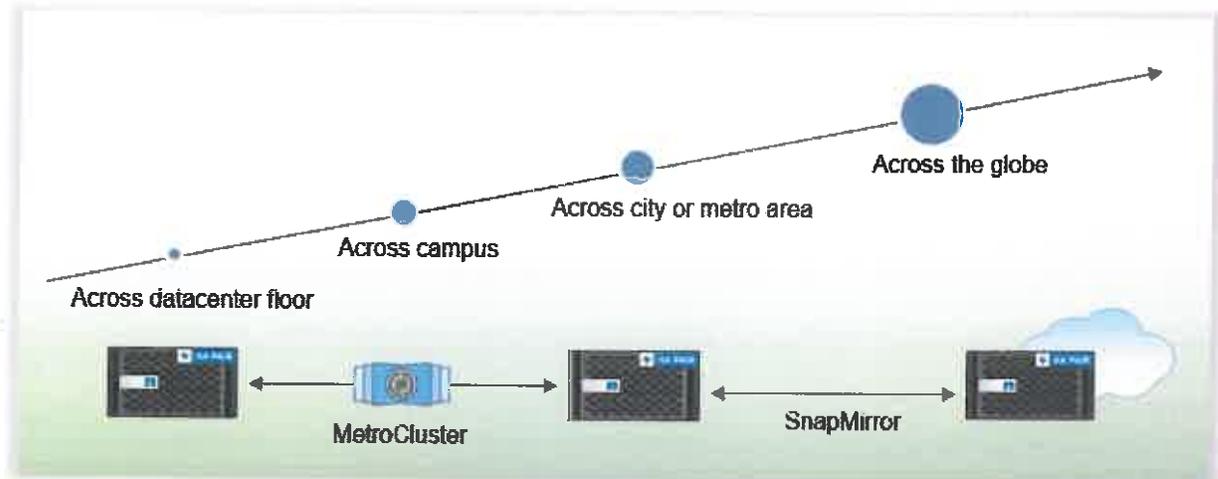


Figure 4: SnapMirror extends data protection across the globe.

"Since implementing NetApp[®] MetroCluster[™] in 2009, Jack Wolfskin hasn't experienced a single second of downtime or any data loss. Another advantage of MetroCluster software is that we manage upgrades from anywhere instead of coming in on the weekends."

— Severin Canisius, Senior IT Manager

Robust Security

Security capabilities in ONTAP help you integrate data security across your hybrid cloud and avoid unauthorized data access. You can easily and efficiently protect at-rest data by encrypting any volume on an AFF or FAS system with NetApp Volume Encryption—a feature that is built in to ONTAP. It does not require special encrypting disks. In-flight encryption for backup and replication protects data in transit. Plus, other features such as multifactor authentication (MFA), role-based access control (RBAC), and onboard and external key management increase the security of your data. With ONTAP 9.7, it is simpler to protect your data by automatically enabling data at-rest encryption for new volumes when an encryption key manager is configured on the cluster. Included with ONTAP 9.7, Active IQ Unified Manager now provides a security dashboard that highlights where you can improve cluster-wide security based on best practices.

Secure Consolidation

ONTAP gives you the ability to save time and money by sharing the same consolidated infrastructure for workloads or tenants that have different performance, capacity, and security requirements without fear that the activity in one tenant partition will affect another. With multitenancy, a storage cluster can be subdivided into secure partitions governed by rights and permissions.

Rigorous Compliance

To meet stringent compliance and data retention policies, NetApp SnapLock® software enables write once, ready many (WORM) protected data for your ONTAP environment. NetApp also provides superior integration with enterprise backup vendors and leading applications. Our IDP solutions include integrated and unified disk-to-disk backup and disaster recovery in a single process for VMware and Microsoft virtualization. In addition, cryptographic shredding enables General Data Protection Regulation (GDPR) compliance.

“The secure multitenancy built into ONTAP is key to our cloud business model.”

— Frank Bounds, Senior Storage Engineer, TCDI

Simple, Straightforward Transition to ONTAP 9

No matter what your starting point, NetApp streamlines your move to ONTAP 9. You can:

- Upgrade from ONTAP 8.3 with a simple update of your ONTAP software—no disruption and zero downtime.
- Make a smooth transition from ONTAP 7-Mode with proven tools and best practices, including 7-Mode Transition Tool (7MTT) and Copy Free Transition (CFT).
- Use straightforward import processes from third-party storage to ONTAP 9.

Consult our experts to plan and implement your transition and gain the latest ONTAP advantages from day one. You can use either NetApp Services or NetApp Certified Services Partners, do it yourself using our proven tools and processes, or choose a combination of approaches.

“Using the brand-new copy-free transition process to achieve both the hardware refresh and upgrade to ONTAP with minimal business disruption was the perfect option. It reduced risk, slashed migration time, and cut costs and was something we were able to fully justify.”

— Andrew Bentley, Infrastructure Lead, Repsol Sinopec Resources UK

ONTAP Technical Highlights

The building blocks for ONTAP scale-out storage configurations are high-availability (HA) pairs in which two storage controllers are interconnected to the same set of disks. If one controller fails, the other takes over its storage and continues serving data.

With ONTAP, each storage controller is referred to as a cluster node. Nodes can be different models and sizes of AFF and FAS systems. Disks are made into aggregates, which are groups of disks of a type that are composed of one or more RAID groups protected by using NetApp RAID DP® and RAID TEC technology.

A key differentiator in an ONTAP environment is that numerous HA pairs are combined into a cluster to form a shared pool of physical resources that are available to applications, SAN hosts, and NAS clients. The shared pool appears as a single system image for management purposes. This means that there is a single common point of management, whether through the graphical user interface or command-line interface tools, for the entire cluster.

Although the members of each HA pair must be the same controller type, the cluster can consist of heterogeneous HA pairs of AFF all-flash arrays as well as FAS hybrid-flash arrays. Over time, as the cluster grows, and new controllers are released, it is likely to evolve into a combination of several different node types. All cluster capabilities are supported, regardless of the underlying controllers in the cluster.

To improve data access in NAS applications, NetApp virtualizes storage at the file-system level. This enables all client nodes to mount a single file system, access all stored data, and automatically accommodate physical storage changes that are fully transparent to the clients. Each client or server can access a huge pool of data residing across the ONTAP system through a single mount point.

Meet High-Availability Requirements

The proven reliability features in NetApp hardware and software result in data availability of more than 99.9999% as measured across the NetApp installed base. Backup and replication technologies integrated in the NetApp ONTAP data management software help keep your applications and data continuously available to users.

Nondisruptive Operations to Eliminate Downtime

Nondisruptive operations (NDO) are fundamental to the superior scale-out architecture of NetApp ONTAP. NDO is achieved as the storage infrastructure remains up and serving data throughout the execution of hardware and software maintenance operations as well as during other IT lifecycle operations. The goal of NDO is to eliminate downtime—whether it is preventable, planned, or unplanned—and to allow changes to your systems to occur at any time.

ONTAP allows you to transparently move data and network connections anywhere within the storage cluster. The capability to move individual data volumes or LUNs allows you to redistribute across a cluster at any time and for any reason. It's transparent and nondisruptive to NAS and SAN hosts, and it enables the storage infrastructure to continue to serve data throughout these changes. This is helpful to rebalance capacity usage, to optimize for changing performance requirements, or to isolate one or more controllers or storage components when it becomes necessary to execute maintenance or lifecycle operations.

Table 1: Hardware and software maintenance operations can be performed nondisruptively with ONTAP.

Operation	Details
Upgrade software	Upgrade from one version of ONTAP to another
Upgrade firmware	System, disk, switch firmware upgrade
Replace failed controller or component within a controller	Network interface cards (NICs), host bus adapters (HBAs), and power supplies
Replace failed storage components	Cables, drives, shelves, and I/O modules

Table 2: Lifecycle operations can be performed nondisruptively with ONTAP.

Operation	Details
Scale storage	Add storage (shelves or controllers) to a cluster and redistribute volumes for future growth
Scale hardware	Add hardware to controllers to increase scalability, performance, or capability (HBAs, NICs, NetApp Flash Cache™ or Flash Pool™ caching)
Refresh technology	Upgrade storage shelves, storage controllers, back-end switch
Rebalance controller performance and storage utilization	Redistribute data across controllers to improve performance
Rebalance capacity	Redistribute data across controllers to account for future capacity growth
Rebalance disk performance and utilization	Redistribute data across storage tiers within a cluster to optimize disk performance

On-Demand Scalability—Expand as you Build

The ONTAP architecture is key to delivering maximum on-demand scalability for your shared IT infrastructure, offering performance, price, and capacity options.

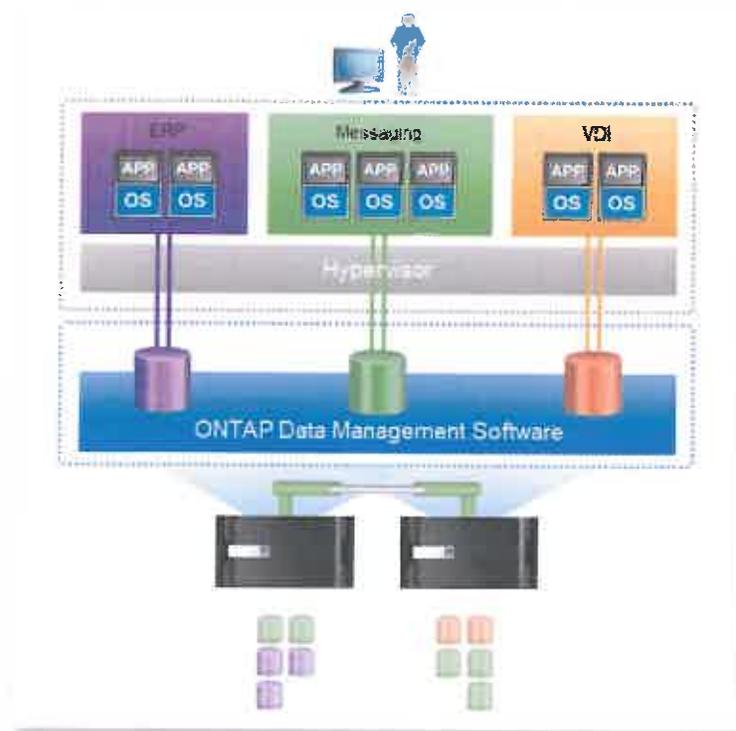


Figure 5: Expand as you build – Start with a two-node cluster and expand controllers and capacity when you need to, nondisruptively.

There are several approaches for leveraging flash in NetApp FAS hybrid-flash systems to accelerate workloads and reduce latency. Flash Cache can increase read performance for frequently accessed data. Plus, Flash Pool aggregates combine SSDs with traditional hard drives for delivering optimal performance and efficiency.

NetApp AFF all-flash systems offer the advantage of scalable performance with consistent low latency for SAN and NAS workloads. Customers can start with deploying AFF in an HA pair configuration to deliver enterprise-grade data management and high performance for a dedicated workload. If additional performance is required, AFF can scale out in a cluster—up to 24 nodes, delivering millions of IOPS at submillisecond latency and a total of over 88PB of SSD capacity.

The extra value of AFF shines when it is used as a high-performance node combined with hybrid-flash FAS systems in an ONTAP environment. This becomes a single storage repository for all workloads. And it enables nondisruptive movement of workloads to the node that best meets your performance and price/performance requirements at different points in time.

Multiprotocol Unified Architecture

A multiprotocol unified architecture provides the capability to support several data access protocols concurrently in the same overall storage system across a range of controller and disk storage types. ONTAP protocol support includes:

- SMB 1, 2, 2.1, 3, 3.1.1 (CIFS)
- NFS v3, v4, and v4.1, including pNFS
- iSCSI
- FCP (Fibre Channel Protocol)
- FCoE (Fibre Channel over Ethernet)
- NVMe over FC (NVMe/FC), starting with ONTAP 9.4

Data replication and storage efficiency features in ONTAP are seamlessly supported across all protocols.

SAN Data Services

With the supported SAN protocols (FC, FCoE, iSCSI, and NVMe/FC), ONTAP provides LUN services. This is the capability to create LUNs and make them available to attached hosts. Because the cluster consists of numerous controllers, there are several logical paths to any individual LUN. A best practice is to configure at least one path per node in the cluster. Asymmetric Logical Unit Access is used on the hosts so that the optimized path to a LUN is selected and made active for data transfer. Support for multipath I/O is also available from leading OS and third-party driver vendors.

NAS Data Services

ONTAP can provide a single namespace with the supported NAS protocols such as SMB [CIFS] and NFS (NAS clients can access a very large data container by using a single NFS mount point or CIFS share). Each client, therefore, needs only to mount a single NFS file system mount point or access a single CIFS share, requiring only the standard NFS and CIFS client code for each operating system.

The namespace of ONTAP is composed of potentially thousands of volumes joined by the cluster administrator. To the NAS clients, each volume appears as a folder or subdirectory,

nested off the root of the NFS file system mount point or CIFS share. Volumes can be added at any time and are immediately available to the clients, with no remount required for visibility to the new storage.

The clients have no awareness that they are crossing volume boundaries as they move about in the file system, because the underlying structure is completely transparent.

ONTAP can be architected to provide a single namespace, yet it also supports the concept of several securely partitioned namespaces, called Storage Virtual Machines or SVMs. This accommodates the requirement for multi-tenancy or isolation of particular sets of clients or applications.

Opex and Capex Efficiency—Grow Your Business, Not IT Expense

NetApp storage solutions operating with ONTAP 9 deliver the industry’s leading storage efficiency capabilities with features such as inline compression, inline deduplication, inline data compaction, thin provisioning, and thin clones. With these features coupled with space-efficient NetApp Snapshot copies, RAID DP, and RAID TEC, you can enjoy significant reductions in required disk capacity (varies by workload) when compared with traditional storage technologies.

Table 3: ONTAP 9 offers a robust set of standard and optional features.

NetApp Software and Features		
	Function	Benefits
Data compaction	Packs more data into each storage block for greater data reduction.	Works with compression to reduce the amount of storage that you need to purchase and operate.
Data compression	Provides transparent inline and postprocess data compression for data reduction.	Reduces the amount of storage that you need to purchase and maintain.
Deduplication	Performs general-purpose deduplication for removal of redundant data.	Reduces the amount of storage that you need to purchase and maintain.
FabricPool	Automates data tiering to the cloud (public and private).	Decreases storage costs for cold data.
Flash Pool™ Caching	Creates a mixed-media storage pool by using SSDs and HDDs.	Increases the performance and efficiency of HDD pools with flash acceleration.
FlexCache®	Caches datasets within a cluster and at remote sites.	Accelerates read performance for hot datasets by increasing data throughput within a cluster and improves the speed and productivity of collaboration across multiple locations. FlexGroup volumes can now be cached with FlexCache, enabling data volumes larger than 100TB to be cached.

NetApp Software and Features

	Function	Benefits
FlexClone®	Instantaneously creates file, LUN, and volume clones without requiring additional storage.	Saves you time in testing and development and increases your storage capacity.
FlexGroup	Enables a single namespace to scale up to 20PB and 400 billion files.	Supports compute-intensive workloads and data repositories that require a massive NAS container while maintaining consistent high performance and resiliency. For enhanced security and locking, NFSv4.0 and NFSv4.1 are now supported.
FlexVol®	Creates flexibly sized volumes across a large pool of disks and one or more RAID groups.	Enables storage systems to be used at maximum efficiency and reduces hardware investment. To enable higher performance and to scale capacity, you can now convert a FlexVol volume to a single-member FlexGroup volume without copying data.
MetroCluster	Combines array-based clustering with synchronous mirroring to deliver continuous availability and zero data loss; up to 700km distance between nodes.	Maintains business continuity for critical enterprise applications and workloads if a data center disaster occurs.
Performance capacity	Provides visibility of performance capacity that is available for deploying new workloads on storage nodes.	Simplifies management and enables more effective provisioning of new workloads to the optimal node.
QoS (adaptive)	Simplifies setup of QoS policies and automatically adjusts storage resources to respond to workload changes (number of TB of data, priority of the workload, etc.).	Simplifies operations and maintains consistent workload performance within your prescribed minimum and maximum IOPS boundaries.
RAID-TEC™ and RAID DP® technologies	Provides triple parity or double-parity RAID 6 implementation that prevents data loss when three or two drives fail.	Protect your data without the performance impact of other RAID implementations; reduce risks during long rebuilds of large-capacity HDDs.
SnapCenter®	Provides host-based data management of NetApp storage for databases and business applications.	Offers application-aware backup and clone management; automates error-free data restores.

NetApp Software and Features

	Function	Benefits
SnapLock	Provides WORM file-level locking.	Supports regulatory compliance and organizational data retention requirements.
SnapMirror	Provides integrated remote backup/recovery and disaster recovery with incremental asynchronous data replication; preserves storage efficiency savings during and after data transfer.	Provides flexibility and efficiency when replicating data to support remote backup/recovery, disaster recovery, and data distribution.
SnapMirror Synchronous	Delivers incremental, volume-granular, synchronous data replication; preserves storage efficiency savings during and after data transfer.	Achieve zero data loss protection (RPO=0).
SnapRestore®	Rapidly restores single files, directories, or entire LUNs and volumes from any Snapshot copy.	Instantaneously recovers files, databases, and complete volumes from your point-in-time Snapshot copy.
Snapshot	Makes incremental data-in-place, point-in-time copies of a LUN or a volume with minimal performance impact.	Enables you to create frequent space-efficient backups with no disruption to data traffic.
Volume encryption	Provides data-at-rest encryption that is built into ONTAP.	Easily and efficiently protect your at-rest data by encrypting any volume on an AFF or FAS system; no special encrypting disks are required.