2019 Washington Street, East
Charleston, WV 25305
Telephone: 304-558-2306
General Fax: 304-558-6026
Bid Fax: 304-558-3970

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.

Welcome, Lu Anne Cottrill | Procurement | Budgeting | Accounts Receivable | Accounts Payable

Solicitation Response(SR) | **Dept:** 1400 | **ID:** ESR06281800000006095 | **Ver.:** 1 | **Function:** New | **Phase:** Final | ▼ | **Modified by** batch , 06/28/2018

Header 📎 5

List View

General Information | Contact | Default Values | Discount | Document Information

Procurement Folder: 461061	**SO Doc Code:** CRFQ
Procurement Type: Central Purchase Order	**SO Dept:** 1400
Vendor ID: 000000219154 🔼	**SO Doc ID:** AGR1800000005
Legal Name: SOFTWARE INFORMATION SYSTEMS LLC	**Published Date:** 6/14/18
Alias/DBA:	**Close Date:** 6/28/18
Total Bid: $199,972.30	**Close Time:** 13:30
Response Date: 06/28/2018 📅	**Status:** Closed

Apply Default Values to Commodity Lines | View Procurement Folder

Proc Folder : 461061

Solicitation Description : Unity 350F SAN

Proc Type : Central Purchase Order

Date issued	Solicitation Closes	Solicitation Response	Version
	2018-06-28 13:30:00	SR 1400 ESR06281800000006095	1

VENDOR

000000219154

SOFTWARE INFORMATION SYSTEMS LLC

Solicitation Number: CRFQ   1400   AGR1800000005

Total Bid : $199,972.30   **Response Date:**   2018-06-28   **Response Time:**   10:26:47

Comments:

FOR INFORMATION CONTACT THE BUYER

Guy Nisbet

(304) 558-2596
guy.l.nisbet@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	Unity 350F SAN	1.00000	EA	$199,972.300000	$199,972.30

Comm Code	Manufacturer	Specification	Model #
43211501			

Extended Description : If Vendor is submitting an Alternate "or Equal" product, this information must be identified per Specification Item 4.2 at the time of submitting bid response.

Comments: NetApp or equal bid

SIS
Strategy | Technology | Results
200 Association Drive
Charleston, WV 25311
304 768-1645
304 768-1671 (fax)

NetApp

June 28, 2018

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

Dear Mr. Nisbet,

Please find attached the SIS response to CRFQ 1400 AGR1800000005 due June 28, 2018. SIS understands the requirements of the RFQ and is submitting an equivalent response offering the NetApp Storage Model AFF-A200A for the EMC Unity350F, the FAS2620A for the Data Domain DD3300 and the OOTAP Select Virtual Appl,M300 for the DD VE Channel 4TB.

We meet and exceed the hardware and functional requirements for this solicitation. Please refer to the Itemized Build List for product details.

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

Sincerely,

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

Enclosures

Proc Folder: 461061				
Doc Description: Unity 350F SAN				
Proc Type: Central Purchase Order				
Date Issued	Solicitation Closes	Solicitation No		Version
2018-06-14	2018-06-28 13:30:00	CRFQ 1400 AGR1800000005		1

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 System, LLC
200 Association Drive, Suite 210
Charleston, WV 25311

304 768-1645

FOR INFORMATION CONTACT THE BUYER
Guy Nisbet
(304) 558-2596
guy.l.nisbet@wv.gov
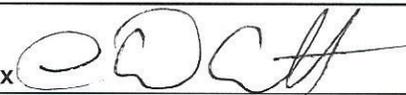
Signature X _(signature)_   FEIN # 61-1371685   DATE 6-28-2018

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

ADDITIONAL INFORMATION:

Request for Quotation

The West Virginia Purchasing Division is soliciting bids on behalf of the Agency, The West Virginia Department of Agriculture t(WVDA) o establish a contract for the one-time purchase of a Dell Unity 350F SAN or Equal per the bid requirements, specifications and terms and conditions as attached hereto.

INVOICE TO		SHIP TO	
PROCUREMENT OFFICER 304-558-2221		AUTHORIZED RECEIVER 304-558-2202	
AGRICULTURE DEPARTMENT OF		AGRICULTURE DEPARTMENT OF	
ADMINISTRATIVE SERVICES		INFORMATION TECHNOLOGY DIVISION	
1900 KANAWHA BLVD E		163 GUS R DOUGLAS LN, BLDG 1	
CHARLESTON	WV 25305-0173	CHARLESTON	WV 25312
US		US	

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Total Price
1	Unity 350F SAN	1.00000	EA		$179,972.30

Comm Code	Manufacturer	Specification	Model #
43211501	NetApp		See Itemized Build List

Extended Description :

If Vendor is submitting an Alternate "or Equal" product, this information must be identified per Specification Item 4.2 at the time of submitting bid response.

Itemized Build List

NetApp Storage Array

Item	QTY	Part Number	Description	List Price	Ext Price
1	2	AFF-A200A-002-SC	**AFF-A200A Flash Bundle**	$0.00	$0.00
			Message: Includes all supported data protocol licenses (FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB), NetApp FlexVol® software, deduplication, compression, compaction, and thin provisioning, Multipath I/O, NetApp RAID-TEC™, RAID DP®, and Snapshot® technology, Storage QoS, NetApp ONTAP FlexGroup NetApp OnCommand® System Manager and OnCommand Unified Manager PLUS FlexClone® SnapMirror®, SnapVault®, SnapRestore®, SnapCenter® Foundation, and SnapManager® Suite		
2	1	AFF-A200A-EXP-105	Cable,Direct Attach CU SFP+10G,0.5M,-C C]	$80,490.00	$80,490.00
			Message: Includes 2x controllers with 4 available UTA2 ports each, 2U 24-drive chassis with 12 x 3.8TB storage, power supplies, 2x 0.5m 10GbE cluster cables (X6566B-05-R6-C), 2x 0.5m SAS cables (X66030A), 2x 0.5m RJ45 cables, Flash Bundle, NetApp Volume Encryption.Power cords, rail kit, optional optics and host cables are configured with the system and appear as separate line items Promo Message: PRM-AMER-EP-3		
3	8	X6589-R6	SFP+Optical 10Gb Shortwave	$570.00	$4,560.00
4	8	X66250-5	Cable,LC-LC,OM4,5m [Cat: M]	$280.00	$2,240.00
5	1	X-02659-00	Rail Kit,4-Post,Rnd/Sq-Hole,Adj,24-32 [Cat: D]	$205.00	$205.00
6	2	X1558A-R6	Power Cable,In-Cabinet,48-IN	$0.00	$0.00
7	2	SW-2-A200A-NVEC	SW,Data at Rest Encryption Enabled,A200,-C	$0.00	$0.00
8	2	SW-2-A200A-TPMC	SW,Trusted Platform Module Enabled,A200,-C	$0.00	$0.00
9	2	DATA-AT-DATA-REST ENCRYPTION	Data at Rest Encryption Capable Operating Sys	$0.00	$0.00
10	456	SW-FLASH BUNDLE-1P-P	ONTAP,Per-0.1TB,FlashBundle,Ult-Perf,1P,-P	$456.00	$178,752.00
11	1	SW-2-CL-BASE	SW-2,Base,CL,Node	$0.00	$0.00
12	1	CS-INSTALL-AFF	Base Installation, All Flash FAS System	$5,000.00	$5,000.00
13	1	CS-MV-CI-FLEXPOD	FlexPod Support, AFF-A200-SYS-SC	$0.00	$0.00
14	1	CS-O2-NBD	SupportEdge Premium NBD Onsite	$17,361.21	$17,361.21
15	2	X-50540-00	Blank,Dsk Drv Filler,12-Pack,DE224C	$350.00	$700.00
16	1	X-02659-00	Rail Kit,4-Post,Rnd/Sq-Hole,Adj,24-32	$205.00	$205.00
17	1	X800-42U-35	Power Cable,In-Cabinet,C13-C14,35-inch	$40.00	$80.00
18	2	X66030A	Cable,12Gb,Mini SAS HD,0.5m	$185.00	$740.00
19	1	X5721A	SHELF,EMPTY,2 PSU,913W,MIDPLANE II,DS224C	$6,950.00	$6,950.00
20	2	X5720A	IOM12,SAS,12G	$3,945.00	$7,890.00
			Subtotal		**$305,173.21**
			Discounted Subtotal		**$167,845.27**

Item	QTY	Part Number	Description	List Price	Ext Price
21	2	FAS2620A-002-SC	**FAS2620A Premium Bundle** Message: Includes All Protocols, SnapRestore SnapMirror, SnapVault, FlexClone, SnapManager Suite, Single Mailbox Recovery(SMBR), SnapCenter Foundation	$0.00	$0.00
22	1	FAS2620A-EXP-101	FAS2620,HA,12X4TB,Premium Bundle,NVE Message: Includes 2x controllers with 512GB Flash Cache and 4 available UTA2 ports each, 2U 12-drive chassis with 12 x 4TB storage power supplies, 2x 0.5m 10GbE cluster cables (X6566B-05-R6-C), 2x 0.5m SAS cables (X66030A), 2x 0.5m RJ45 cables, Premium Bundle, NetApp Volume Encryption. Power cords, rail kit, optional optics and host cables are configured with the system and appear as separate line items. PRM-AMER-EP-3	$18,965.00	$18,965.00
23	1	X-02657-00	Rackmount Kit,212C,4-post,Adj	$150.00	$150.00
24	2	X1558A-R6	Power Cable,In-Cabinet,48-IN,C13-C14	$0.00	$0.00
25	8	X6589-R6 SFP+	SFP+Optical 10Gb Shortwave	$570.00	$4,560.00
26	8	X66250-5	Cable,LC-LC,OM4,5m	$280.00	$2,240.00
27	1	SW-2-CL-BASE	SW-2,Base,CL,Node	$0.00	$0.00
28	2	SW-2-2620A-NVE-C	SW,Data at Rest Encryption Enabled,2620A,-C	$0.00	$0.00
29	480	OS-ONTAP1-CAP1-PREM-1P-P	ONTAP,Per-0.1TB,PREMBNDL,Capacity,1P,-P [	$41.00	$19,680.00
30	2	DATA-AT-REST ENCRYPTION	Data at Rest Encryption Capable Operating Sys	$0.00	$0.00
31	2	SW-2-2620A-TPMC	SW,Trusted Platform Module Enabled,2620A,-C	$0.00	$0.00
32	1	CS-MV-CI-FLEXPOD	FlexPod Support, FAS2620-SYSSC	$0.00	$0.00
33	1	CS-O2-NBD	SupportEdge Premium NBD Onsite	$4,980.30	$4,980.30
34	1	CS-INSTALL	Base Installation	$2,500.00	$2,500.00
			Subtotal		**$53,075.30**
			Discounted Subtotal		**$29,191.42**

Item	QTY	Part Number	Description	List Price	Ext Price
35	4	SW-ONTAP-	**SW,ONTAP Select,Virtual Appl,M300**	$1,036.00	$4,144.00
36	1	ONTAP-SELECT-NVE	Data at Rest Encryption required	$0.00	$0.00
37	4	SW-SSP ONTAPSEL M300-PREM	SW Support,ONTAP,Select,M300,Premium, SW ONTAP-SEL-M300-PREM	$559.44	$2,237.76
			Subtotal		**$6,381.76**
			Discounted Subtotal		**$2,935.61**
			Total		**$199,972.30**

All of the requirements of this solicitation are met with this solution.

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: _6-27-2018_

State of _West Virginia_

County of _Kanawha_, to-wit:

Taken, subscribed, and sworn to before me this _27_ day of _June_, 20_18_.

My Commission expires _11/24/20_, 20___.

AFFIX SEAL HERE

NOTARY PUBLIC _Janet Christman_

Official Seal
Notary Public, State of West Virginia
Janet Christman
South Charleston Public Library
312 Fourth Avenue
South Charleston, WV 25303
My commission expires November 24, 2020

Purchasing Affidavit (Revised 01/19/2018)

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)
_6-28.2018_

(Date)
304 768.1645   Fax 304 768 1671
(Phone Number) (Fax Number)

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.:

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

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

Addendum Numbers Received:
(Check the box next to each addendum received)

☐ 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 Information Systems LLC

Company

[signature]

Authorized Signature

6-28-2019

Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

Exhibit "A"

PRICING PAGE

Item Spec	Description	Alternate Part # and Description of or equal Products	Unit of Measure	Qty	Unit Price	Extended Price
3.1.1	Unity 350F SAN or Equal		Each	1	0.00	0.00
					Total Bid Amount:	*See Itemized Bid List*

Speed Performance Across Flash, Disk and Cloud with FAS

West Virginia Department of
Agriculture
Address

Products
NetApp FAS9000
NetApp FAS8200
NetApp FAS2600

Key Benefits

- **Reduce TCO and extend system lifecycle with fully upgradable modular design**

- **Simplify operations with enhanced serviceability**

- **Accelerate SAN and NAS workloads with up to 50% more performance**

- **Deliver nondisruptive operations and greater than 99.9999% availability**

- **Build a flexible Data Fabric to manage your hybrid cloud environment**

Estimated Costs for West Virginia Department of Agriculture

Hardware / Software Installation*	$
3 Years Premium Support	$
Total	$

In a world where technology is changing our everyday lives, digital transformation remains top of mind for executives. In order to successfully transform, data must become the lifeblood of an organization and seen as a business accelerator. However, the complex infrastructure to achieve these goals can drive up management costs, require specialized training, and increase the chances of costly errors.

The NetApp® FAS series hybrid storage systems are engineered specifically to address these needs. Powered by NetApp ONTAP® data management software, the FAS series unifies your SAN and NAS infrastructure, accelerates business-critical applications and delivers on crucial IT demands for flexibility, scalability and uptime.

Boost Reliability, Availability and Serviceability

The intelligent modular design of the NetApp FAS series hybrid storage system is designed for high performance and to enhance reliability, availability, and serviceability (RAS).

The superior serviceability of the FAS series makes it possible to perform updates during regular work hours. Scaling occurs without maintenance windows or the challenge of coordinating downtime across teams.

All FAS models are designed to deliver the most demanding availability requirements—99.9999% availability or greater—through a comprehensive approach that combines highly reliable hardware, innovative software, and sophisticated service analytics.

The FAS9000, for example, is the most powerful FAS system that NetApp has ever created, built to take full advantage of 40GbE and 32Gb FC. Service operations are greatly simplified, minimizing the risk of errors

and reducing the time needed to accomplish the operations.

Deliver High Performance and Superior TCO

The fully upgradable modular design of the FAS series increases flexibility, streamlines maintenance and extends the life of the platform, reducing the disruption and expense that come with tech refreshes. Simplify West Virginia Department of Agriculture's operations with a powerful, hybrid storage based on a modular design to extend system life, increase utilization and improve long-term ROI.

Integrated NVMe flash accelerates workloads and drives price-to-performance value. Reduce latency and speed your operations with up to 50% higher performance.

You can leverage existing investments in third-party storage arrays using NetApp storage virtualization software to consolidate them behind the FAS series.

Consolidate and Respond to Change

Each of the NetApp FAS systems can be clustered with flash as you build the foundation for a Data Fabric. The FAS9000 can easily be clustered with NetApp All Flash FAS (AFF) arrays to be integrated with the cloud, scale up to 172PB, and integrate existing third-party storage arrays. AFF combines leading data management with submillisecond latency, so you can move your data where it's needed to deliver the optimal combination of performance, storage capacity, and cost-efficiency.

Optimize Hybrid Cloud Deployment

The FAS system running ONTAP is optimized for private and hybrid cloud with secure multitenancy, quality of service (QoS), nondisruptive

operations, and easily defined tiers of service. When tightly integrated with the industry-standard OpenStack cloud infrastructure, FAS enables West Virginia Department of Agriculture to build a private cloud that delivers a simple service-oriented IT architecture and meets the demands of enterprise applications. For organizations that need an enterprise-class hybrid cloud with predictable performance and availability FAS 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. You can connect to industry-leading clouds such as Amazon Web Services (AWS), Microsoft Azure, or IBM Cloud and switch between them at any time, while maintaining complete control of your data on your dedicated, private FAS. You get the elasticity of the public cloud and protect your data with NetApp technologies that you understand and trust. For maximum flexibility, ONTAP Cloud is a version of ONTAP software that runs in AWS and Azure, providing the storage efficiency, availability, and scalability of ONTAP. It allows quick and easy movement of data between your on-premises FAS and AWS or Azure environment with NetApp SnapMirror® data replication software.

The NetApp FAS series has the proven agility and data management capabilities that enables you to maintain control of your data as you grow—on premises and in the cloud.

Table 1:   FAS9000 technical specifications.

FAS9000	
NAS scale-out: 1–24 nodes (12 HA pairs)	
Maximum drives (HDD/SSD)	17,280/5,760
Maximum raw capacity	172PB
Maximum onboard Flash Cache based on NVMe technology	192TB
Maximum Flash Pool	1728TB
Maximum memory	12,288GB
SAN scale-out: 1–12 nodes (6 HA pairs)	
Maximum drives (HDD/SSD)	8,640/2,880
Maximum raw capacity	86PB
Maximum onboard Flash Cache based on NVMe technology	96TB
Maximum Flash Pool	864TB
Maximum memory	6144GB
Cluster interconnect	2 x 40GbE
Specifications per HA Pair (Active-Active Dual Controller)	
Maximum drives (HDD/SSD)	1,440/480
Maximum raw capacity	14.4PB
Maximum onboard Flash Cache based on NVMe technology	16TB
Maximum Flash Pool	144TB
Controller form factor	8U
ECC memory	1024GB
NVRAM	64GB
PCIe expansion slots	20
OS version ONTAP 9.1 RC1 and later	

FAS9000	
Shelves and media	See the Shelves and Media page[1] on NetApp.com for the most current information
Storage protocols supported	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB
Host/client operating systems supported	Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Windows XP, Linux, Oracle Solaris, AIX, HP-UX, Mac OS, VMware, ESX

Table 2:   FAS9000 series software.

FAS9000 Series Software	
Software included in ONTAP 9 Base Bundle	The Base Bundle includes the following NetApp technologies: **Storage protocols:** All supported data protocol licenses are included (FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB) **Efficiency:** NetApp FlexVol® technology, deduplication, compression, compaction, and thin provisioning **Availability:** Multipath I/O **Data protection:** NetApp RAID-TEC™, RAID DP, and Snapshot™ technologies **Performance:** NetApp storage QoS **Scalable NAS container:** FlexGroup **Automated tiering of cold data to the cloud:** FabricPool (on all-SSD aggregates for FAS) **Management:** OnCommand System Manager and OnCommand Unified Manager
Software included in ONTAP 9 Premium Bundle (optional)	To add capabilities to the Base Bundle, the optional Premium Bundle includes the following NetApp technologies: **FlexClone® technology:** data replication technology for instant virtual copies of databases or virtual machines **SnapMirror:** simple, efficient, flexible disaster recovery **SnapVault® software:** disk-based backup software for complete backups and online archiving to primary or secondary storage in minutes instead of hours or days **SnapRestore® software:** data-recovery software to restore entire Snapshot copies in seconds **SnapCenter® technology:** unified, scalable platform and plug-in suite for application-consistent data protection and clone management **SnapManager® software:** suite for application- and virtual machine–aware backup, recovery, and cloning
Extended-value software (optional)	Separate optional software, beyond the Base Bundle and Premium Bundle, is also available: **OnCommand suite of management software:** provides the visibility and control to help maximize system usage, meet storage SLAs, minimize risks, and boost performance **NetApp SnapLock® technology:** compliance software for write once, read many (WORM)–protected data **NetApp Volume Encryption:** granular, volume-level data-at-rest encryption **FlexArray:** virtualization of existing third-party storage arrays into an ONTAP environment to leverage the array storage capacity behind a NetApp FAS system

[1] netapp.com/us/products/storage-systems/disk-shelves-and-storage-media/index.aspx.

Table 3:   FAS8200 technical specifications.

FAS8200	
NAS scale-out: 1–24 nodes (12 HA pairs)	
Maximum drives (HDD/SSD)	5,760/2,880
Maximum raw capacity	57PB
Maximum onboard Flash Cache™ based on NVMe technology	48TB
Maximum Flash Pool	576TB
Maximum memory	3072GB
SAN scale-out: 1–12 nodes (6HA pairs)	
Maximum drives (HDD/SSD)	2,880/1,440
Maximum raw capacity	28PB
Maximum onboard Flash Cache based on NVMe technology	24TB
Maximum Flash Pool	288TB
Maximum memory	1536GB
Cluster Interconnect	210GbE
Specifications per HA Pair (Active-Active Dual Controller)	
Maximum drives (HDD/SSD)	480/480
Maximum raw capacity	4800TB
Maximum onboard Flash Cache based on NVMe technology	4TB
Maximum Flash Pool	48TB
Controller form factor	3U
ECC memory	256GB
NVRAM	16GB
PCIe expansion slots	4
Onboard I/O: UTA 2 (8Gb/16Gb FC, GbE/10GbE, or FCVI ports [MetroCluster only])	8
Onboard I/O: 10GbE	4
Onboard I/O: 10GbE Base-T	4
Onboard I/O: 12Gb SAS	8
OS version ONTAP 9.1 RC1 and later	
Shelves and media	See the Shelves and Media page[2] on NetApp.com for the most current information

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[2] netapp.com/us/products/storage-systems/disk-shelves-and-storage-media/index.aspx.

FAS8200	
Storage protocols supported	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB
Host/client operating systems supported	Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Windows XP, Linux, Oracle Solaris, AIX, HP-UX, Mac OS, VMware, ESX

Table 4:   FAS8200 series software.

FAS8200 Series Software	
Software included in ONTAP 9 Base Bundle	The Base Bundle includes the following NetApp technologies: **Storage protocols:** All supported data protocol licenses are included (FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB) **Efficiency:** NetApp FlexVol® technology, deduplication, compression, compaction, and thin provisioning **Availability:** Multipath I/O **Data protection:** NetApp RAID-TEC™, RAID DP, and Snapshot™ technologies **Performance:** NetApp storage QoS **Scalable NAS container:** FlexGroup **Management:** OnCommand System Manager and OnCommand Unified Manager
Software included in ONTAP 9 Premium Bundle (optional)	To add capabilities to the Base Bundle, the optional Premium Bundle includes the following NetApp technologies: **FlexClone® technology:** data replication technology for instant virtual copies of databases or virtual machines **SnapMirror:** simple, efficient, flexible disaster recovery **SnapVault® software:** disk-based backup software for complete backups and online archiving to primary or secondary storage in minutes instead of hours or days **SnapRestore® software:** data-recovery software to restore entire Snapshot copies in seconds **SnapCenter® technology:** unified, scalable platform and plug-in suite for application-consistent data protection and clone management **SnapManager® software:** suite for application- and virtual machine–aware backup, recovery, and cloning
Extended-value software (optional)	Separate optional software, beyond the Base Bundle and Premium Bundle, is also available: **OnCommand suite of management software:** provides the visibility and control to help maximize system usage, meet storage SLAs, minimize risks, and boost performance **NetApp SnapLock® technology:** compliance software for write once, read many (WORM)–protected data **FlexArray:** virtualization of existing third-party storage arrays into an ONTAP environment to leverage the array storage capacity behind a NetApp FAS system

Table 5:   FAS2600 technical specifications.

Specifications per HA Pair	FAS2650	FAS2620
Maximum raw capacity[3]	1243TB	1440TB
Maximum disk drives	144	144

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[3] 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 the most current information.

Specifications per HA Pair	FAS2650	FAS2620
Controller form factor	2U/24 drives (SFF)	2U/12 drives (LFF)
ECC memory	64GB	64GB
Onboard NetApp Flash Cache based on NVMe technology	1TB	1TB
Maximum Flash Pool™	24TB	24TB
NVMEM/NVRAM	8GB	8GB
Onboard I/O: UTA2 (8Gb FC/16Gb FC/ FCoE/10GbE/1GbE5[4])	8[4]	8[4]
Onboard I/O: 10GbE	4	4
Onboard I/O: 12Gb SAS	4	4
OS version	ONTAP 9.1 and later	
Shelves and media	See the Shelves and Media page[3] on NetApp.com for the most current information.	
Storage protocols supported	FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB	
Host/client operating systems supported	Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Windows XP, Linux, Oracle Solaris, IBM AIX, HP-UX, Apple Mac OS, VMware ESX	

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

Table 6: Specifications for scale-out configurations (hybrid and disk-only configurations).

	FAS2650	FAS2620
NAS/SAN scale-out	1–8 nodes (4 HA pairs)	1–8 nodes (4 HA pairs)
Maximum drives	576	576
Maximum raw capacity	5.0PB	5.7PB
Maximum onboard Flash Cache based on NVMe technology	4TB	4TB
Maximum Flash Pool	96TB	96TB
Maximum ECC memory	256GB	256GB
Cluster interconnect	10GbE: Supported using either 10GbE or UTA2 ports for maximum flexibility	

Table 7: FAS2600 series software.

FAS2600 Series Software	
Software included in ONTAP 9 Base Bundle	The Base Bundle includes the following NetApp technologies:
	Storage protocols: All supported data protocol licenses are included with licenses (FC, FCoE, iSCSI, NFS, pNFS, CIFS/SMB)
	Efficiency: NetApp FlexVol®, deduplication, compression, compaction, and thin provisioning
	Availability: Multipath I/O
	Data protection: NetApp RAID-TEC, RAID-DP, and Snapshot technologies
	Performance: NetApp storage QoS
	Scalable NAS container: FlexGroup
	Automated tiering of cold data to the cloud: FabricPool (on all-SSD aggregates for FAS)

[4] Onboard UTA2 ports for FAS2650 and FAS2620 can be configured as either an 8Gb/16Gb FC port pair or a 10GbE port pair and mixed combinations. Also, GbE supported with SFP+ modules X6567-R6 for optical and X6568-R6 for RJ45.

FAS2600 Series Software	
	Management: OnCommand System Manager and OnCommand Unified Manager
Software included in ONTAP 9 Premium	To add capabilities onto the Base Bundle, the optional Premium Bundle includes the following NetApp technologies:
	FlexClone®: instant virtual copies of databases or virtual machines
	SnapMirror®: simple, efficient, flexible disaster recovery
	SnapVault®: disk-based backup software for complete backups and online archives to primary or secondary storage in minutes instead of hours or days
	SnapRestore®: restore entire Snapshot copies in seconds
	SnapCenter®: unified, scalable platform and plug-in suite for application-consistent data protection and clone management
	SnapManager® suite: application- and virtual machine–aware backup, recovery, and cloning
	For descriptions of these products and information about additional software available from NetApp, go to NetApp.com.
Extended value software (optional)	Separate optional software, beyond the Base Bundle and Premium Bundle, is also available:
	OnCommand suite of management software: Provides the visibility and control to help maximize system utilization, meet storage SLAs, minimize risks, and boost performance
	SnapLock®: Compliance software for write once, read many (WORM) protected data
	Volume Encryption: Granular, volume-level data-at-rest encryption

AFF Speeds Your Data Between Local and Cloud

West Virginia Department of Agriculture

Technical Benefits

- Simplify management of SAN/NAS and data protection
- Boost your storage efficiency by 5:1
- Enable consistent sub-millisecond latency with Flash Essentials to 7million IOPS

Products and Services

NetApp All-Flash FAS (AFF)

NetApp Snapshot™ and SnapRestore® technologies

NetApp SnapMirror® technology

NetApp Deduplication

Estimated Costs for West Virginia Department of Agriculture

Hardware / Software Installation*	$
3 Years Premium Support	$
Total	$

In a world where technology is changing our everyday lives, digital transformation remains top of mind for executives. In order to successfully transform, data must become the lifeblood of an organization and seen as a business accelerator.

Why is Flash Storage Compelling?

Flash is simpler than conventional storage because it uses electricity to store data in addressable locations on a fixed, thin layer of oxide, rather than on spinning disks. There are no moving parts and data is retained when the power is turned off. Flash storage reads ~ 100 x faster than a traditional spinning hard drive, yet consumes ~20% of the power.

Flash can reduce overall costs compared to using conventional storage alone.

The Benefits of NetApp

NetApp flash-based solutions can create an architecture that meets West Virginia Department of Agriculture's requirements for price, performance, reliability and scalability.

All-Flash FAS (AFF) built on the NetApp® ONTAP® data management software accelerates the performance of your solution and optimizes it with high availability and scalability.

NetApp all-flash converged infrastructure with FlexPod is the world's leading converged product

- Excellent performance at the 1ms latency point
- The most data management features of any storage platform in the world
- Extensive cloud integration, live data movement between different node types (AFF to hybrid and back, and to cloud for instance)
- Single storage platform for all data management needs, optimized for mixed workloads and applications
- Comprehensive automation, replication, storage efficiency mechanisms
- Application-aware automation for cloning and backups for most major Enterprise apps
- Multiprotocol support (FC, iSCSI, NFS 3,4, pNFS, SMB 1,2,3)
- 6-nines proven availability, robust data integrity, no single failure domain
- Scale-up (up to 480 SSDs per 2 controllers) and scale out (up to 24 controllers)
- Non-disruptive everything, including changing controller types

Proposed NetApp Products

- NetApp AFFA200 with ONTAP
- ONTAP Flash Essentials
- 49 TBEstimated useable per array
- 3 years of Premium Support

Table 1:   All Flash FAS technical specifications.

	AFF A700s	AFF A700	AFF A300	AFF A200
NAS Scale-Out	2–24 nodes (12 HA pairs)			2–8 nodes (4 HA pairs)
Maximum SSD	1,440	5,760	4,608	576
Maximum raw capacity: all flash	22.0PB/19.6PiB	88.1PB/78.3PiB	70.5PB/62.6PiB	8.8PB/7.8PiB
Effective capacity[1]	87.8PB/78.0PiB	360PB/319.7PiB	288PB/256.3PiB	35.9PB/31.9PiB
Maximum memory	12288GB	12288GB	3072GB	256GB
SAN Scale-Out	2–12 nodes (6 HA pairs)			2–8 nodes (4 HA pairs)
Maximum SSD	720	2,880	2,304	576
Maximum raw capacity	11.0PB/9.8PiB	44.1PB/39.1PiB	35.3PB/31.3PiB	8.8PB/7.8PiB
Effective capacity[1]	43.9PB/39.0PiB	180PB/159.8PiB	144.3PB/128.2PiB	35.9PB/31.9PiB
Maximum memory	6144GB	6144GB	1536GB	256GB
Cluster interconnect	2 x 40GbE or 4 x 10GbE	2 x 40GbE or 8 x 10GbE	2 x 10GbE	
Per HA Pair Specifications (Active-Active Dual Controller)				
Maximum SSD	120	480	384	144
Maximum raw capacity: all flash	1.8PB/1.6PiB	7.3PB/6.5PiB	5.9PB/5.2PiB	2.2PB/2.0PiB
Effective capacity[1]	7.3PB/6.5PiB	30.0PB/26.6PiB	24.0PB/21.4PiB	9.0PB/8.0PiB
Controller form factor	4U chassis with two HA controllers and 24 SSD slot	8U chassis with two HA controllers	3U chassis with two HA controllers	2U chassis with two HA controllers and 24 SSD slots
Memory	1024GB	1024GB	256GB	64GB
NVRAM	32GB	64GB	16GB	8GB
PCIe expansion slots	8	20	4	N/A
FC target ports (32Gb autoranging)	8	32	8	N/A
FC target ports (16Gb autoranging)	8	64	24	8
FCoE target ports, UTA2	N/A	64	24	8
40GbE ports	12	32	8	N/A
10GbE ports	24	64	32	8
10GbE Base-T ports (1GbE autoranging)	N/A	64	12	N/A
12Gb/6Gb SAS ports	8	64	24	4

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

	AFF A700s	AFF A700	AFF A300	AFF A200
Storage networking supported	FC iSCSI, NFS, pNFS, CIFS/ SMB	FC, FCoE, iSCSI, NFS, pNFS, SMB		
OS version	ONTAP 9.1 RC2 or later	ONTAP 9.1 RC1 or later		ONTAP 9.1 RC2 or later
Shelves and media	DS224C (2U; 24 drives, 2.5" SFF); DS2246 (2U; 24 drives, 2.5" SFF) See NetApp All Flash FAS Tech page[2] for more details about supported drive types.			
Host/client OSs supported	Windows 2000, Windows Server 2003, Windows Server 2008, Windows Server 2012, Windows Server 2016, Linux, Oracle Solaris, AIX, HP-UX, Mac OS, VMware, ESX			

Table 2:   AFF A series software included with the system.

AFF A Series Software	
Features and software Included with ONTAP software	**Efficiency:** NetApp FlexVol®, deduplication, compression, compaction, and thin provisioning **Availability**: NetApp MetroCluster and multipath I/O **Data protection**: NetApp RAID DP® and Snapshot technology **Performance:** Storage quality of service (QoS) **Management:** OnCommand Workflow Automation, System Manager, Performance Manager, and Unified Manager **Scalable NAS container**: ONTAP FlexGroups
Flash bundle	- All storage protocols supported (FC, FCoE, iSCSI, NFS, pNFS, SMB) - NetApp **SnapRestore®** software: Restore entire Snapshot copies in seconds - NetApp **SnapMirror** software: Simple, flexible disaster recovery - NetApp **FlexClone®** technology: Instant virtual copies of files, LUNs, and volumes - NetApp **SnapCenter® Standard**: 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.

Why NetApp?

NetApp is the current market and technology leader in unified storage, and one of the fastest growing SAN vendors and the largest provider of storage to the US Federal Government. NetApp provides more storage to the US Federal Government than all other storage vendors combined including Dell, EMC, HP, IBM and Hitachi. Gartner has ranked NetApp as a leader for mid-range disk and NAS in its *Magic Quadrant*. Gartner also recognizes NetApp's merit in other storage-related markets, including storage resource management, data protection services, storage implementation services, and backup and recovery.

NetApp customers have recognized us as the industry leader in providing flexible, efficient, and future-ready storage architecture.

ONTAP is the Number One Storage Operating System

International Data Corporation (IDC) 2017 Q4 Storage Hardware and Software Market Share shows that NetApp ONTAP® is the number one storage operating system.[1]
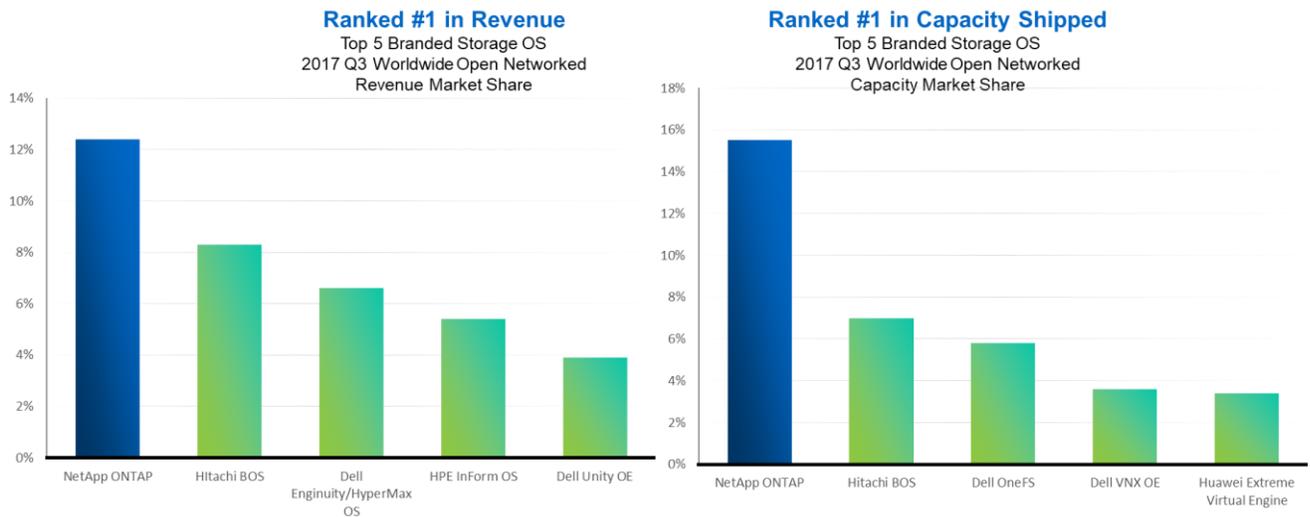
Figure 1:   NetApp ONTAP is the #1 Open Networked Branded Storage OS – *The latest IDC Enterprise Storage Systems Tracker confirms that NetApp ONTAP was ranked #1 based on sales of Open Networked Enterprise Storage Systems (for both revenue and terabytes).*

The following table highlights the features and functions that set NetApp ONTAP solution apart from other storage platforms.

Table 1:   NetApp ONTAP features and functions.

NetApp ONTAP	
Universal Data Platform	• All protocols: CIFS, FCoE, FCP, iSCSI, NFS • All disk types: SSD, SAS, NL-SAS, SATA

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[1] Source: IDC, Worldwide Quarterly Enterprise Storage Systems Tracker - 2017Q4, March 1, 2018.

NetApp ONTAP	
	• All workload types: Small or large block, random or sequential • Maximum simplicity: One system to learn and support, for all your needs
Flexible Scalability	• Expandable performance: Scale up and out, controllers and disk • Expandable capacity: Scale up and out • Operational efficiency: Grow without adding points of management
Integrated Data Protection	• Native zero-impact, space-efficient snapshots • Deep application integration (application-consistent snapshots, and so on) • Native disaster recovery replication: SnapMirror® • Native optional disk-to-disk backup: SnapVault®
Open and Extensible Platform	• Robust APIs that support third-party and custom integration • Several supported tools and environments • Designed to scale from small to massive environments
Zero-downtime Lifecycle Maintenance	• Replace all components without downtime or costly migrations • Add performance, connectivity, and capacity without disruption
Secure Multi-tenancy	• Shared storage to maximize efficiency, while maintaining secure separation • Secure, scalable, and fully-functional multi-tenant solution • Robust QoS and role-based access control to achieve service level success
Business-empowering Efficiency	• Highly-granular 4KB block-level deduplication of NAS and SAN primary data • Cache amplification with deduplication-aware SSD Flash Pools • Zero-cost near-instantaneous clones revolutionize dev/test and VM build-out
Complete Data Portability	• The ability to move data anytime, without disruption to any type of disk • The flexibility to move data in and out of private, hybrid, and public clouds • Highly efficient, deduplication-enabled replication

Leading Provider of Storage Efficiency Capabilities

NetApp is a leading provider of storage efficiency capabilities such as thin provisioning and deduplication. Our unique approach delivers a universal platform, which provides a challenge to the legacy unified storage offered by competitors. The flexibility and efficiency of NetApp architecture directly translates into better operation and significantly improves total cost of ownership.

NetApp is differentiated by our ability to:

- Enable automation that matches pre-defined service levels
- Unify heterogeneous environments under a single, highly capable, management umbrella
- Deliver application-consistent point-in-time copies, as well as integrate storage operations into the application environments
- Provide functional, capable data protection and disaster recovery with our disk arrays—not just deliver what amounts to checkmark boxes for such functionality
- Deliver capabilities such as secure multi-tenancy and a comprehensive SRM environment that easily plugs into existing system frameworks

NetApp ONTAP 9 Data Management Software

No matter what deployment model you choose, ONTAP data management software provides the foundation of the NetApp data fabric. It offers multiple deployment options, a large set of data and storage management capabilities, and deep ecosystem integration to enable a system that spans a broad range of environments and use cases. With NetApp ONTAP 9 simplify data management for any application, anywhere; accelerate and protect data across the hybrid cloud; and future-proof your data infrastructure.

NetApp ONTAP 9 provides West Virginia Department of Agriculture with next-generation data management capabilities and storage efficiencies, fueled by simplicity and flexibility. ONTAP 9 enables West Virginia Department of Agriculture to deploy the foundation for a Data Fabric across your choice of architectures: engineered systems, software-defined storage (SDS), and the cloud, while unifying data management across each of them.

ONTAP 9 innovations in version 9.0-9.3 for our all-flash and hybrid-flash portfolio

West Virginia Department of Agriculture can leverage ONTAP 9 to:

- Simplify deployment and data management
- Adapt to changing business needs
- Accelerate your enterprise applications
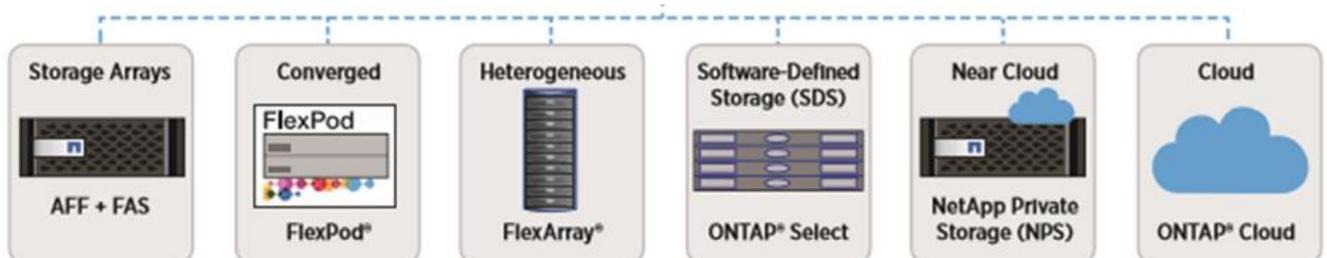
Figure 1:   Standardize data management across architectures with a rich set of enterprise data services.

Performance assurance made easier:

- Adaptive QoS: Automatically adapt QoS levels to changes in the workload
- Over 40% higher performance – now 850K IOPS for AFF HA pair
- ONTAP optimizations and path parallelization deliver more IOPS, lower latency
- 30% higher storage efficiency
- Optimized deduplication further increases space savings
- Even stronger security, plus new compliance capabilities
- Higher protection: External key management for NVE, multi-factor authentication
- MetroCluster over IP simplifies and reduces cost

ONTAP 9.4: Modernize your Data Management

NetApp® ONTAP 9® is the next generation of data management software, combining new levels of simplicity and flexibility with powerful data management capabilities and storage efficiencies.

It enables integration of modern and traditional technologies—across flash, cloud, and software-defined architectures—to build a foundation for the data fabric.

As your business grows, you can add capacity across both SAN and NAS environments. Plus, you can combine all-flash and hybrid flash storage nodes into a larger storage cluster and connect them to the cloud. You can then nondisruptively move and access your data from the node that delivers the optimal combination of performance, capacity, and cost efficiency.

Accelerate your enterprise applications with flash—without compromising on the rich data services that you need. You can start small and grow with your business by scaling your storage environment, leveraging high-capacity solid-state drives (SSDs) or hard disk drives (HDDs), and growing up to 24 nodes in a cluster. Reduce your overall storage costs by leveraging leading ONTAP data reduction technologies to minimize your storage footprint and maximize your effective capacity.

Supportive Platforms

	NetApp® AFF	A800, A700S, A700, A300, A220, A200 AFF8080, AFF8060, AFF8040
	NetApp FAS*	FAS9000, FAS8200, FAS2750, FAS2720, FAS2650, FAS2620 FAS8080, FAS8060, FAS8040 *Only solid-state drive (SSD) aggregates can use FabricPool
	NetApp ONTAP® Cloud for Amazon Web Services (AWS)	Performance tier: gp2 and st1 EBS volumes Capacity tier: Amazon S3
	Object storage	Amazon S3 (Standard, Infrequent Access) Microsoft Azure Blob Storage (Hot, Cool) NetApp StorageGRID® Webscale 10.3+ Others via PVR

Respond to Business needs with Seamless Scale-out without Silos

With ONTAP 9, you can flexibly deploy storage on your choice of architectures—engineered systems, software-defined storage (SDS), and the cloud—while unifying data management across all of them. You can modernize your infrastructure with new applications. And as your business grows, you can add capacity across both SAN and NAS environments.

- Scale out by intermixing your choice of flash and hybrid nodes
- Upgrade hardware/software or scale up without disrupting users
- Incorporate software-defined, cloud, and future-generation flash

Future-proof your Infrastructure

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

- NetApp engineered systems: All Flash FAS (AFF) systems and hybrid-flash FAS systems

- Converged infrastructure: FlexPod® solution • 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: ONTAP Cloud

West Virginia Department of Agriculture can move your data seamlessly between architectures to place it in the optimal environment for performance, capacity, and cost efficiency. Plus, you have the flexibility to consolidate both NAS and SAN workloads onto any ONTAP environment while delivering consistent data services.
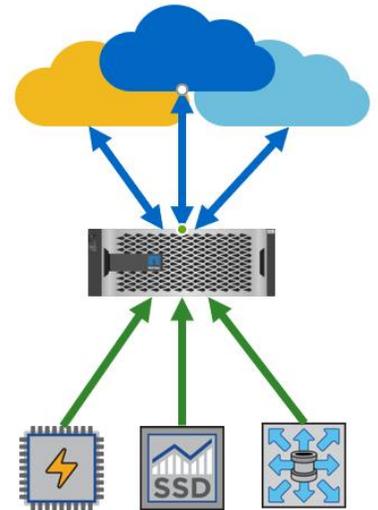
Integrate with Emerging Applications

- Support new enterprise apps
  - OpenStack integration
  - Connector for Hadoop
  - Connector for Docker
  - Certification for MongoDB

- Provide enterprise-grade data services

- Common infrastructure for existing and new apps

Figure 2: Future-proof and ultra-high performance

Simplify Deployment and Management

Although West Virginia Department of Agriculture's 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 West Virginia Department of Agriculture's staff can prioritize and 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 West Virginia Department of Agriculture 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. West Virginia Department of Agriculture can 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. West Virginia Department of Agriculture can 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 storage processes by integrating into your data center orchestration platform for end-to-end service delivery for your private and hybrid cloud services.

Table 1:   OnCommand management software product portfolio.

OnCommand Area/Product	Primary User Case
System Manager	Provides simple yet powerful out-of-the box management of NetApp storage systems and clusters. Included with ONTAP 8.3 and beyond.
Unified Manager	Enables centralized management of physical and virtual storage environments through a unified interface. Used to deploy, automate, protect, and monitor the entire NetApp storage environment. Must be downloaded separately.
Performance Manager	Integrated component of Unified Manager that provides performance monitoring and root-cause analysis of ONTAP. Must be downloaded separately.
Workflow Automation	Eliminates manual, error-prone storage administration by automating provisioning, setup, migration, and decommissioning tasks. Must be downloaded separately.
Cloud Manager	Provides management for hybrid clouds, including ONTAP Cloud and NetApp Private Storage, easing configuration, provisioning, and monitoring across all virtual and hardware cloud storage nodes. Must be downloaded separately. If Cloud Manager is deployed on the cloud, the provider will charge a cost for the compute resource that ONTAP Cloud runs.
NetApp Service Level Manager (Basic)	Enables customers to build, maintain, and simplify the integration of NetApp platforms with the IT ecosystem of tools. With Service Level Manager, IT can deliver storage-as-a-service or private cloud more easily because they are able to build a framework that simplifies how storage is consumed.
OnCommand API Services	Allows integration of disparate software tools to simplify management of on-premises and cloud storage. Using REST APIs, you can access events from OnCommand Unified Manager and historical performance metrics from OnCommand Performance Manager.
Insight	Offers multivendor performance, configuration, and capacity management for on-premises and hybrid cloud storage

	environments. Provides advanced cost analysis and reporting for showback and chargeback. This is a licensed product that must be purchased separately.

Adapt to Changing Business Needs

ONTAP 9 provides the flexibility West Virginia Department of Agriculture needs 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: FlexArray®
- Next to the cloud: NetApp Private Storage (NPS) for Cloud
- In the cloud: ONTAP Cloud

West Virginia Department of Agriculture can 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.

West Virginia Department of Agriculture can use new software stacks such as Dockers and OpenStack to modernize your infrastructure. You can 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 new FabricPool technology can deliver up to 40% storage TCO savings by automatically tiering cold data from AFF or all-SSD FAS aggregates to the cloud, including Amazon Web Services S3.

Accelerate Enterprise Applications

To support your critical applications West Virginia Department of Agriculture needs 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, providing up to 60% more 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 West Virginia Department of Agriculture the ability to perform critical tasks without interrupting your business. You can dynamically assign, promote, and retire 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.
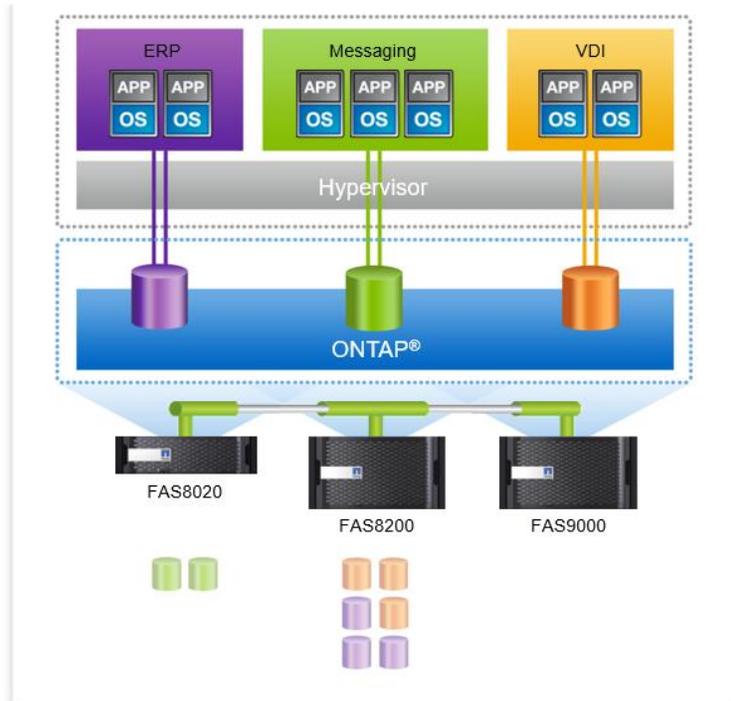

Figure 3: Nondisruptive operations – *West Virginia Department of Agriculture can move data to available nodes and retire existing hardware.*

> *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) and replication features to support backup and disaster recovery requirements. ONTAP provides IDP to safeguard West Virginia Department of Agriculture's operations and keep them running smoothly. Technologies include space-efficient Snapshot® technology, near-instant backup and recovery with SnapVault®, and synchronous and asynchronous replication with MetroCluster™ and SnapMirror®, which can meet your requirements for business continuity and disaster recovery.

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

West Virginia Department of Agriculture can 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.

West Virginia Department of Agriculture can easily and efficiently protect at-rest data with NetApp Storage Encryption (NSE)—that uses self-encrypting drives. Or encrypt any volume and any disk 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, West Virginia Department of Agriculture 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 storage costs and maximize effective capacity.

Maximized Shared Storage Investments

ONTAP gives West Virginia Department of Agriculture 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. QoS can now be used to set both maximum and minimum resource levels, which is especially important for business-critical workloads.

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. West Virginia Department of Agriculture can also 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.

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.
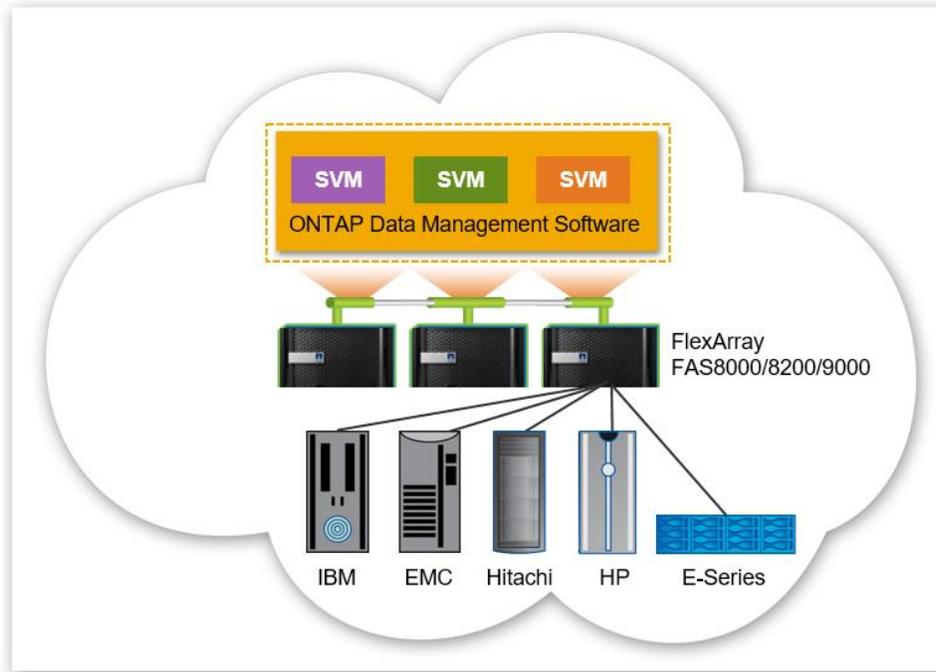

Figure 4:   Investment protection – *West Virginia Department of Agriculture can integrate your existing storage arrays into your private cloud with ONTAP and FlexArray.*

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 West Virginia Department of Agriculture 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 West Virginia Department of Agriculture's 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, known as NetApp DataMotion™ allows you to redistribute across a cluster at any time and for any reason. DataMotion is transparent and nondisruptive to NAS and SAN hosts, and it enables the storage infrastructure to continue to serve data throughout these changes.

DataMotion might be performed 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 2:   Hardware and software maintenance operations can be performed nondisruptively with ONTAP.

Operations	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 3:   Lifecycle operations can be performed nondisruptively with ONTAP.

Operations	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

Aggregate relocate (ARL) is a feature that was introduced in ONTAP 8.2. Because all cluster nodes in ONTAP are part of an HA pair (with the exception of single-node clusters), ARL makes it possible to temporarily transfer aggregate ownership from one controller in an HA pair to the other to facilitate the upgrade process without moving data.

By using ARL, you can accomplish controller upgrades in significantly less time than it would take to move data to other controllers, upgrade the existing controllers, and moving the data back.

On-Demand Scalability—Expand as you Build

The ONTAP architecture is key to delivering maximum on-demand scalability for West Virginia Department of Agriculture's shared IT infrastructure, offering performance, price, and capacity options.
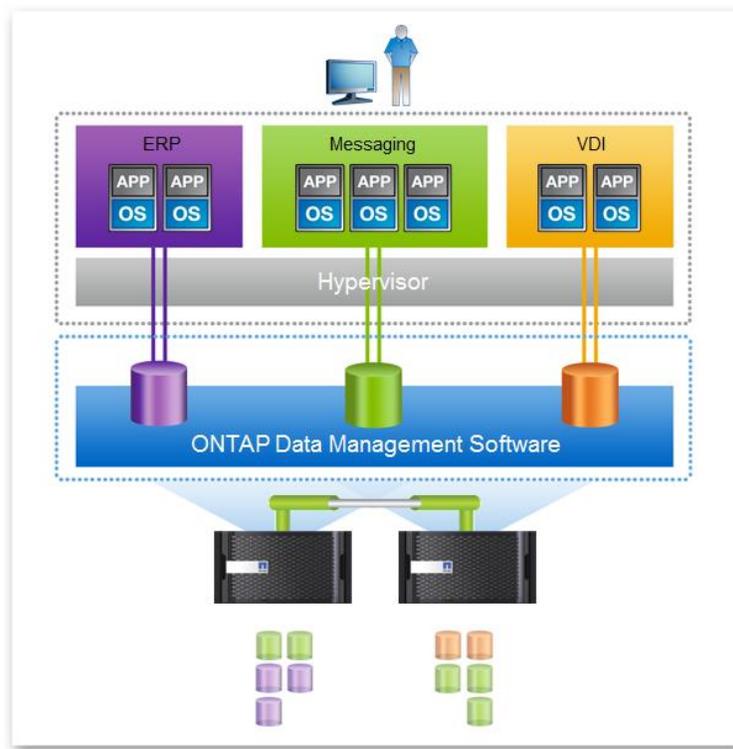

Figure 5:   Expand as you build – *Start with a two-node cluster and expand controllers and capacity when you need to, nondisruptively.*

ONTAP allows the inclusion of a variety of controller types in the same cluster, protecting West Virginia Department of Agriculture's hardware investments and giving the company the flexibility to adapt resources to meet the business demands of workloads. Support for different disk types, including SAS, SATA, and SSD, makes it possible to deploy integrated storage tiering for different data types, together with the transparent data motion capabilities of ONTAP.

The ability to scale both vertically and horizontally is another key benefit of ONTAP. High individual node capacities mean a cluster can scale to tens of petabytes. This scalability, combined with storage efficiency that works on all of the protocols, can meet the needs of West Virginia Department of Agriculture's most demanding workloads.

There are several approaches for leveraging flash 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 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 West Virginia Department of Agriculture's 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

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

SAN Data Services

With the supported SAN protocols (FC, FCoE, and iSCSI), 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, West Virginia Department of Agriculture can enjoy significant reductions in required disk capacity (varies by workload) when compared with traditional storage technologies.

Active IQ: Proactive care and predictive insights

Active IQ delivers customers a unique value-add not available from other competitors. It provides predictive analytics and proactive support for your hybrid cloud, leveraging NetApp's massive installed base.

With Active IQ you get:

- Improved storage efficiency information and system risk profile by leveraging community wisdom and advisories based on machine learning
- Predictive health summary and trends
- Upgrade recommendations
- One-click capacity and contract renewal requests
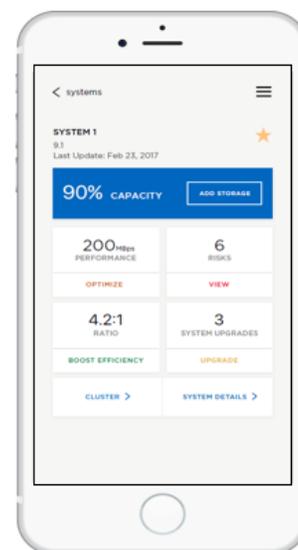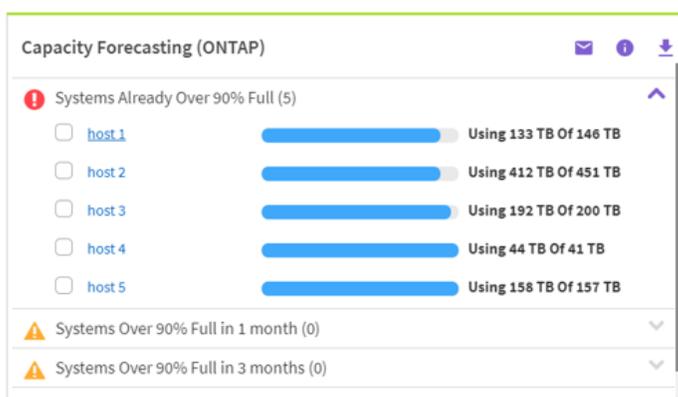- Inventory of NetApp systems

Figure 6:   Active IQ: Low touch Capacity Addition.

ONTAP 9 offers a robust set of standard and optional features.		
	Function	**Benefit**
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
FlexClone	Instantaneously creates file, LUN, and volume clones without requiring additional storage	Saves you time in testing and development and increases your storage capacity
FlexGroup	Enables a single namespace to scale up to 20PB and 400 billion files	Supports compute-intensive workloads and data repositories that require a massive NAS container while maintaining consistent high performance and resiliency
FlexVol®	Creates flexibly sized volumes across a large pool of disks and one or more RAID groups	Enables storage systems to be used at maximum efficiency and reduces hardware investment
MetroCluster	Combines array-based clustering with synchronous mirroring to deliver continuous availability and zero data loss; up to 300km distance be-tween 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 work-load 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

	Function	Benefit
ONTAP 9 offers a robust set of standard and optional features.		
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	Enables automatic, incremental asynchronous data replication between NetApp systems; preserves storage efficiency from primary (deduplication, compression, compaction) without rehydration	Provides flexibility and efficiency when replicating data to support backup, data distribution, and disaster recovery; recover from or fail over to any point in time
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
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