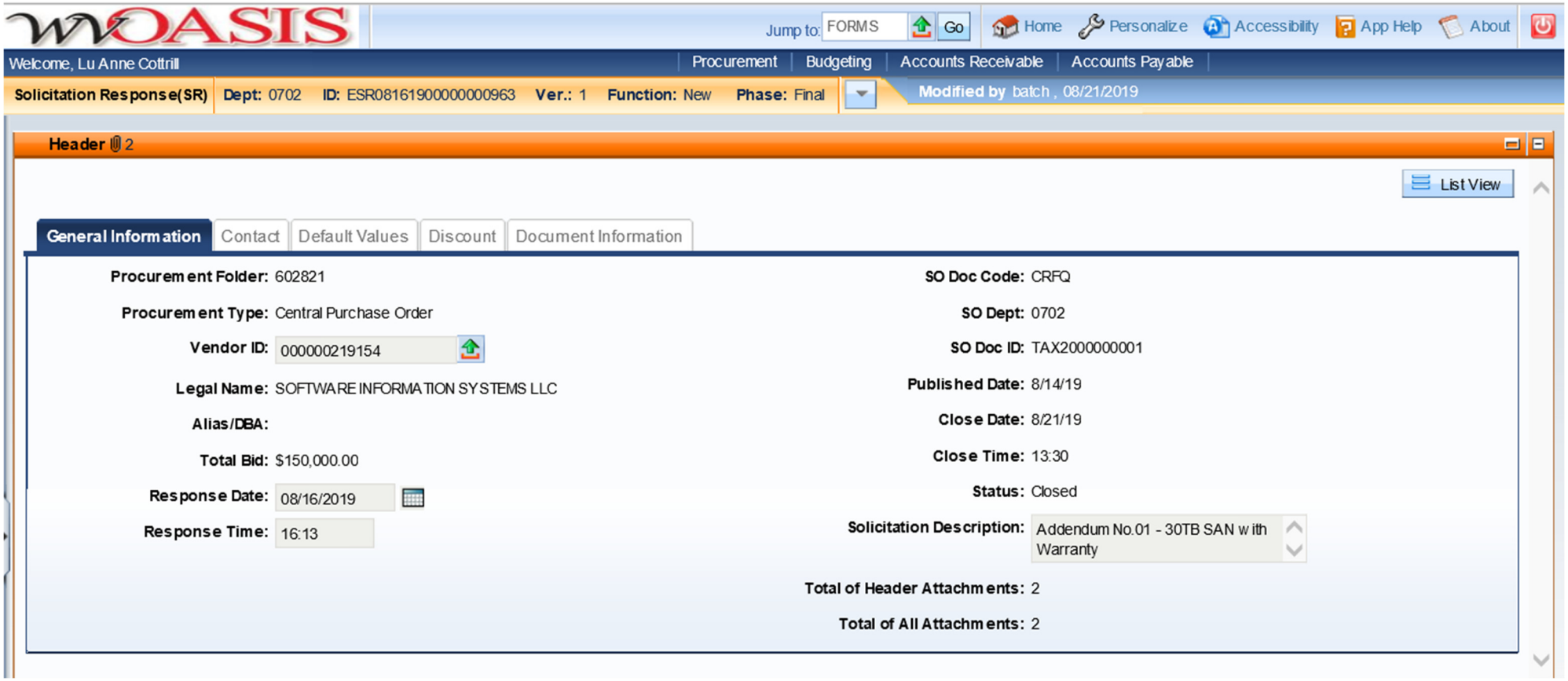
The following documentation is an electronically-submitted vendor response to an advertised solicitation from the *West Virginia Purchasing Bulletin* within the Vendor Self-Service portal at ***wvOASIS.gov***. As part of the State of West Virginia's procurement process, and to maintain the transparency of the bid-opening process, this documentation submitted online is publicly posted by the West Virginia Purchasing Division at ***WVPurchasing.gov*** with any other vendor responses to this solicitation submitted to the Purchasing Division in hard copy format.


wvOASIS
Jump to: FORMS Go
Home
Personalize
Accessibility
App Help
About
Welcome, Lu Anne Cottrill
Procurement
Budgeting
Accounts Receivable
Accounts Payable
Solicitation Response(SR) Dept: 0702 ID: ESR08161900000000963 Ver.: 1 Function: New Phase: Final
Modified by batch , 08/21/2019
Header 2
List View
General Information
Contact
Default Values
Discount
Document Information
Procurement Folder: 602821
Procurement Type: Central Purchase Order
Vendor ID: 000000219154
Legal Name: SOFTWARE INFORMATION SYSTEMS LLC
Alias/DBA:
Total Bid: $150,000.00
Response Date: 08/16/2019
Response Time: 16:13
SO Doc Code: CRFQ
SO Dept: 0702
SO Doc ID: TAX2000000001
Published Date: 8/14/19
Close Date: 8/21/19
Close Time: 13:30
Status: Closed
Solicitation Description: Addendum No.01 - 30TB SAN with Warranty
Total of Header Attachments: 2
Total of All Attachments: 2

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

State of West Virginia
Solicitation Response

Proc Folder : 602821

Solicitation Description : Addendum No.01 - 30TB SAN with Warranty

Proc Type : Central Purchase Order

Date issued	Solicitation Closes	Solicitation Response	Version
	2019-08-21 13:30:00	SR 0702 ESR08161900000000963	1

VENDOR

000000219154

SOFTWARE INFORMATION SYSTEMS LLC

Solicitation Number: CRFQ 0702 TAX2000000001

Total Bid : $150,000.00 **Response Date:** 2019-08-16 **Response Time:** 16:13:36

Comments:

FOR INFORMATION CONTACT THE BUYER

Brittany E Ingraham

(304) 558-2157
brittany.e.ingraham@wv.gov

Signature on File **FEIN #** **DATE**

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

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	30TB SAN	1.00000	EA	$150,000.000000	$150,000.00

Comm Code	Manufacturer	Specification	Model #
43212200			

Extended Description : Please see 3.1.1 of the attached specifications.

Comments: NetApp AFF A220

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
2	3 Year Warranty for 30TB SAN	1.00000	EA	$0.000000	$0.00

Comm Code	Manufacturer	Specification	Model #
81111818			

Extended Description : Please see 3.1.2 of the attached specifications.

Comments: included

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

State of West Virginia
Request for Quotation
21 — Info Technology

Proc Folder: 602821

Doc Description: Addendum No.01 - 30TB SAN with Warranty

Proc Type: Central Purchase Order

Date Issued	Solicitation Closes	Solicitation No	Version
2019-08-14	2019-08-21 13:30:00	CRFQ 0702 TAX2000000001	2

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

Respon 2

FOR INFORMATION CONTACT THE BUYER

Brittany E Ingraham
(304) 558-2157
brittany.e.ingraham@wv.gov

Signature X [signature] **FEIN #** 61-1371685 **DATE** 8-21-2019

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

Charles D. Arnett

ADDITIONAL INFORMATION:

Addendum

Addendum No.01 issued to publish and distribute the attached information to the vendor community.

****

Request for Quotation

The West Virginia Purchasing Division is soliciting bids on behalf of the Tax Division to establish a fixed term contract for the purchase of hardware, software, licensing, and support for a Storage Area Network (SAN) solution, per the bid requirements, specifications, terms, and conditions attached to this solicitation.

INVOICE TO	SHIP TO
OPERATIONS DIVISION TAX DIVISION OF PO BOX 11748 CHARLESTON WV25339-1748 US	OPERATIONS DIVISION TAX DIVISION OF REVENUE CENTER 1001 LEE ST E, STE 1 CHARLESTON WV 25301-1725 US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	30TB SAN	1.00000	EA	$150.00	$150.00

Comm Code	Manufacturer	Specification	Model #
43212200	NetApp	AFF A220	

Extended Description :

Please see 3.1.1 of the attached specifications.

INVOICE TO	SHIP TO
OPERATIONS DIVISION TAX DIVISION OF PO BOX 11748 CHARLESTON WV25339-1748 US	OPERATIONS DIVISION TAX DIVISION OF REVENUE CENTER 1001 LEE ST E, STE 1 CHARLESTON WV 25301-1725 US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
2	3 Year Warranty for 30TB SAN	1.00000	EA	Included	

Comm Code	Manufacturer	Specification	Model #
81111818			

Extended Description :

Please see 3.1.2 of the attached specifications.

INVOICE TO	SHIP TO
OPERATIONS DIVISION TAX DIVISION OF PO BOX 11748 CHARLESTON WV25339-1748 US	OPERATIONS DIVISION TAX DIVISION OF REVENUE CENTER 1001 LEE ST E, STE 1 CHARLESTON WV 25301-1725 US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
3	This line is inactive - do not provide pricing.	0.00000	EA		

Comm Code	Manufacturer	Specification	Model #
81111818			

Extended Description :

This line is inactive - do not provide pricing.

INVOICE TO	SHIP TO
OPERATIONS DIVISION TAX DIVISION OF PO BOX 11748 CHARLESTON WV25339-1748 US	OPERATIONS DIVISION TAX DIVISION OF REVENUE CENTER 1001 LEE ST E, STE 1 CHARLESTON WV 25301-1725 US

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
4	This line is inactive - do not provide pricing.	0.00000	EA		

Comm Code	Manufacturer	Specification	Model #
81111818			

Extended Description :

This line is inactive - do not provide pricing.

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 Drive Suite 210, Charleston, WV 25311
(Address)
304 768-1645 Fax 304 768-1671
(Phone Number) / (Fax Number)
carnett@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 Information Systems LLC
(Company)

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

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

8-21-2019
(Date)

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

7.2.2 Immediate cancellation of one or more release orders issued under this Contract.

7.2.3 Any other remedies available in law or equity.

8. MISCELLANEOUS:

8.1 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

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: CRFQ TAX20*01

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)

[✓] Addendum No. 1	[ ] Addendum No. 6
[ ] Addendum No. 2	[ ] Addendum No. 7
[ ] Addendum No. 3	[ ] Addendum No. 8
[ ] Addendum No. 4	[ ] Addendum No. 9
[ ] Addendum No. 5	[ ] 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 Informatics Systems LLC
Company

Authorized Signature

9-21-2019
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 exceed 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 Information Systems, LLC

Authorized Signature: _____ Date: 8/15/2019

State of West Virginia

County of Kanawha, to-wit:

Taken, subscribed, and sworn to before me this 15 day of August, 2019.

My Commission expires March 14, 2023.

AFFIX SEAL HERE

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
C. Aaron Harper
South Charleston Public Library
312 Fourth Avenue
South Charleston, WV 25303
My Commission Expires March 14, 2023

NOTARY PUBLIC _____

About NetApp

Throughout the world, leading organizations count on NetApp for software, systems, and services to store, manage, protect, and retain one of their most precious assets: their data. We enable enterprises, service providers and partners to envision, deploy, and evolve their IT environments. Customers benefit from our open collaboration with other technology leaders to create the specific solutions they need. We were incorporated in 1992 and created the world's first networked storage appliance.

Today, we offer a portfolio of products and services that satisfy a broad range of customer workloads across different data types and deployment models. NetApp's cloud-connected flash solutions, an element of a Data Fabric strategy, provide the simplicity, operational efficiency and protection needed to support innovation, add unprecedented performance and power the most demanding data sets and technologies, such as artificial intelligence or 5G networks. Only NetApp delivers everything that companies need to build their own unique Data Fabric that spans public cloud, private cloud and on-premises environments. With NetApp solutions, this Data Fabric can deliver applications that engage users and can provide analytics that turn insights into a competitive advantage.

The industry has awarded NetApp with hundreds of honors for our innovation, leadership, and culture.

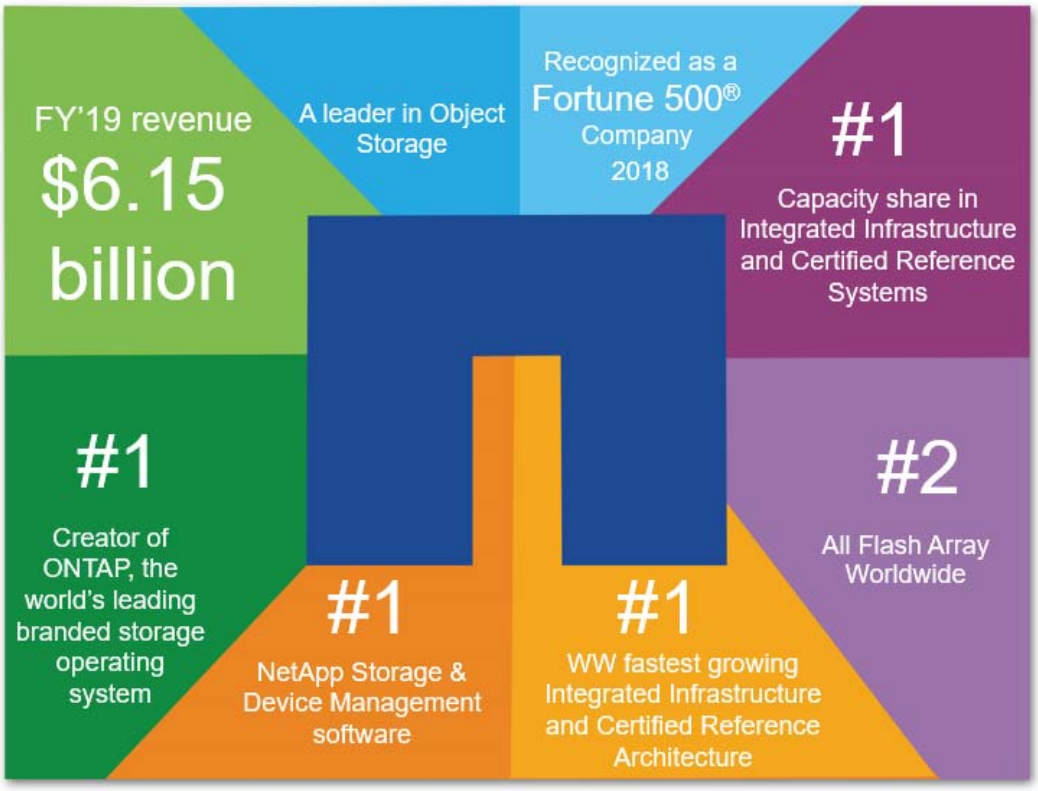


Figure 1: Successful customers drive NetApp Industry leadership.[1]

[1] http://fortune.com/fortune500/list/.

Industry Leadership

NetApp continues to lead the market with our integrated portfolio of platforms and solutions. We set the standards for the industry in Flash, OS, capacity, OpenStack, and Object Storage, to name a few. Our innovations help organizations to accelerate critical applications, increase data visibility, streamline data protection, and boost operational agility.

- #1 Integrated Infrastructure and Certified Reference Systems in Capacity Shipped[2]
- Leader in two Gartner Magic Quadrants:
  - General-Purpose Disk Arrays, November 8, 2018
  - Solid-State Arrays, July 23, 2018
- #1 in Commercial Storage for OpenStack[3]
- #1 WW NetApp Storage & Device Management software[4]
- #1 Creator of ONTAP, the world's leading open networked branded storage OS[5]
- Fastest growing Converged Systems vendor (YoY revenue growth) [2]
- Fastest growing Storage for Converged Systems vendor (YoY revenue growth)[2]
- #2 All Flash Array (AFA) Worldwide[5]
- Market-leading growth for six successive quarters with NetApp FlexPod[2]
- A Key Player in Data Services for Hybrid Cloud[6]

Financial Information

NetApp is a publicly held FORTUNE 500® [1] company with over $6 billion in revenue, and more than 10,000 employees in 149 offices worldwide. We are a member of the S&P 500 and NASDAQ 100 and our stock symbol is NTAP. Our annual reports can be found at http://investors.netapp.com/annuals.cfm.

The following table summarizes NetApp's financial information over the last five years. All amounts are in U.S. dollars.

Table 1: NetApp revenue and financial information for the last five years.

	FY 2019	FY 2018	FY 2017	FY 2016	FY 2015
(In millions, except per-share amounts)					
Total revenues	$6,146	$5,919	$5,491	$5,546	$6,123
Total cost of revenue	$2,201	$2,210	$2,127	$2,173	$2,290
Net income	$1,169	$116	$481	$229	$560
Current assets	$5,610	$6,952	$6,198	$6,448	$6,773

[2] IDC Worldwide Quarterly Converged Systems Tracker - 2018Q4, April 2, 2019.

[3] **OpenStack User Survey:** https://www.openstack.org/analytics.

[4] IDC Worldwide Storage Software and Cloud Services Overview, 2019Q1, June 6, 2019 (#1 Storage & Device Management vendor – revenue share).

[5] IDC Worldwide Quarterly Enterprise Storage Systems Tracker, 2019Q1, June 6, 2019.

[6] IDC, Worldwide Data Services for Hybrid Cloud – Key Players Portfolio Analysis, IDC #US44266318, September 2018 A Key Player in Data Services for Hybrid Cloud

	FY 2019	FY 2018	FY 2017	FY 2016	FY 2015
Total assets	$9,865	$9,493	$10,037	$9,401	$9,214
Shareholder's equity	$2,067	$2,780	$2,881	$3,414	$3,787

Our Customers

NetApp delivers data management solutions to over 30,000 businesses worldwide to help them unleash the full potential of their data. In a world transformed by digital technology, businesses cannot move ahead with data in silos. They need fast insights, seamless access, and the peace of mind of knowing their data is protected and within their control.

Figure 2: Businesses around the world and in every vertical market trust NetApp.

Strategic Partnerships

To empower our customers' continuing growth and success, we form partnerships with the industry's best reseller, application, infrastructure, consulting, and cloud service provider partners including:

- 50+ distributors globally
- 3500 active resellers
- 200+ Technology Alliance and Global System Integrator partners
- Hyperscale Service Providers

The following graphic shows a sample of our strategic alliances and partnerships.

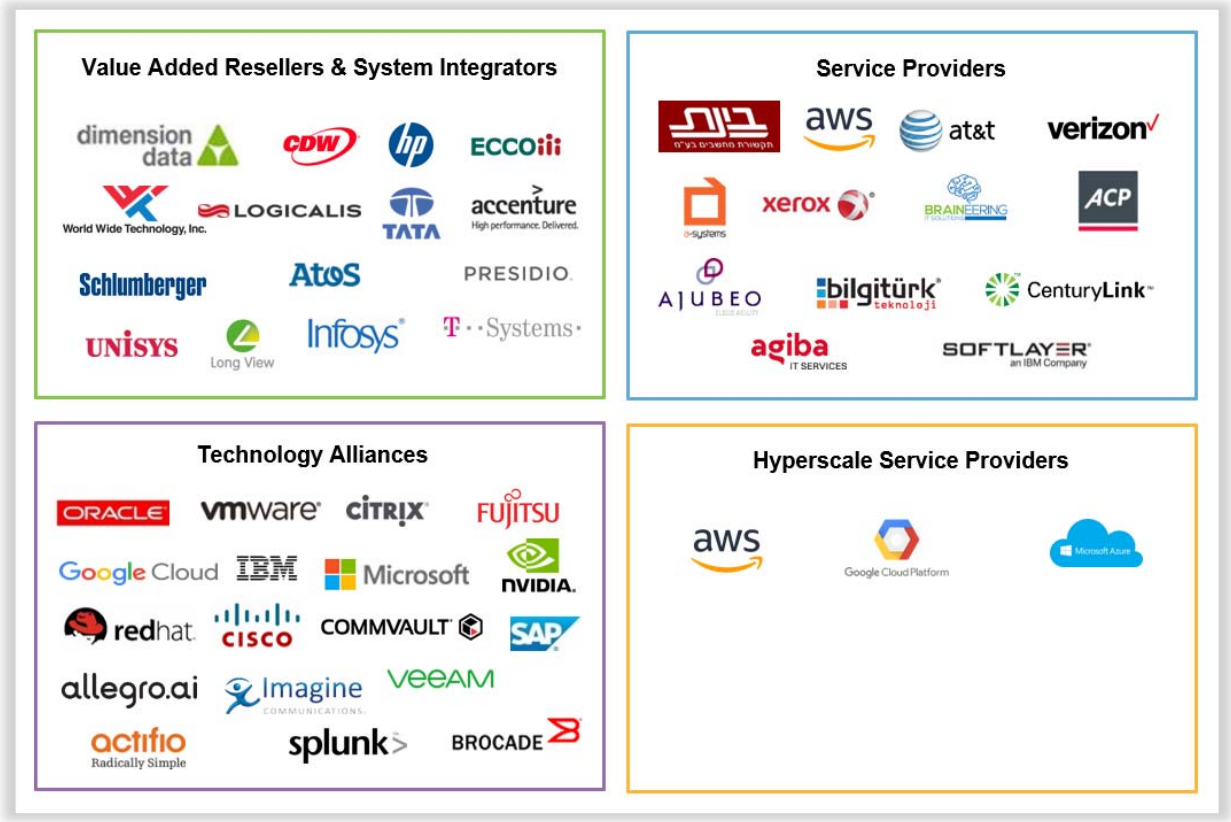


Figure 3: NetApp's partner ecosystem – *Developing and delivering integrated solutions to customers around the world.*

Research and Development

NetApp invests heavily in R&D to ensure that we provide the best value to our customers and maintain our market leadership. Our global R&D activities represent 14% to 16% of NetApp's net revenues.

One recent success story includes enabling control and choice in hybrid cloud. NetApp was the first data management vendor to build capabilities that support the cloud service provider community of 100s of xSPs, offering over 500 cloud-based services.

NetApp continues to advance its data replication, disaster recovery and data archive portfolio through building upon integration with SAP, Oracle, OpenStack, industry ISVs. Our acquisition of SolidFire helps accelerate our customers' transition to next generation data centers and web-scaled cloud applications.

As of June 2019, NetApp holds over 2,900 patent assets worldwide. This includes over 2,400 issued patents worldwide and hundreds of U.S. and international patent applications. In 2015, we held the second highest patent filings in our history, with 300 new patent applications filed and over 200 patents related to our Flash portfolio.

NetApp also supports innovative research in the academic community as part of its innovation strategy. The NetApp Advanced Technology Group is focused on exploring and evaluating the ideas, technologies, and trends that define the future of data management.

This group is a current member of the following university-industry consortiums:

- CERES: Center for Unstoppable Computing (University of Chicago)
- Parallel Data Laboratory (PDL), Carnegie Mellon University
- MIT CSAIL Alliance Program (Massachusetts Institute of Technology)
- Storage Systems Research Center (University of California, Santa Cruz)
- Wisconsin Institute on Software-defined Datacenters of Madison (University of Wisconsin –Madison)

The NetApp Advanced Technology Group has also sponsored research projects of professors and students at over twenty renowned IT universities across America, Canada, Italy and India.

NetApp's Global Support Capabilities

NetApp offers a broad portfolio of products and services including support services, professional services, and education. Businesses can rely on the NetApp support organization to resolve issues quickly, on a 24/7 basis. NetApp support is organized on a regional, country and city basis with overlapping service and parts coverage. Over 250,000 customer systems rely on our support worldwide.

The NetApp support organization manages:

- 400 depots
- 120 dispatchers with local language capability and security
- 3 test and repair centers
- 13 Technical Support locations: Amsterdam, Netherlands; Costa Rica; Dalian, China; Newcastle, U.K.; Lake Mary, Florida; Raleigh, North Carolina; Wichita, Kansas; Tokyo, Japan; Bangalore, India; Boulder, Colorado; Rochester, NY; Bogota, Colombia; Sofia, Bulgaria

NetApp Team

Our Team Is Data Driven and supports your vision for digital transformation. The strength of NetApp culture and vision attracts the industry's best, a fact reflected in our place on the FORTUNE "100 Best Companies to Work For®" list for 13 consecutive years. [7]

NetApp is committed to achieving market leadership by living our values and embracing strong principles. The NetApp executive team combines experience with innovation to help deliver our company strategies.

[7] Fortune Magazine.

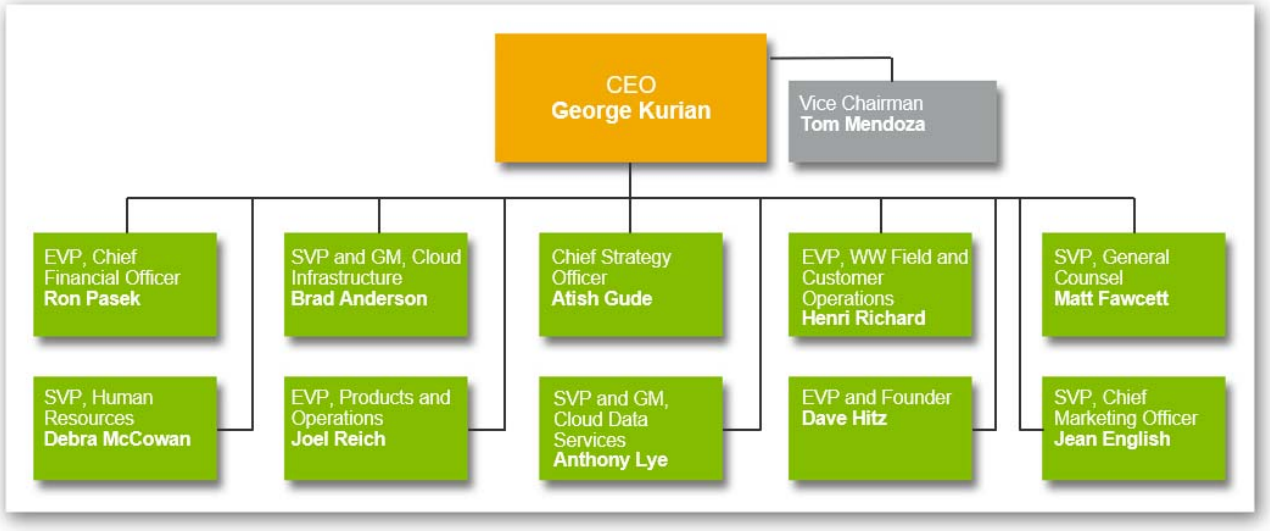


Figure 4: NetApp's executive team.

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. ONTAP 9 is the next generation combining new levels of simplicity and flexibility with powerful data management capabilities and storage efficiencies. The latest version, ONTAP 9.5, enables additional integration of modern and traditional technologies—across flash, cloud, and software-defined architectures—to build a foundation for the data fabric.

<<ClientShort>>'s transformation into a digital business brings with it complexities in the short term. Your new priorities might require adding all-flash arrays for business-critical workloads, while integrating new applications into your existing environment, and managing data on premises as well as in the cloud—yet operations must be simplified, costs reduced, and budgets stretched.

NetApp® ONTAP 9® provides unmatched versatility, comprehensive data protection, and leading storage efficiency—delivering next-generation data management capabilities and efficiencies, fueled by simplicity and flexibility. ONTAP 9 enables you to deploy storage across your choice of architectures: engineered systems, software-defined storage (SDS), and the cloud, while unifying data management across each of them.

Leverage ONTAP 9 to:

- Simplify deployment and data management
- Adapt to changing business needs
- Power your enterprise applications

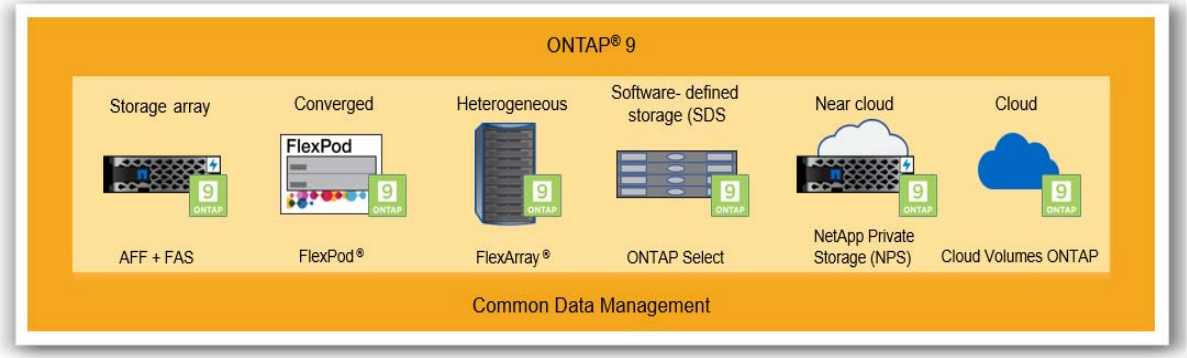


Figure 1: Standardize data management across architectures with a rich set of enterprise data services.

Simplify Deployment and Management

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

Deploy New Workloads in Less Than 10 Minutes

New, 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, enabling you to 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.

Unified 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.

Simplified, Powerful Management Capabilities

The NetApp OnCommand® software portfolio includes management products that manage virtualized private and hybrid cloud environments. Centrally monitor capacity, availability, performance, and data protection. You can take advantage of storage service analytics to make better informed decisions about your storage.

OnCommand management platform automates your data management processes by integrating into your data center orchestration platform for end-to-end service delivery for your private and hybrid cloud services.

Adapt to Changing Business Needs

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 arrays: All Flash FAS (AFF) systems and hybrid-flash FAS systems
- Converged infrastructure: FlexPod®
- On commodity servers as SDS: ONTAP Select
- In front of third-party arrays: NetApp FlexArray® software
- Next to the cloud: NetApp Private Storage (NPS) for Cloud
- In the cloud: Cloud Volumes ONTAP

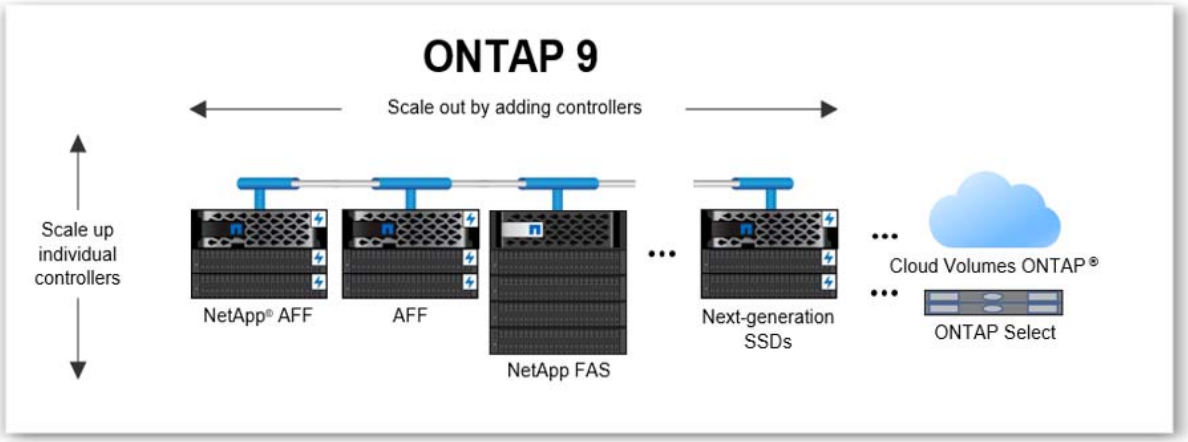


Figure 2: Scale seamlessly – *Scale out by intermixing your choice of flash and hybrid-flash nodes, upgrade hardware/software or scale up without disrupting users, incorporate software-defined, cloud, and future-generation flash.*

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

Add capacity as your business grows across both SAN and NAS environments. You can combine all-flash and hybrid-flash storage nodes into a larger storage cluster and connect them to the cloud. And ONTAP FabricPool technology can deliver up to 50% storage TCO savings by automatically tiering cold data from AFF/FAS systems, ONTAP Cloud, and ONTAP Select to the cloud, including Azure, AWS, and StorageGRID.

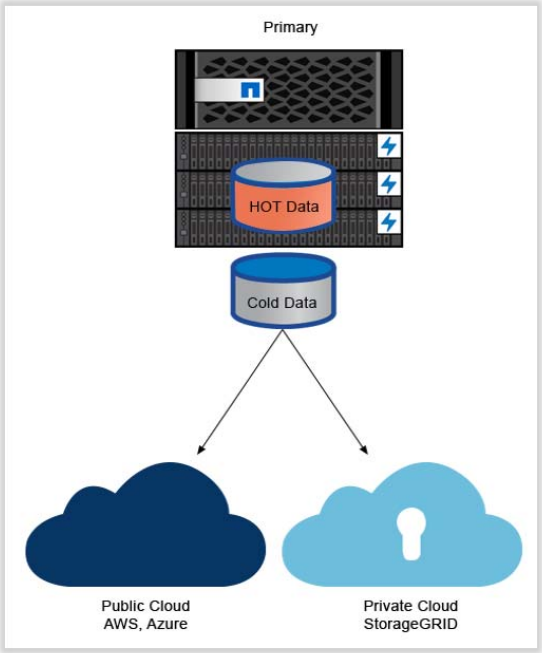


Figure 3: Automated cloud tiering of cold data.

Power Enterprise Applications

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 new NVMe technologies, providing up to twice the performance compared to the same workloads running on recent ONTAP 8 releases, while still delivering consistent submillisecond latency.

ONTAP 9 also enables FAS hybrid-flash storage 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.

Nondisruptive Operations

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. Storage controllers and disk shelves can be replaced without disruption, and with ONTAP you can mix models and generations of hardware to extend the life of existing investments.

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.

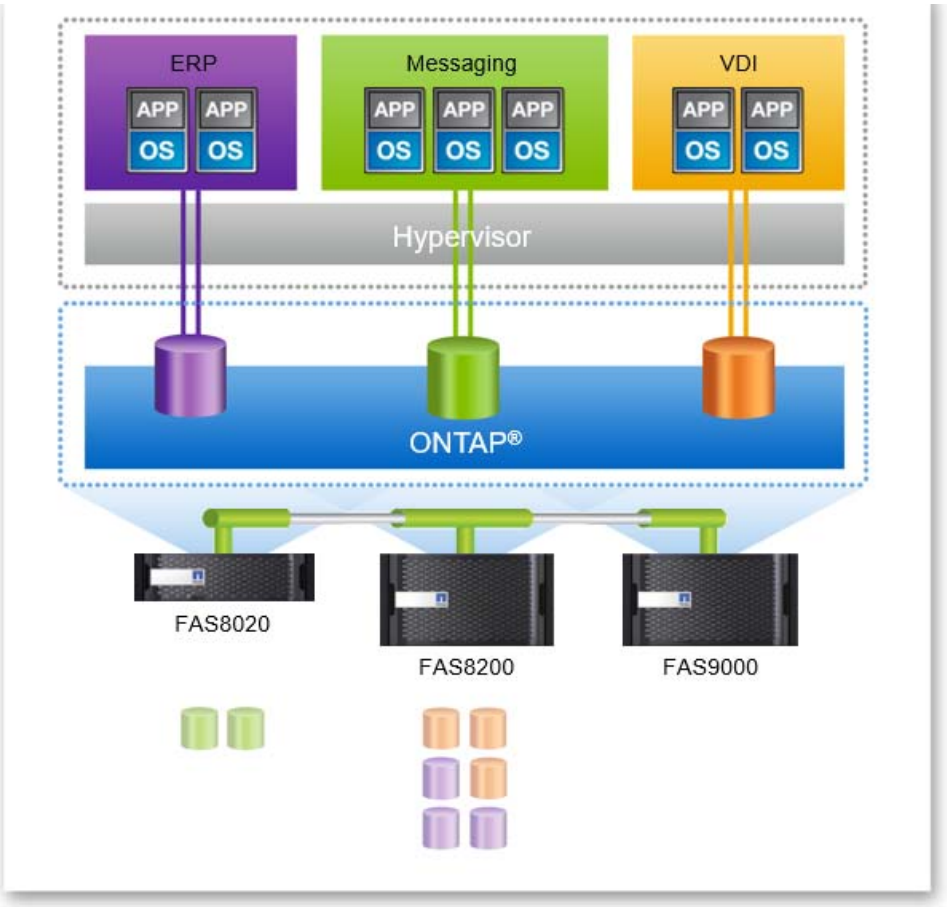


Figure 4: Nondisruptive operations – *Move data to available nodes and retire existing hardware.*

> *We can now provide access to our systems 24 hours a day. That's important to us and for our patients needing immediate care."*
>
> *— Tony Beaird, Director, Infrastructure and Security, DuPage Medical Group*

Integrated Data Protection

NetApp offers a complete suite of Integrated Data Protection (IDP) to safeguard your operations and keep them running smoothly. Meet your requirements for local backup with near-instant recovery by using space-efficient NetApp Snapshot™ copies. Achieve remote

backup/recovery and disaster recovery with SnapMirror® asynchronous replication. Get zero data loss protection (RPO=0) with SnapMirror Synchronous replication.

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.

Security and Compliance

Simplify and strengthen your security posture by integrating data security throughout your hybrid cloud. You can help meet governance, risk, and compliance (GRC) requirements such as HIPAA, PCI-DSS, and GDPR and cost effectively secure your NetApp ONTAP environment by incorporating industry-standard, built-in security that meets FIPS 140-2 compliance.

You> can easily and efficiently protect at-rest data with NetApp Storage Encryption (NSE)—that uses self-encrypting drives. Or encrypt any volume across FAS, AFF, and ONTAP Select deployments with NetApp Volume Encryption (NVE)—that does not require special encrypting disks. Key management can be delivered in a self-contained encryption solution using Onboard Key Manager (OKM), included with ONTAP, or with external key management solutions that provide separation of duties and a centralized key repository.

To meet stringent compliance and data retention policies, NetApp SnapLock® software enables write once, ready many (WORM) protected data for your ONTAP environment.

Superior 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, and 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.

Maximized Shared Storage Investments

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. And 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 172PB. Scale up by adding solid-state drive (SSD) and HDD 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 also have the ability to 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.

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. Get more value from existing investments in third-party arrays by virtualizing them with NetApp FlexArray virtualization and using the storage capacity in your ONTAP environment.

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.

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. In addition, nodes can be FAS systems running FlexArray storage virtualization, leveraging third-party and NetApp E-Series arrays as the storage capacity behind the FAS system. Disks are made into aggregates, which are groups of disks of a particular type that are composed of one or more RAID groups protected by using NetApp RAID DP® and RAID TEC technology.

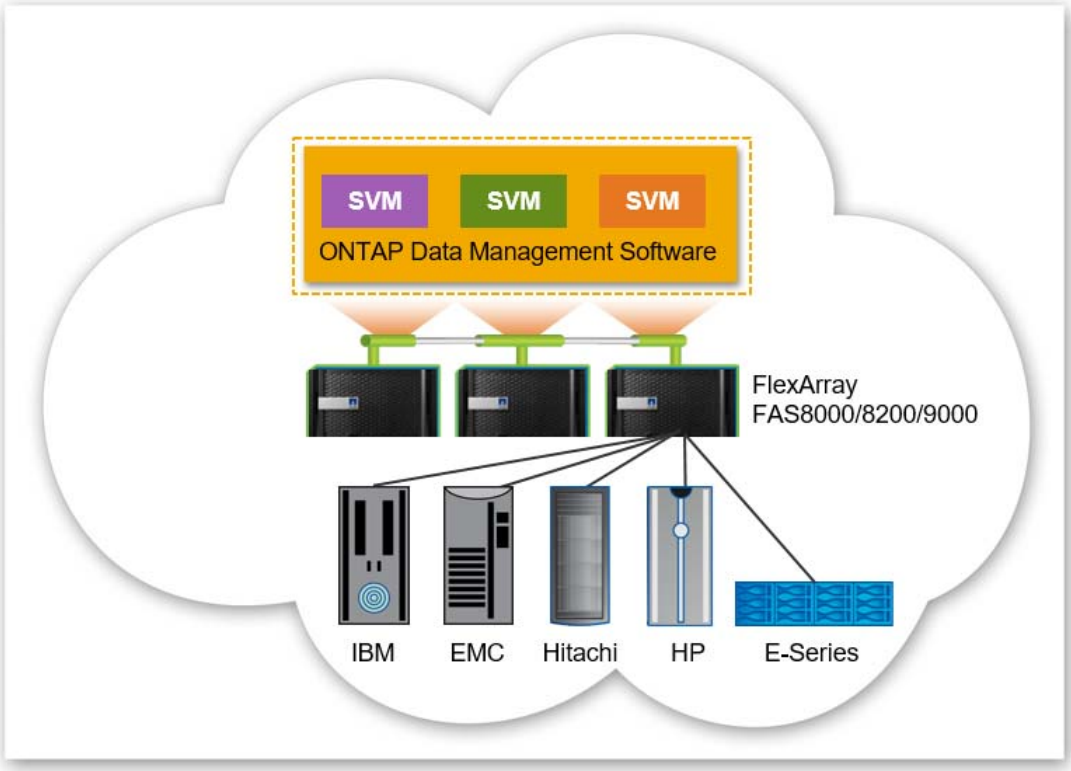


Figure 5: Investment protection – *Integrate your existing storage arrays into your private cloud with ONTAP and FlexArray.*

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.

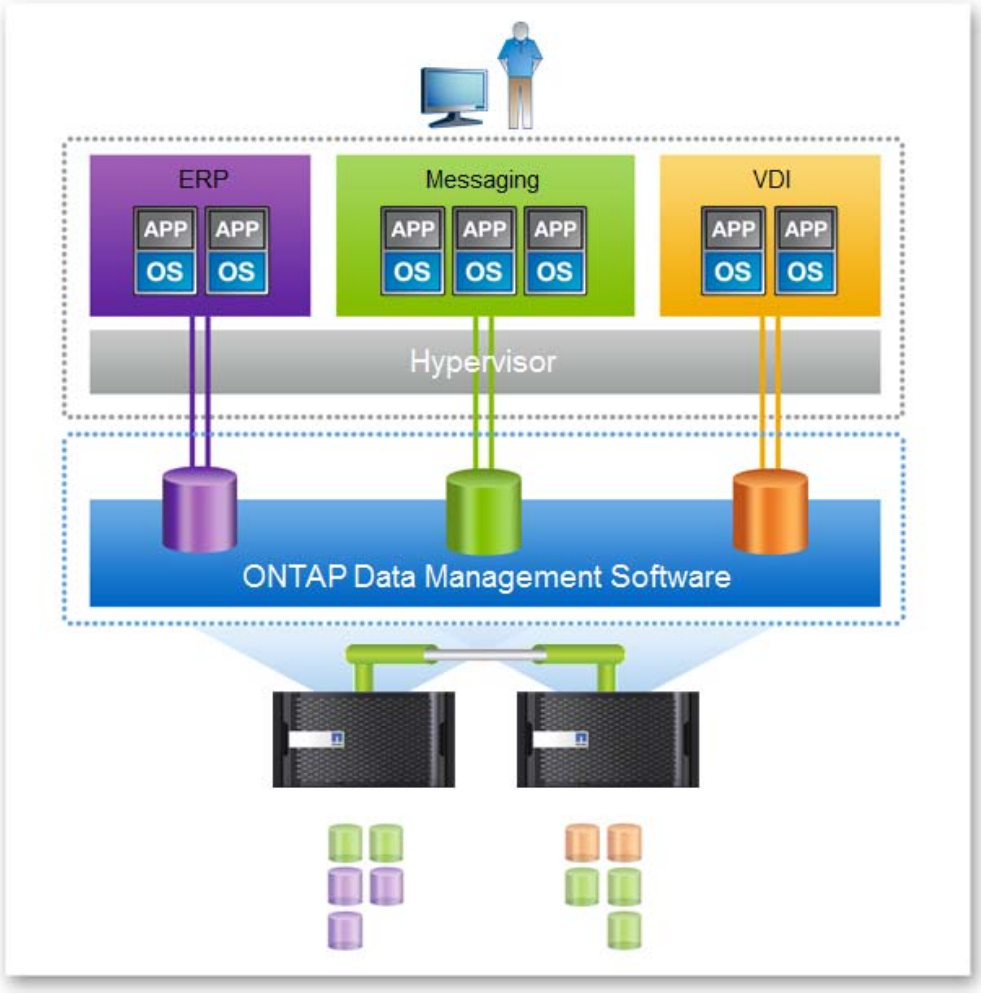


Figure 6: Expand as you build – *Start with a two-node cluster and expand controllers and capacity when you need to, nondisruptively.*

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:

- CIFS/SMB
- NFS, pNFS
- iSCSI
- FC
- FCoE
- NVMe over FC (NVMe/FC)

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 together 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**
Balance placement	Automates loading of new workloads onto a cluster	Increases cluster utilization and performance by adding a new workload to the optimal node
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
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

NetApp Software and Features		
	Function	**Benefits**
Headroom	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
MetroCluster	Combines array-based clustering with synchronous mirroring to deliver continuous availability and zero data loss; up to 300km distance between nodes	Maintains business continuity for critical enterprise applications and workloads if a data center disaster occurs
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
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 backup	Instantaneously recovers files, databases, and complete volumes from your backup

NetApp Software and Features		
	Function	**Benefits**
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	Let's 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

NetApp OnCommand Data Management Software

The more information you have about your storage infrastructure, the better equipped you are to effectively manage it. NetApp OnCommand® management software can help you to improve storage and service efficiency. It offers functions that help you control, automate, and analyze your shared storage infrastructure. OnCommand tools offer simplified, effective, cost-efficient management of your shared storage infrastructure so that you can optimize utilization, meet SLAs, reduce risk, and boost performance.

Table 4: OnCommand management software product portfolio.

Product Name	Description
System Manager	Provides device-level management of NetApp storage systems. Ideal for one-off and nonrepeatable management and configuration tasks.
Unified Manager	Monitors the availability, capacity, performance, and protection of NetApp FAS and All Flash FAS resources. Unified Manager provides a single view of NetApp storage health. It also collects, retains, and analyzes NetApp storage performance statistics so users can troubleshoot and resolve issues quickly.
NetApp Service Level Manager and API Services	NetApp Service Level Manager simplifies storage consumption and enables delivery of predictable performance for your workloads. Provides a set of REST APIs to integrate with your automation and orchestrators including industry leading ITSM solutions. Also provides monitoring and conformance checking APIs.
Workflow Automation	Customized automation and delegation of repeatable storage management and storage service tasks. It facilitates your specific needs for storage infrastructure management via customized workflows based on NetApp best practices. It also integrates with orchestrators for end-to-end automated service delivery.
Cloud Manager	Deploys NetApp ONTAP® management software on AWS and Azure cloud storage in minutes. Manage and track cloud resources with ease. Cloud Manager is for ONTAP Cloud and private storage environments and supports CloudSync.

Product Name	Description
Insight	OnCommand Insight is an open data center management platform that provides operational intelligence, business insight, and IT ecosystem integration within complex enterprise IT environments.

RAID-DP

Reduce Storage Costs

RAID-DP® lets State of WV TAX safely store data. Unlike RAID 0+1, RAID-DP protects against double disk failure with only one additional parity disk in the RAID group. RAID 5 implementations often limit RAID group size to 3+1 or 5+1 (a 17% to 25% parity cost overhead). RAID 1+0 requires 1+1 (a 50% overhead).

In contrast, NetApp supports RAID group sizes of up to 28 (26+2) for a low 7% capacity overhead. No other RAID protection level offers simultaneous high availability, high performance, and low cost. State of WV TAX gets protection plus the performance needed for the most demanding applications.

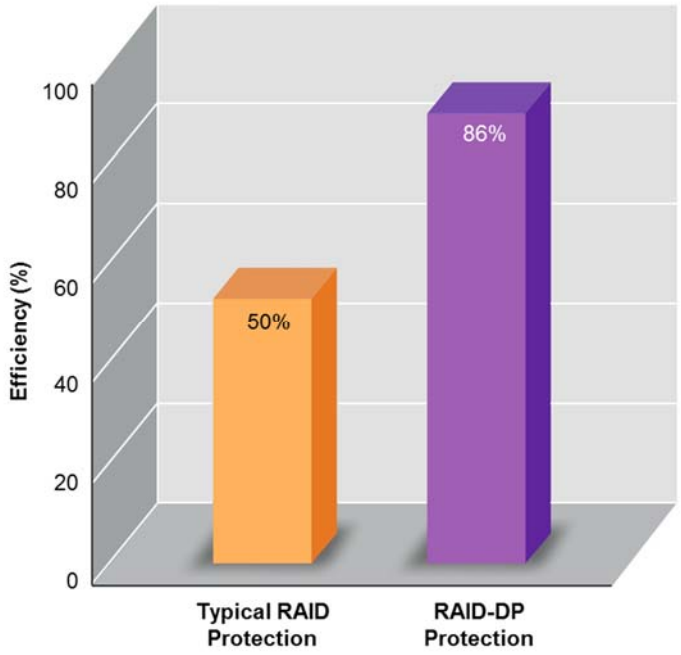


Figure 1: RAID-DP offers protection and efficiency.

Protect Against Double Disk Failure

RAID-DP®, a high-performance dual-parity version of RAID 6, protects against double disk failure. RAID-DP is integrated with WAFL to prevent dedicated parity drives from becoming a performance bottleneck. It provides higher availability than RAID 1 (mirroring), RAID 0+1 (striping + mirroring), and RAID 5 and incurs no performance penalty while providing superior rebuild performance as compared to RAID 5

With traditional single-parity RAID (RAID 3, 4, or 5) or even RAID 1 (mirroring), the entire volume and all its data would be lost if a second drive failed (or had an uncorrectable bit error) while another drive in the RAID group was rebuilding. As disk drive sizes increase, so do the rebuild times for failed drives, creating ever-larger “at-risk” windows. Even technologies such as RAID 0+1 (disk striping and mirroring all disk) are not as available

as RAID-DP because RAID 0+1 protects against any two drives failing at the same time except the same two drives on each side of the mirror.

In addition to having no single point of failure, RAID-DP lets you expand or reconfigure storage while online. State of WV TAX can run applications without interruption—even while adding more storage capacity or throughput.

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.

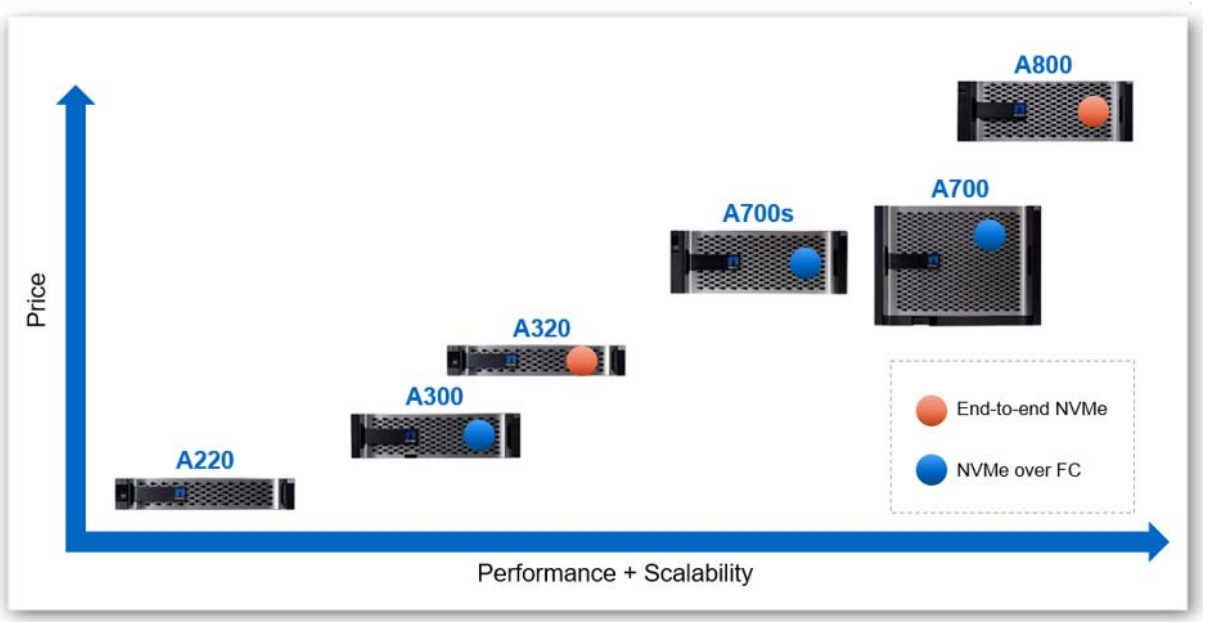


Figure 1: AFF A-Series portfolio—from enterprise to mid-size business.

“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*

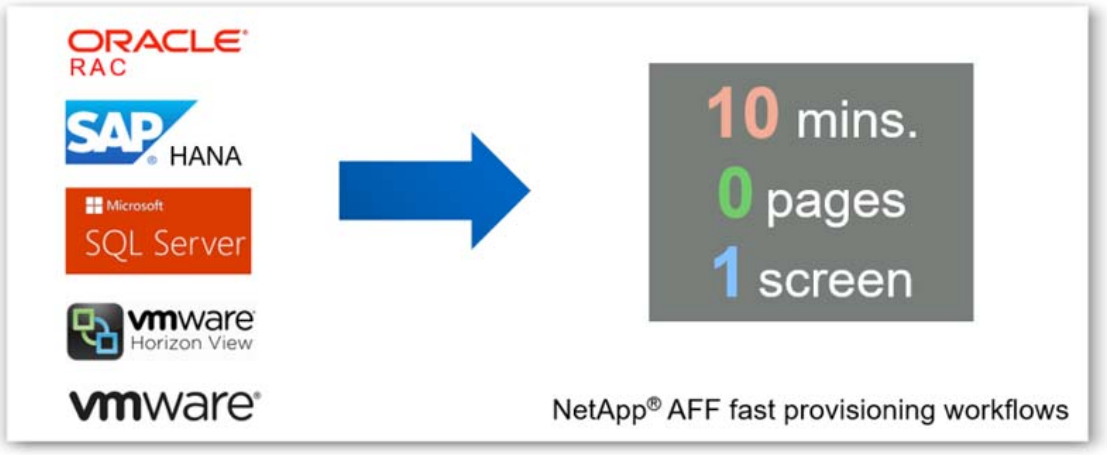


Figure 2: Application-aware data management – *Deploy key workloads in less than 10 minutes with OnCommand System Manager.*

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.

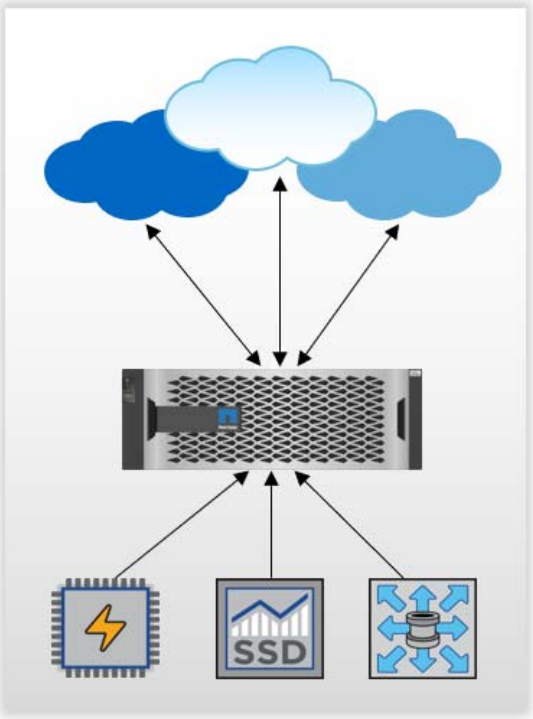


Figure 3: Future-proof your infrastructure with the most cloud-connected all-flash array – *Designed for the cloud era to connect to more clouds, in more ways, and to more services—to virtually any service provider or private cloud.*

Accelerate Applications and Future-Proof Your Infrastructure

NetApp AFF systems deliver industry-leading performance proven by SPC-1[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. 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

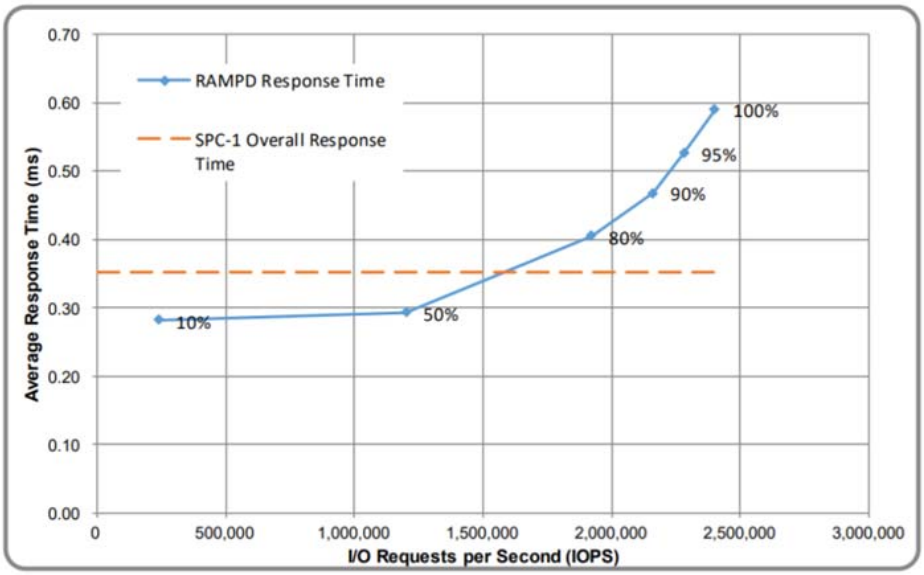


Figure 4: AFF A800 Places in the Top 4 of SPC-1v3 – *Best performance and value among major vendors who publish benchmarks.*

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 lms 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.

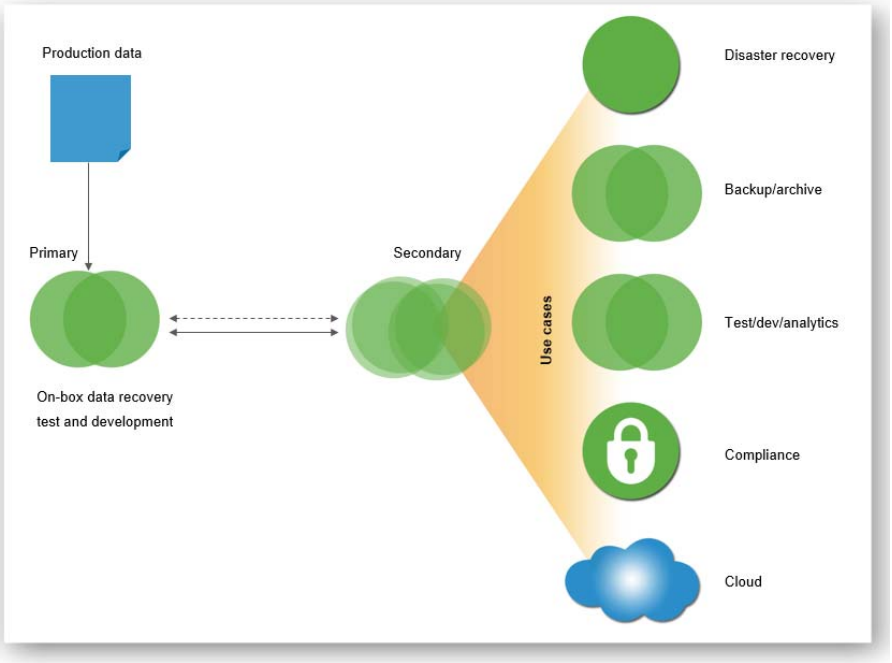


Figure 5: NetApp integrated data protection – *Offers one data management flexible platform that provides data availability to keep applications running, mitigate risk, control costs, and improve data protection processes.*

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.

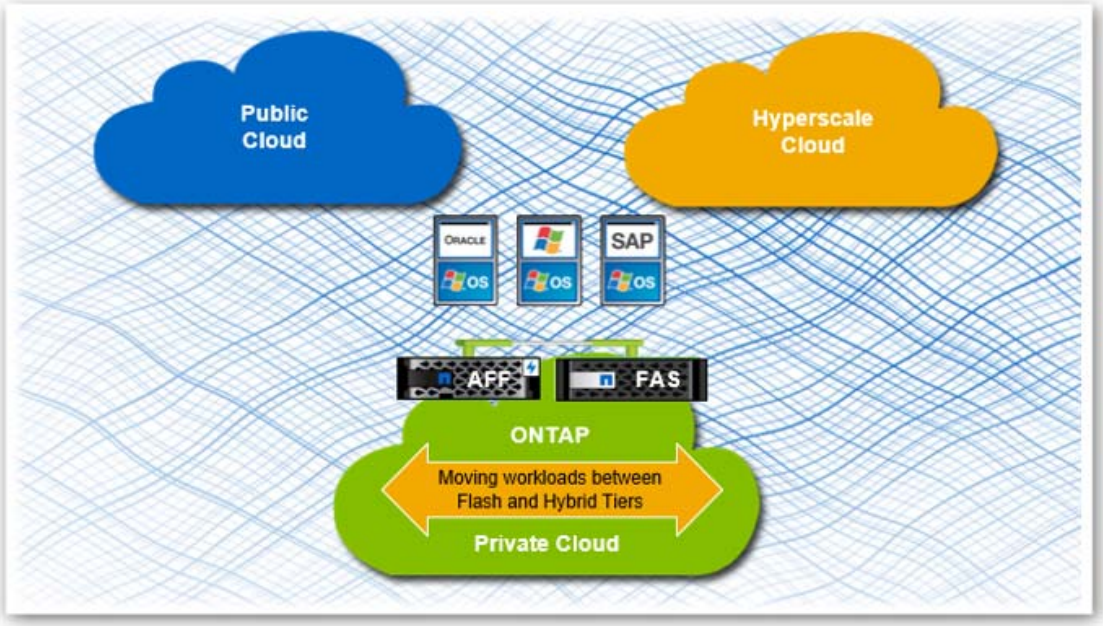


Figure 6: AFF is Data Fabric ready—moving data between tiers and different clouds.

> *"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 OnCommand Simplifies Management

NetApp OnCommand® 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 OnCommand 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.

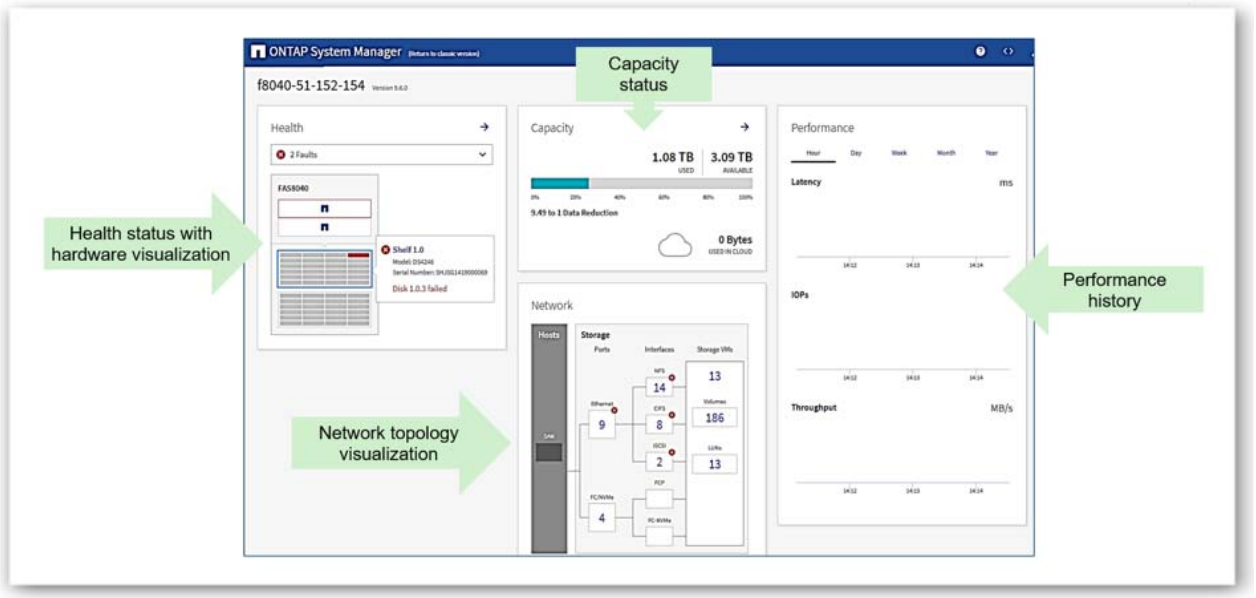


Figure 7: Intuitive ONTAP System Manager *–Based on REST APIs, the new System Manager dashboard is more intuitive and displays richer information in a more actionable view.*

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 new 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 low 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 includes100GbE, 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 the entry system to the NetApp all-flash array series. It 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*

Table 1: All Flash FAS 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

[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.

Table 2: AFF A-Series software.

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

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.

NetApp®

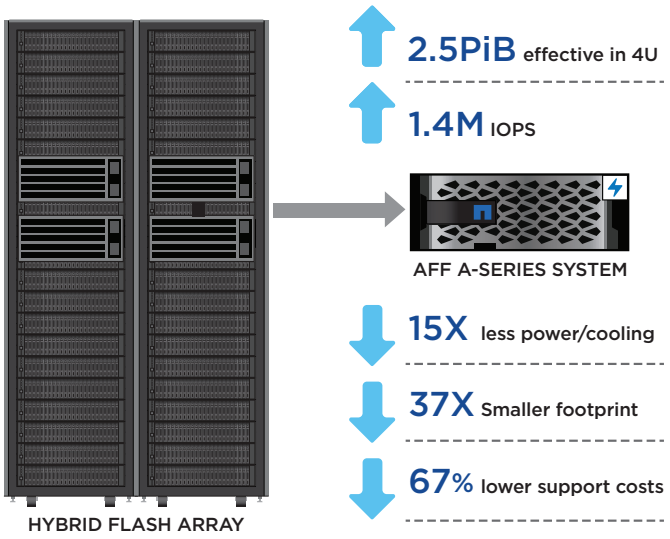


Figure 1) Benefits of Modernizing with All-Flash.

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.

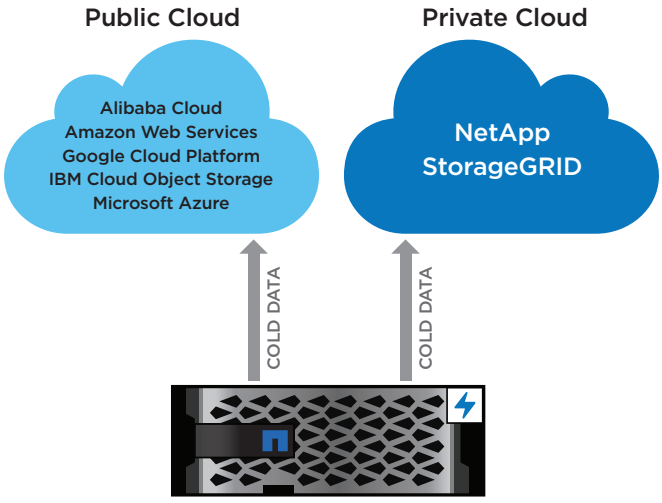


Figure 2) Automatic tiering to the cloud.

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 multiwork-load 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.

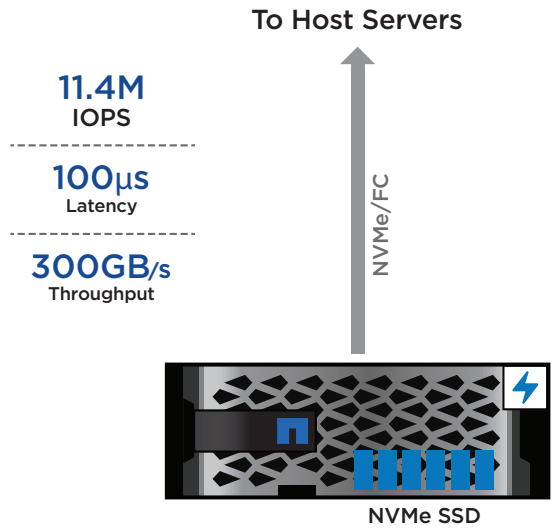


Figure 3) Industry-leading NVMe performance.

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

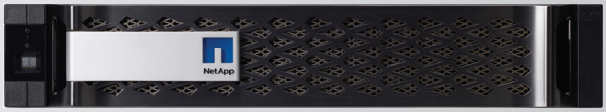
Table 1) AFF technical specifications.

	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)		NS224 (2U; 24 drives, 2.5" SFF NVMe)	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	**Efficiency:** NetApp FlexVol® technology, inline deduplication, inline compression, inline compaction, and thin provisioning **Availability:** active-active HA pair and multipath I/O **Data protection:** NetApp RAID DP®, RAID-TEC™, and Snapshot technology **Whole cluster synchronous replication:** NetApp MetroCluster **Performance control:** adaptive QoS and balanced placement **Management:** NetApp OnCommand Workflow Automation, ONTAP System Manager, and Active IQ Unified Manager (formerly OnCommand Unified Manager) **Scalable NAS container:** NetApp ONTAP FlexGroup **Storage protocols supported:** NVMe/FC, FC, FCoE, iSCSI, NFS, pNFS, and SMB
Flash bundle	**NetApp SnapRestore®** software: restoration of entire Snapshot copies in seconds **NetApp SnapMirror** software: simple, flexible backup and replication for disaster recovery **NetApp FlexClone®** technology: instant virtual copies of files, LUNs, and volumes **NetApp SnapCenter®**: unified, scalable platform and plug-in suite for application-consistent data protection and clone management **NetApp SnapManager®** software: application-consistent backup and recovery for enterprise applications For information about additional software that is available from NetApp, visit. netapp.com.
Extended-value software (optional)	**NetApp OnCommand Insight:** Flexible, efficient resource management for heterogeneous environments **NetApp SnapLock® software:** compliance software for WORM protected data **NetApp Volume Encryption (free license):** granular, volume-level, data-at-rest encryption **FabricPool:** automatic data tiering to the cloud (free when tiering to NetApp StorageGRID® object-based storage) **NetApp SnapMirror Synchronous:** synchronous data replication with zero recovery point objective **NetApp Data Availability Services:** cloud-native backup solution for NetApp ONTAP storage **NetApp FlexCache:** acceleration for data access for single or multisite deployment For information about additional software that is available from NetApp, visit netapp.com.



Datasheet

NetApp FAS2700 Series Hybrid Storage Systems

Simplify your storage with leading data management

Key Benefits

Delivers Best Value for Your IT Investment

- Achieves aggressive price/performance with 30% higher performance
- Serves SAN and NAS workloads with advanced unified architecture
- Meets more business needs with best-in-class data management
- Increases return on investment with enhanced storage efficiencies

Simplifies Storage Operations

- Allows you to upgrade software and add or retire storage with zero downtime
- Streamlines application provisioning
- Handles complicated management tasks

Grows with Your Changing Needs

- Lets you start small and grow big, invest in what you need, and add without disruption
- Connects seamlessly to the cloud with leading integration
- Builds a foundation for a NetApp® Data Fabric across flash, disk, and cloud

The Challenge

Integrating data management across flash, disk, and cloud

Organizations of all sizes and local offices of larger companies are increasingly challenged by shrinking budgets, overextended staff, and the ever-changing demands caused by data growth. Plus, there are flash and cloud adoption to consider. These challenges, coupled with the increasing complexity of your Microsoft Windows, VMware, or server virtualization environment, can quickly consume your budget and affect the productivity of your staff.

The Solution

Hybrid storage with best-in-class data management and cloud integration

Designed to support more of your IT needs, the NetApp FAS2700 hybrid storage arrays offer more value than other systems in their class. The FAS2700 running NetApp ONTAP® storage software simplifies the task of managing growth and complexity by delivering high performance, providing leading integration with the cloud, supporting a broader range of workloads, and seamlessly scaling performance and capacity.

You can build a foundation for a Data Fabric that leverages flash acceleration and public cloud storage resources to cost-effectively handle dynamic storage needs. For growing organizations that are concerned about budgets today and meeting challenging IT needs in the future, the FAS2700 is the perfect choice.

Simplifies storage operations

Free up your time, money, and people. You don't need to be a storage expert to deploy and manage NetApp storage systems. The NetApp FAS2700 series offers a powerful range of technologies to help reduce complexity and increase the efficiency of your storage administrators. Your organization can:

- **Manage 2 to 3 times more storage.** Leading integration with key business applications helps administrators to be more efficient.
- **Streamline application provisioning.** Application-aware data management automatically applies best practices and optimizes data placement on your NetApp storage based on adaptive quality of service (QoS) policies.
- **Upgrade software and add or retire storage without downtime.** The FAS2700 with nondisruptive operation (NDO) technology lets you dynamically handle more storage tasks during regular work hours without costly interruptions to IT.

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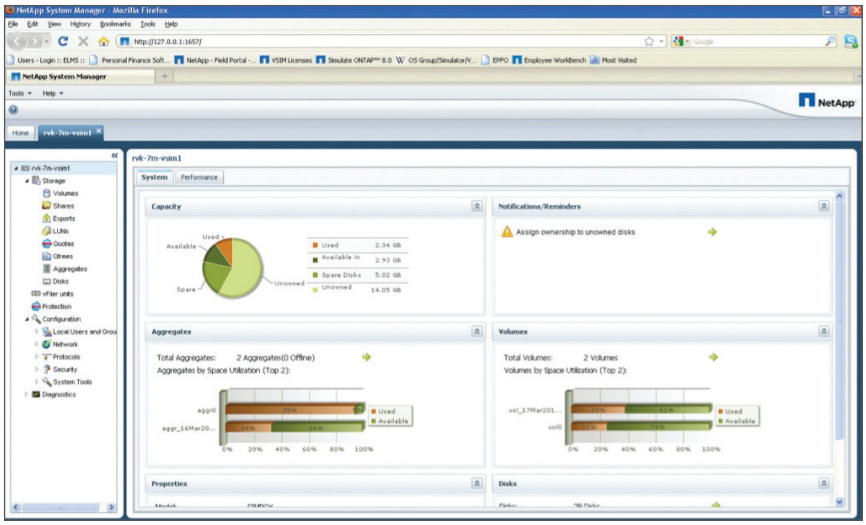

Figure 1) You don't need to be an expert to configure your storage with the simple, easy-to-use NetApp OnCommand System Manager console.

- **Optimize your NetApp systems with the predictive analytics and proactive support of NetApp Active IQ®.** Fueled by NetApp's massive user base, Active IQ artificial intelligence and machine learning create actionable insights that help you prevent problems, optimize your configuration, save time, and make smarter decisions.
- **Protect your critical data** more efficiently with integrated data protection by using NetApp technologies such as RAID-TEC® (triple-parity) and Snapshot™.

ONTAP System Manager is a simple but powerful browserbased management tool to simplify ongoing management and administration. Now running natively in ONTAP, it can be accessed using a browser to initialize the cluster and create storage virtual machines (SVMs) for data access. Later, System Manager can manage the entire cluster from within ONTAP, eliminating the need for an external management server.

In addition to the standard set of powerful software that comes in the Base Bundle with every FAS2700 system, the optional Premium Bundle and extended value software products offer advanced capabilities such as instant data recovery, instant cloning, synchronous data replication, application-aware backup and recovery, NetApp Volume Encryption, and data retention.

Delivers the most value for your IT investment

FAS2700 hybrid storage arrays are built to deliver robust capabilities, so your investment supports the broadest possible set of IT needs. Each FAS2700 delivers:

- **Increased price performance value.** Flash Cache™ intelligent data caching, based on NVMe technology, is integrated into all FAS2700 models to accelerate workloads, reduce latency, and deliver 30% higher performance compared to the previous FAS2600 generation.
- **Best-in-class storage efficiency.** Enhanced inline compression delivers efficiency and storage savings without compromising performance. Along with inline deduplication, inline compaction, thin provisioning, and other data reduction technologies, these features deliver leading storage efficiency.
- **Advanced IT integration options.** The enhanced onboard connectivity of the FAS2700 supports a broader set of applications with your choice of eight flexible, unified target adapters (UTA2s) or eight 10GBase-T ports, as well as four 10GbE ports.
- **Expanded enterprise-class data management.** Leverage NDO, adaptive QoS, and superior virtualization integration, which are usually offered only in the highest-end systems, to meet complicated IT needs.
- **Security.** Easily, efficiently protect your at-rest data by encrypting any volume on FAS (and AFF) systems with NetApp Volume Encryption. No special encrypting disks required. Plus, multifactor authentication increases security, and cryptographic shredding enables GDPR compliance.
- **Scalable NAS containers.** With NetApp FlexGroup, support very large NAS environments in a single namespace that can scale up to 20PB and 400 billion files with consistent high performance and resiliency.

Built to meet your changing needs

As your business grows and priorities change, it is important to have a storage solution that responds to your changing IT requirements dynamically and cost effectively. The NetApp FAS2700 series provides multiple ways to support your growing needs:

- Start small and grow big by nondisruptively adding more nodes as needed, without incurring large capital expenses up front.
- Support and consolidate new NAS and SAN workloads with a unified architecture.
- Scale out up to 24 nodes to support your increasing storage requirements.
- Upgrade to higher-end NetApp systems while using the same data management software and tools, which reduces administrative overhead by up to 60% by eliminating retraining.
- Get built-in investment protection with the ability to convert your FAS2750 and FAS2720 systems to an external disk shelf when you upgrade to larger NetApp systems.

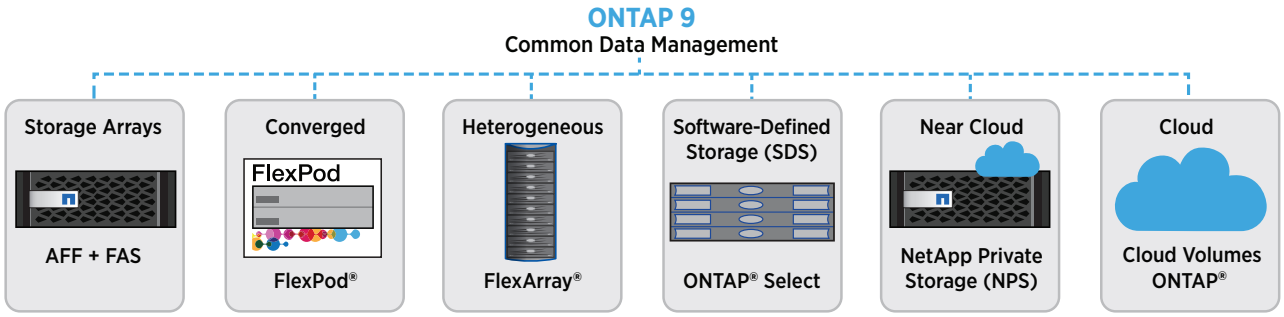

Figure 1) Standardize data management across architectures with a rich set of enterprise data services.

You can also build a foundation of a Data Fabric across flash, disk, and cloud. Move your data to where it's needed and place it on the storage environment that delivers the best combination of flash performance, storage capacity, and cost efficiency. Organizations are increasingly turning to the cloud to be more responsive to user needs. If your plans include the cloud, now or in the future, the FAS2700 running ONTAP is a great choice.

NetApp offers a number of options for extending your FAS2700 to the hybrid cloud with Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), and other leading cloud providers. Options include:

- Easily burst capacity to public clouds without typical capex constraints with NetApp Cloud Volumes Service, the first enterprise-class cloud-native file service for AWS and GCP, or Azure NetApp Files for Microsoft Azure. Ideal for data-intensive workloads such as analytics and DevOps, these cloud data services combine elastic, on-demand storage as a service from NetApp with ONTAP data management in a fully-managed offering.
- For those seeking advanced data services for cloud block or object storage services such as AWS EBS or S3, or Azure storage, Cloud Volumes ONTAP provides data management between your on-premises environment and the public cloud with a single, common view. Running in AWS or Azure as an on-demand instance, Cloud Volumes ONTAP provides the storage efficiency, availability, and scalability of ONTAP software to allow easy movement of data between your on-premises FAS2700 and AWS or Azure storage environment with NetApp SnapMirror® data replication software.
- For organizations that need an enterprise-class hybrid cloud with data governance and security, the FAS2700 can be used in a NetApp Private Storage (NPS) for Cloud solution. With NPS for Cloud, you can directly connect to multiple clouds by using a private, high-bandwidth, low-latency connection. Connect to industry-leading clouds such as AWS, GCP, Microsoft Azure, or IBM Cloud and switch between them at any time, all while maintaining complete control of your data on your dedicated, private FAS2700.

With best-in-class data management and control for the hybrid cloud, NetApp cloud solutions enable seamless movement of data into and out of the cloud.

Visit netapp.com/cloud to find out more about our full range of cloud offerings.

Choosing the Right System

NetApp offers two systems in the FAS2700 family to help you find the balance of price, performance, capacity, and features that best fits your needs.

FAS2750

Equipped for higher performance needs, with space for up to 24 internal SFF drives and expansion up to a total of 144 drives, the FAS2750 is a great fit for:

- Midsize organizations and distributed sites of larger organizations
- Windows applications and virtual server consolidation with multiple workloads
- Customers who require higher performance, I/O flexibility, and investment protection for future growth

FAS2720

Geared toward value-oriented, larger capacity deployments, with space for up to 12 internal LFF drives and expansion up to a total of 144 drives, the FAS2720 is a good fit for:

- Customers who require cost-effective larger capacity for secondary workloads and backup targets
- Smaller organizations, remote offices, and local storage
- Customers who want I/O flexibility and investment protection for future growth
- Consolidating virtualized environments with a small number of Windows applications or general file-serving workloads

Get It Right from the Start by 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.

Table 1) FAS2700 series overview.

Specifications per HA pair	FAS2750	FAS2720
Maximum raw capacity[1]	1243TB	1440TB
Maximum drives	144	144
Controller form factor	2U/24 internal drives	2U/12 internal drives
OS version	ONTAP 9.4 and later	ONTAP 9.4 and later
Shelves and media	See the Shelves and Media page[1] on NetApp.com for current information.	
Storage protocols supported	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB

Note: All specifications are for dual-controller, active-active configurations.

1. Maximum raw capacity depends on the drive offerings. See the Shelves and Media page on NetApp.com (netapp.com/us/products/storage-systems/disk-shelves-and-storage-media/index.aspx) for current information.

Table 2) Specifications for scale-out configurations (hybrid and disk-only configurations).

	FAS2750	FAS2720
NAS scale-out	1–24 nodes (12 HA pairs)	1–24 nodes (12 HA pairs)
SAN scale-out	1–12 nodes (6 HA pairs)	1–12 nodes (6 HA pairs)
Maximum drives	1728	1728
Maximum raw capacity	15.0PB	17.1PB

FAS2700 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, NetApp Volume Encryption, and data retention.

Table 3) FAS2700 series software.

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 technologies • Performance: Adaptive QoS • Scalable NAS container: FlexGroup • Management: ONTAP System Manager and Active IQ Unified Manager
Software included in ONTAP 9 Premium Bundle (optional)	To add capabilities onto 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®: Data recovery software to 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 for your IT infrastructure • SnapMirror Synchronous: Synchronous replication for zero data loss protection (RPO=0) • FlexCache: Accelerate read performance with cached datasets within a cluster and at remote sites. • SnapLock®: Compliance software for write once, read many (WORM)–protected file data • Volume Encryption: Granular, volume-level data-at-rest encryption

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

Datasheet

NetApp Storage Encryption

Full disk encryption that protects data at rest with no operational impact

Key Benefits

Gain Full Disk Encryption
SEDs prevent data access until the drive's encryption key is unlocked by an authorized administrator.

Perform Mandatory Data Encryption
NSE and NVMe SEDs are file system and network independent: No action is required by the operator when aggregates, volumes, shares, or LUNs are created or deleted, and your data is always protected.

Enhance Data Confidentiality and Integrity
Use NSE or NVMe SEDs along with NVE and NAE to take advantage of the industry's first double encryption solution using two distinct layers. This combination provides a more robust data encryption solution.

Maintain Storage Efficiencies
By using NSE, NVMe SEDs, NVE, or NAE, you can encrypt your data while maintaining NetApp storage efficiencies such as deduplication and compression.

Satisfy Governance and Compliance Requirements
Use established security best practices to adhere to and support industry regulation and security compliance, including FIPS 140-2 level 2 with NSE.

The NetApp® ONTAP® storage management solution continues to evolve, with security as an integral part of the solution. With NetApp Storage Encryption (NSE), full disk encryption is available using self-encrypting drives (SEDs) that are FIPS 140-2 level 2 certified. In addition, the strength of the portfolio and ONTAP solution continues with the arrival of NVMe SEDs, available in ONTAP 9.6 (not FIPS 140-2 certified); NetApp Volume Encryption (NVE), available in ONTAP 9.1; and NetApp Aggregate Encryption (NAE), available in ONTAP 9.6. NVE and NAE let you encrypt the data at a volume level, making the solution agnostic of the physical drive. In addition, the ability to take advantage of both hardware and software encryption options, providing double encryption at rest, is an industry first.

The Challenge

Encrypt your data without getting in the way

You work for a government, financial, or healthcare entity and are subject to regulations surrounding data protection. The requirement to keep all the personally identifiable information, personal healthcare information, and customer information protected within your storage infrastructure becomes a challenge when you repurpose drives, return defective drives, or upgrade to larger drives by selling them or trading them in. Wouldn't it be nice if there were a way for all of your data to be encrypted all the time without affecting everyday operations?

The Solution

NetApp Storage Encryption

NSE uses FIPS 140-2 level 2 SEDs to facilitate compliance and spares return by enabling the protection of data at rest, through AES 256-bit transparent disk encryption. The drives perform all the data encryption operations internally, as depicted in Figure 1, including encryption key generation. To prevent unauthorized access to the data, the storage system must authenticate itself with the drive by using an authentication key that is established the first time the drive is used. This can be done with either the onboard key manager (OKM) or an external key manager.

NSE can use the OKM to set and store the authentication keys for NSE drives. When the system uses an external key manager, the authentication keys are backed up externally using the industry-standard OASIS Key Management Interoperability Protocol (KMIP). With the external key manager, only the storage system, drive, and key manager have access to the key, and the drive cannot be unlocked if it is moved outside the security domain, thus preventing data leakage.

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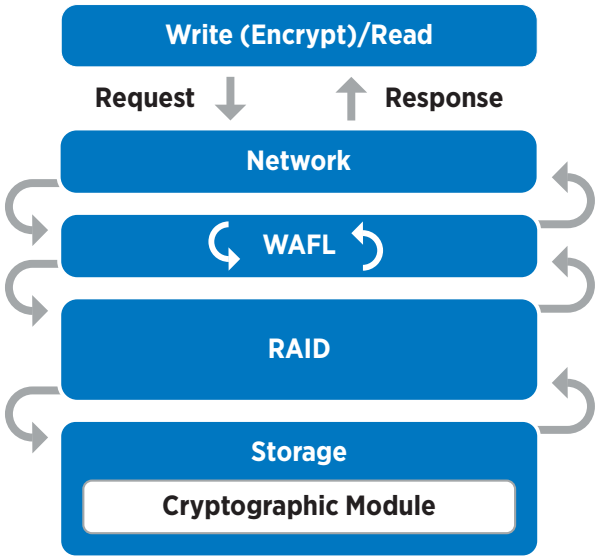

Figure 1) NSE cryptographic function.

Do I Need NSE?

Here are some questions to ask yourself:

- Must physical media be encrypted?
- Do I have any physical drive encryption requirements—for example, tamper evidence solutions?
- Must root aggregate volumes and storage virtual machine volumes be encrypted?
- Do I require ubiquitous disk encryption of all data?

If the answer to any of these questions is yes, then NSE is a viable solution.

Combine encryption for double encryption (layered defense)

If you need to segregate access to data as well as make sure that data is protected all the time, NSE can be combined with network- or fabric-level encryption. NSE can act like a backstop if an administrator forgets to configure or misconfigures higher-level encryption. For two distinct layers of encryption, you can combine NSE drives with NVE.

NSE Supported Storage Architectures

- NetApp AFF A-Series
- NetApp FAS9000 series
- NetApp FAS8200 series
- NetApp FAS2650 series
- NetApp FAS2620 series

Contact your account team to find out more about how the NSE solution can solidify your organization's needs. The following table lists some of the basics of NSE.

Entire disk encrypted
Hardware based
AES 256 encryption
NSE SEDs required
Onboard or external key management for the authentication key
FIPS 140-2 validated when used with external key manager; FIPS level depends on key manager use and implementation
All drives (including HA pairing) must be NSE drives; no mixing NSE and non-NSE drives

Resources

- NetApp Storage Encryption, NVMe Self-Encrypting Drives, NetApp Volume Encryption, and NetApp Aggregate Encryption datasheet
- NetApp Volume Encryption and NetApp Aggregate Encryption datasheet

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