SOUTH DAKOTA MINES
Atmospheric &
Environmental Sciences

2021 Unidata Community Equipment Award Program

Proposal Title:

Reimagining SD Mine's Weather and Climate Program's Cyberinfrastructure

Date: 26 March 2021

Principal Investigator: **William J Capehart**
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Email Address: William.Capehart@sdsmt.edu

[redacted]

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Title: Vice President for Research, SD School of Mines

Telephone Number: +1 (605) 394-2493

Email Address: Sponsored.Programs@sdsmt.edu

[redacted]

B. Project Summary

In 2019, the Atmospheric Sciences degree at the South Dakota School of Mines and Technology (henceforth, SD Mines) transitioned from a specialization within the school's Interdisciplinary Sciences degree to a separate bachelor's degree managed entirely within the Atmospheric and Environmental Sciences. While both the old and new programs provided all of the coursework for the federal requirements to qualify as a meteorologist (i.e., the GS-1340 Requirements), the new program has more flexibility in the availability and timing of undergraduate coursework. Enrollment numbers in the new program show a higher growth rate than the previous program, which places increased strain on the Atmospheric Science's aging cyberinfrastructure and teaching facilities.

This equipment grant requests updates to convert the Atmospheric Sciences program's computer lab into a flexible teaching classroom for Weather and Climate coursework. This conversion is presently underway with a modern 4K-resolution class display, smart board, and movable chairs and desks to create a flexible learning space. This grant will complete the process by acquiring and configuring the last elements of cyberinfrastructure needed for the teaching space.

Specifically, this will include the following acquisitions and associated benefits.

- Scalable upgrades to CI combined with repurposing and redirecting existing CI to increase current student teaching and research computing capacity and better facilitate integration into current campus CI management plans.
- Integration of existing local data storage and delivery infrastructure into more efficient teaching and resource data services (THREDDS, LDM, and Jupyter Hub Services).
- A wireless testbed to explore alternative access to traditional LAN-lined weather analysis and research resources.
- Telecommunication additions to learning space to facilitate distance learning, and outreach.
- Leveraging existing campus resources and surplus to reduce non-computing costs to this grant and reduce campus waste.

The overarching goal is to create a dynamic high-use classroom environment with access to state-of-the-art technology and resources for student teaching and improve access to and exchange of UNIDATA and other weather and climate community resources.

C. Project Description

1. Background and Overview

South Dakota School of Mines and Technology's Atmospheric and Environmental Science (AES) Program has undergone significant changes over recent years. One of the most exciting changes is a Bachelor's degree entirely managed by the Atmospheric and Environmental Sciences program (previously managed under the school's Interdisciplinary Sciences Program). The program also added an accelerated master's Program to complement its existing master's and doctoral degrees. Applications and admissions to the program have increased with the added visibility of the program. SD Mines' Admissions predict growth in the undergraduate program in the coming years.

Table 1: *SD Mines enrollment statistics for the Interdisciplinary Studies -- Atmospheric Sciences specialization, before Academic Year (AY) 2019-20, and B.S. in Atmospheric and Environmental Sciences, AY 2019-20 and beyond). AY 2020-21 data is valid as of 17 March 2021.*

UNDERGRADUATE ACADEMIC PROGRAM	IS-ATM FALL 2018	IS-ATM FALL 2019	AES FALL 2020	AES FALL 2021
Applications by Major	5	12	24	22
Acceptances by Major	5	10	15	13

In contrast to our undergraduate program's growth, our cyberinfrastructure (CI) for teaching and student research is aging, with the last major updates to the existing student computer lab infrastructure occurring in 2015 with the purchase of six desktop workstations. Increasing enrollment coupled with limited growth in campus classroom space has made the current AES computer lab also serve as classroom space for our curriculum, with students sitting at computer consoles regardless of course format. Additionally, the lab space's original layout was static and congested with large 5x3-foot tables, underused central tablespace, a PC projector, and utility space along the back wall (Figure 1, Left Panel). The resulting environment became an unwelcoming space not conducive to teaching or research as technologies marched forward.

In early 2020, before COVID-19 restrictions, we began the process of designing a new classroom environment (This included a previously submitted Unidata Equipment Proposal). To date, changes to the lab space include the purchase of a 4K-display screen, and the addition of movable tables and smartboard provided through university salvage. While full implementation of these updates has been delayed due to classroom capacity restrictions owing to COVID-19 (the current configuration

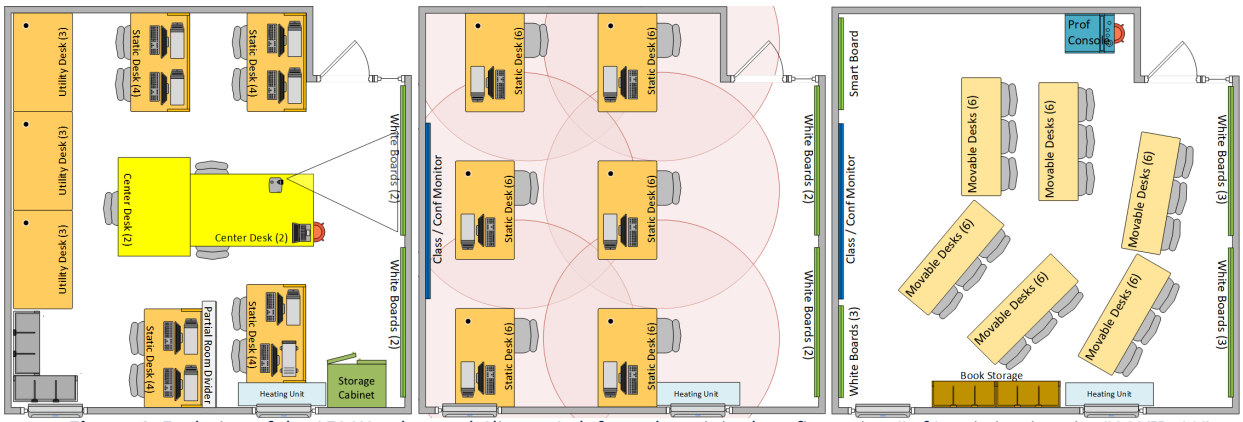


Figure 1: *Evolution of the AES Weather and Climate Lab from the original configuration (Left), existing interim "COVID-19" Configuration with 6-ft distancing radii (Center), and proposed "post-COVID-19" wireless configuration (Right).*

is also shown in Figure 1, Center Panel), we anticipate being able to fully leverage this updated space beginning in Fall 2021

Our final proposed configuration (Figure 1, Right Panel) represents the last phase, which leverages the university trend of moving from static computer labs to more powerful student laptops. SD Mines has had a strong student tablet laptop program since 2006. Laptops are provided to undergraduates on a lease-to-own basis with hardware support (including repair and replacement), access to university-restricted licensed software, and networking inside the university firewall. Graduate students who do not have their own computing options can join the program by renting a supported laptop.

As the program has evolved, the student laptop model has changed between vendor contracts and increasing software demands on the laptops' minimum hardware. In response, the most recent version of the SD Mines student laptop is more powerful than earlier models. Given this jump in machine-power, students will have machines that will eventually be more powerful than the current AES computer lab's workstations.

Additionally, from the perspective of Atmospheric Sciences education, science platforms are evolving from the workstation paradigm. IDV and Python resources that can be accessed on Windows laptops are gradually replacing GEMPAK. Local Unix computing can be satisfied with Virtual Machines and Docker Containers as those technologies have become increasingly used. High-Performance Computing (HPC) resources, while still needed for many atmospheric sciences applications, are now typically accessed remotely. These high-capital assets are located away from the students' access points elsewhere on- or off-campus. Finally, networking at SD Mines, both on- and off-campus, has also improved over recent years.

With these developments, the AES program has decided to make a significant change to how meteorology courses are taught at Mines leveraging the steadily improving laptop computing resources which are outpacing the traditional static workstation paradigm. We are also committed to transforming the environment in which we teach our courses by moving towards more active and collaborative learning approaches.

With these influences on pedagogical development, growth in the program, and changed usage of our computer lab, we have decided to use the lab space as the new hub for course delivery of AES and closely affiliated programs at SD Mines once COVID-19 restrictions are lifted.

While much of the physical space changes are nearly complete, we are proposing the following elements to complete the transformation of our space from an underused research space to a dynamic classroom around which to center our curriculum:

- Scalable upgrades to our cyberinfrastructure (CI) combined with repurposing and redirecting existing CI to increase current student teaching and research computing capacity, which will also be in-line with current campus CI management plans.
- Integration of existing local data storage and delivery infrastructure into more efficient teaching and resource data services (THREDDS, LDM, and Jupyter Hub Services).
- A wireless testbed to explore alternative access to traditional land-lined weather analysis and atmospheric sciences research resources.
- Improved telecommunication capacity within the classroom space.

2. Migration from Student Consoles to Student Laptops and HPC Redeployment

This proposal's technology centerpiece is the migration of students from hard-lined weather analysis platforms to their existing mobile platforms, the migration of project-based HPC, and repurposing our existing infrastructure. The current student laptops and their proposed replacements are shown in Table 2 (which also shows the existing configuration for the six deployed student workstations in our computer lab). The newer student laptops are expected to reach approximately half of the students on campus by the beginning of the Fall 2021 semester.

Table 2: *Specifications for current and future SD Mines student laptops and AES lab workstations.*

GENERATION	OUTGOING CURRENT LAPTOPS		INCOMING MODEL LAPTOPS	CURRENT AES LAB WORK STATIONS
Platform	Fujitsu Lifebook T726	Fujitsu Lifebook P728	Lenovo ThinkPad P1 Gen 3 Mobile Workstation	HP EliteDesk 800 G2 TMR
CPU	Intel Core i7-6600U	Intel Core i7-8650U	Intel Core i7-10750H	Intel Core i7-6700
Memory	8 GB	8 GB	16GB	16GB
HDD	256GB	256GB	256GB	512GB
Graphics	Intel H.D. Graphics 520 720p	Intel UHD 620 Graphics 1080p	NVIDIA Quadro P2000 4GB	NVIDIA GeForce GT 730

As part of this plan, we will remove *all* permanent workstations from the existing computer lab and into the university's Information Technology Services (ITS) facility. The facility already houses the existing AES RAID storage and its aging servers. These older servers (the same model as the current AES Lab Workstations) also host the current THREDDS and RAMADDA services. This will place all hard-wired computing in direct contact with data servers and the RAID storage, an improvement from machines being spread across offices and lab space in two buildings separated by network routers and switches. More importantly, they will be in a far better support environment than in their existing locations.

Students will be able to access the university THREDDS, RAMADDA, Jupyter Hub, and R-Shiny Services, as well as local LDM stored data remotely from their laptops. Analysis tools such as Anaconda Python, IDV, and CAVE will be used locally on student laptops with remote access to the HPC resources using SSH and X11 clients. More formal access to CAVE, VAPOR, and other UNIX resources that cannot be efficiently accessed remotely will use virtual UNIX machines on their laptops and Docker containers.

3. Specific Equipment Acquisitions.

To facilitate the above plan to reimagine the AES Weather and Climate lab and move toward a more a wireless student workspace we need to add the following hardware to our existing CI.

The physical Weather and Climate Lab space has all elements required for the proposed classroom except for the wireless routing and telecommunication systems. Desks, chairs, and storage for the new lab have been identified and secured from university storage and salvage. AES has already acquired a SmartBoard and a 4K Display Monitor. This leaves only the wireless router and teleconferencing hub for the classroom.

- High-Speed Internet Wireless Access Point: Because the Mineral Industry building has poor wireless penetration through thick brick walls, we are requesting a *high-speed 802.11ac/802.11ax wireless router access point* for the room.

- Teleconferencing System: Given increased attention on distance learning, remote conferences, and community outreach, we also want the room to have teleconferencing facilities to reach off-site students, collaborators, and the broader community. Therefore, we are also requesting a *PTZOptics HuddleCam-Speakerphone Combo*.

While away from the view of visitors, faculty, and students alike, the HPC redeployment is the unseen but essential component of this equipment grant. By moving computing capital resources out of the Weather and Climate Lab we increase usable space while creating an improved overall computing ecosystem of our resources. While we plan to fully leverage existing servers and workstations to the extent possible, there is no avoiding that much of this hardware is nearing the end of its useful lifespan. To this end, we propose purchasing four additional HPC servers, as detailed below. The capital equipment listed here will be integrated into the existing university and AES cyberinfrastructure in the ITS server rooms. ITS has identified rack locations, power, and networking for all AES HPC and UNIX workstations.

- Three HPC servers: We have budgeted funds in this grant to purchase *Three HP ProLiant DL 360 servers and requisite SAS drive hardware* to operate independently and as "nodes." The ***new servers will serve the student computational needs,*** taking over computationally intensive tasks currently handled by desktop Linux workstations***,*** and will be designed to be expanded in the future. The machines will be networked to operate as a micro-cluster with load software and queuing software to balance high-priority real-time operational needs in AES (e.g., real-time modeling and fire-weather support) and basic research and teaching needs.

4. Impact and Integration of Equipment Grant Assets into Existing Infrastructure

The assets acquired in this grant will free the existing and aging H.P. Elite workstations from intensive student access. We do not expect to immediately retire these resources or any other existing AES HPC resource through this grant. However, the older machines are underused in the current regime. These older assets will be transferred with the balance of our UNIX and HPC resources to ITS. There, their use will be optimized in service to the AES research and teaching enterprise. One possible expected use would be to dedicate specific individual units to serve as the THREDDS, Jupyter Hub, R-Shiny, and RAMADDA servers, thus freeing the existing RAID servers, which also shoulder these additional services.

These new assets would effectively more than double the computing capacity openly available to AES faculty and students.

SD Mines is working with other schools in South Dakota, and the Great Plains Network is exploring distributed computing between universities, including the acquisition of node servers at each institution. While AES is supportive and partnering with the school, a considerable amount of weather and climate research, teaching, and service include the need for real-time resources. For example, in-class exercises cannot use queueing systems apart from training on HPC resources. Likewise, AES research and support to South Dakota include real-time WRF, fire and severe weather, and regional forecast uncertainty research. All these resources need dedicated no-wait computing time that does not compete with research that can wait in a queue. Therefore, we expect to have some resources secured for exclusive real-time use in AES even as we plan to integrate our CI with our campus partners in HPC in Chemical and Biological Engineering, and Physics. Any changes to

our long-term cyberinfrastructure that would impact the assets acquired in this grant will only be made through close consultation and approval of UCAR-UCP-Unidata.

5. Education Plan, and Technical & Broader Impacts

This proposal does not just "upgrade" the teaching infrastructure of the AES program. We hope that the Weather and Climate Lab funded by this grant will ***transform*** the AES's overall teaching and research culture.

The classroom will not merely be a meteorology lab but a *hub* for the Atmospheric and Environmental Sciences Program. We plan to use the new space extensively, effectively using it as the primary class venue for Atmospheric and Environmental Sciences courses with enrollments of up to 18 students. This reduces the burden on class space during what is now a period of heavy renovation across campus. Classes in AES have already been scheduled with minimal overlap for the upcoming 2021-2022 Academic Year, ensuring extended resource use.

The classroom is also functional, pending attendance capacity, to host distance "green guest seminars," in-situ seminars, and other outreach events. This capacity is also important for pending proposals with the National Science Foundation and long-term AES program goals of supporting a service-learning program, GeoEPICS, modeled after the Purdue University EPICs community service-learning program, connecting S.D. Mine's geosciences programs with K-12 students and the South Dakota Discovery Center.

From a larger perspective, the creation of this environment allows us to leverage many of the developing resources and technologies developed by NCAR, UCAR programs, and the larger meteorology community more effectively. This includes,

- an increase in power for our cyberinfrastructure due to centralization and concentration of assets, in addition to the newly-acquired computing resources,
- remote and uninterrupted access to HPC resources elsewhere, rather than classroom desktop workstations, allows students to run WRF on a queuing system, reducing use congestion with other classes,
- enhanced capacity to serve our existing products (Real-Time WRF output and fire weather products) to the larger community, including the National Weather Service, UCAR, and other Unidata partners,
- the ability to show and share complex visualization of IDV, VAPOR, CAVE, and Python (e.g., wrfpy, metpy, and GeoCat),
- increased integration of scientific programming in Python via Jupyter notebooks via a Jupyter Hub service,
- training, testing and evaluation of virtualization, and docker containers such as CloudAWIPS and,
- improved and expanded access to SD Mines project datasets through better organization of our THREDDS, RAMADDA and R-Shiny servers' climate research holdings.

6. Support for Equipment and Networking

One of this plan's advantages is to move critical CI infrastructure from AES office, lab, and classroom space to the ITS server rooms. The current facility is far from an ideal environment for housing and maintaining sensitive HPC equipment. Also, while the AES faculty have specialized knowledge of meteorology-and climate-oriented software, they lack expertise in computer hardware and

networking. ITS has committed to housing and supporting AES systems in ITS, and as the campus CI strategic plan evolves, help coordinate the way forward for all units on campus who use HPC. This is discussed in the support letter in the backmatter of this proposal.

D. Budget

An itemized budget for this proposal is provided here. The formal university-approved budget forms, their formal budget justification notes, and quotes from State of South Dakota vendors are included in the back material of this proposal

WEATHER AND CLIMATE LAB				
PART NUMBER	**DESCRIPTION**	**No.**	**UNIT PRICE**	**TOTAL**
FAP-U433F-A	Fortinet FortiAP U433F wireless access point	1	$672.31	$665.00
HC-HUDDLEPAIR	PTZOptics HuddleCam-Speakerphone Combo	1	$607.47	$607.47
SUBTOTAL				**$1,272.47**

HIGH PERFORMANCE COMPUTING				
PART NUMBER	**DESCRIPTION**	**No.**	**UNIT PRICE**	**TOTAL**
P19771-B21	HPE DL360 Gen10 5220 2P 64G NC 8SFF Svr	3	$5,095.23	$15,285.69
J9F46A	HPE MSA 600GB 12G SAS 10K 2.5in ENT HDD	3	$341.14	$1023.42
SUBTOTAL				**$16,309.11**

TOTAL		
SUBTOTAL (WCL)	Weather and Climate Lab Upgrades	$1,279.78
SUBTOTAL (HPC)	High Performance Computing Upgrades	$16,309.11
OVERHEAD	Charged To Assets Under $5000 At 42%	$255.14
TOTAL		**$17,836.72**

E. Project Milestones and Timeline

Our intention is to have the Weather and Climate Lab up and running by the beginning of Fall Semester 2021. Therefore much of the work is expected to occur over Summer 2021.

TIME	PROJECT MILESTONES
May 2021	Wireless Access Point purchased HPC Servers purchased Begin migration of existing UNIX AES cyberinfrastructure to ITS
June 2021	Reorganization AES Cyberinfrastructure Environment to receive new servers. Deploying new Weather & Climate Lab movable desks (already in possession) Installing new HPC Blades in ITS
July 2021	Installation of Smart Board (already in possession) Configuration and integration of new HPC servers
01-17 August 2021	Porting THREDDS, RAMADDA and R-Shiny Services to HPC Server blades Creating and testing Jupyter Hub Services Testing new CI components Repurposing/Retirement of older CI
17-22 Aug 2021	Students return to SD Mines for Fall 2021 semester Ribbon cutting and inaugural “map” discussion of Weather & Climate Lab
23 August 2021	Classes begin for Fall semester-- First official use of lab
October 2021	Mid-semester assessment of lab UCAR Members Meeting – Coordinate with Unidata
November 2021	Initial assessment of effectiveness of cyberinfrastructure upgrades
December 2021	End of Fall 2021 semester Assessment of teaching in the lab for semeter
January 2022	Classes begin for Spring 2022 semester
March 2022	Mid-semester assessment of lab
April 2022	Begin Final Reporting
May 2022	End of first full academic year of the Weather & Climate Lab. Assessment of lab and cyberinfrastructure upgrades Final Reporting to Unidata Assess future investment and plans for the future acquisitions

SOUTH DAKOTA MINES
An engineering, science and technology university

South Dakota School of Mines and Technology
Information Technology Services
(605) 394-1234

3/23/2021

Dear Dr. William Capehart,

If your proposal for the Unidata Equipment Grant is selected for funding by UCAR-UCP-Unidata, it is my intent to collaborate and/or commit ITS resources in helping to move the hardware into the data center and support the configuration of the hardware as is needed. We currently have the cooling capacity, power, and rack space to house the necessary equipment for this grant. The network infrastructure is in place and ready to be deployed.

Sincerely,



Bryan Schumacher
Director of Information Technology Services / CIO
South Dakota School of Mines and Technology
Bryan.Schumacher@sdsmt.edu
(605) 394-5102

SOUTH DAKOTA MINES
Information Technology Services

South Dakota School of Mines and Technology
Campus Cyberinfrastructure Plan

SDSMT's Office of Information Technology Services (ITS) builds and supports cyberinfrastructure for the advancement of science and education in South Dakota. The organization has sole responsibility for providing all academic, administrative, and research computing support for the University's Rapid City campus. Cyberinfrastructure (CI) is an essential enabler in 1) expanding interdisciplinary research, 2) increasing national-level recognition in identified niche areas, and 3) enhancing opportunities for research, learning and exploration for both students and faculty.

SDSMT is a member of the Great Plains Network (GPN), a regional service provider, and participates in the GPN CI and GPN Security committees. This CI Plan reflects SDSMT cyberinfrastructure development in campus, regional, and national contexts.

CI Guiding Principal

Have secure computing and networking resources in place and tested before the need is generally recognized. The strategic goals of the campus CI plan are to provide a high-speed campus network and computing resources to enable interdisciplinary collaboration, support the development of new areas of investigation, and facilitate the growth of existing research centers.

Data Center

SDSMT's Rapid City campus data center is a 900 square foot raised floor facility with redundant Uninterruptable Power Supply (UPS) augmented by a dual fuel generator. Current capacity includes 16T of available cooling, 40KVA of redundant UPS capacity, 125kwh generator and a dedicated fire suppression system that is inspected twice a year by a contracted third party.

LAN

SDSMT's campus LAN provides a 100Gb/s fiber backbone that currently connects all research facilities and most buildings on campus. There are 3,900 network ports and 400 wireless access points installed. Wireless access is available in all classrooms, residence halls, and public areas, with most clients connecting at 802.11n speeds. Network Measurement is accomplished through a variety of measurement and monitoring technologies, including Palo Alto, LibreNMS, and PerfSONAR. Network vulnerability scans are performed regularly, and intrusion detection/prevention is provided by an enterprise edge IDS system and will be paired with systems for log and flow correlation and security event management.

PerfSONAR

SDSMT has operated a PerfSONAR node since 2011. The current deployment covers the Rapid City campus.

BCP 38 Adoption

SDSMT implements several best practices outlined in "BCP 38" to prevent network attacks employing IP spoofing. The perimeter and internal equipment filters private addresses, defined in "RFC 1918," on the WAN and internal links at the network using access control lists (ACLs). The

access control lists to prevent spoofing are installed as close as possible to the equipment originating traffic on our network.

IPv6

SDSMT's current public Ipv6 address range is 2607:f558:1000::/40. Infrastructure to support IPv6 has been in place since 2011. SDSMT has fully integrated IPv6 capability throughout the campus network, ensuring all supporting technology is IPv6 capable.

WAN

The South Dakota Research, Education, and Economic Development (SD REED) Network was built in 2008, providing 10Gb/s connectivity to the state's six public higher education institutions, including SDSMT, SDSU, NSU, BHSU, and the SD University Center campus. The SD Bureau of Information Technology (SD BIT) operates SD REED and is currently deploying (Spring 2012) 100G capable service provider equipment, paving the way for a 100G refresh to SD REED. In 2017 SDSMT's campus edge was replaced with a 100G-capable Arista 7280SR in preparation for this statewide 100G upgrade. An NSF CC* grant has provided funding to upgrade campus cyberinfrastructure. The goal is to have at least 40G connectivity to all buildings on campus and 100G connectivity to the science and research building on campus.

Security

By far the biggest challenge is the threat of compromise via phishing and use of personal devices for access to the University network. Devices which can be used for both personal use, (IE Facebook or Netflix), and University business, including research and academics, present a threat to the University's protected data. To that end, these steps are essential to protecting the University's most sensitive data:

1. Sensitive Data discovery and classification
2. Network segmentation based on business need to know
3. Monitoring of network segments to prevent sensitive data loss

Progress: The first step was to distribute a risk assessment survey to the University, which was completed in October 2015. There is now an ongoing analysis at the statewide level of the risk assessment surveys conducted by all South Dakota Board of Regents SDBOR institutions.

Urgent Issues: Adoption of a new Data Classification policy by the Executive Committee is essential to demonstrate executive understanding and "buy-in" of the need to follow procedures which adhere to policy. Completion of the risk assessment is necessary to understand the location of sensitive data on the network. Implementation of proper network segmentation is crucial to protect the sensitive data identified in the risk assessment.

Microsoft Office365 and Google workplace handle most of the SPAM and phishing messages. These systems have augmented the campus IT security and give SDSMT a more robust system.

Cybersecurity Awareness training began 2015, with mandatory annual employee training beginning 2018. Cybersecurity Awareness training enables the campus community (faculty, staff, students and researchers) to assist in providing additional layers of security.

High Performance Computing (HPC)

SDSMT has provided HPC resources since 2006. The campus computer center houses several key research High Performance Computing (HPC) systems for Computational Mechanics, Atmospheric and Environmental Sciences, Physics, Chemical and Biological Engineering. There are several very high-performance workstations used in departmental research throughout the campus. There are more than 300 TB of managed storage available for student, faculty and research use.

The current CI does allow the university researchers to participate in collaborative large data and data intensive research with such groups as Sanford Underground Laboratory, Department of Defense (DOD), National Center for Atmospheric Research (NCAR) and University Center for Atmospheric Research (UCAR), NASA Jet Propulsion Laboratory among others.

Near term HPC goals at SDSMT include increased user engagement, including the introduction of biannual awareness and literacy seminars, new user training, and Software and Data Carpentry workshops.

CI Goals (FY2019-FY2023)

A. Implement a Data Classification policy
B. Identify locations containing sensitive data on campus today
C. Implement procedures for handling sensitive data from the Banner and Colleague systems
D. Restructure the network infrastructure to facilitate segmentation of networks containing sensitive data
E. Implement Data Loss Prevention (DLP) system(s) and strategies
F. Move campus backbone to 100Gb/s
G. Upgrade HPC to a large joint/collaborative use system
H. Provide researchers with HPC support including system and subject matter expertise
I. Encourage research and collaboration by providing secure access to data and HPC resources
J. Work to increase the connection to and through REED to 100Gb/s
K. Work to get high speed network gateway from the western edge of South Dakota to Front Range Gigapop

L. Create a Research Computing Advisory Committee to advise ITS leadership on issues related to academic research and cyberinfrastructure initiatives. Understanding the need for effective prioritization and stewardship of scarce research computing resources, the committee:
    1) advises best strategies for supporting research activities by contributing to policies, procedures, and standards
    2) provides a channel for voicing faculty concerns and suggestions
    3) provides a forum for communicating new initiatives and investigating new research technology.
M. Enhance managed data storage to 1.5 Petabytes (PB) with remote site backup
N. Improve classroom recording and capture equipment as well as improving the video storage and delivery systems

SDSM&T PROPOSAL BUDGET

Reimagining SD Mine's Weather and Climate Program and Cyberinfrastructure

Year One: May 1, 2021 - April 30, 2022

			A. Grant Expenses				
		Annualized Base Salary	Acad	% Effort	Sum	% Effort	Requested Salary/Fringe
A.	**SENIOR PERSONNEL**						
	PI ~ Capehart, William	$131,973					$0
	Fringe @ 27.27%						$0
	Co-PI ~ Clabo, Darren	$87,602					$0
	Fringe @ 27.27%						$0
	Co-PI ~ French, Adam	$119,893					$0
	Fringe @ 27.27%						$0
	TOTAL SENIOR PERSONNEL						**$0**
	TOTAL OTHER PERSONNEL						**$0**
C.	**EQUIPMENT**						
	Fortinet FortiAP U433F - wireless access point						$665
	HPE DL360 Gen10 5220 2P 64G NC 8SFF Svr						$15,286
	HPE MSA 600GB 12G SAS 10K 2.5in ENT HDD						$1,024
	TOTAL EQUIPMENT						**$16,975**
	TOTAL TRAVEL						**$0**
	TOTAL PARTICIPANT/TRAINEE SUPPORT COSTS						**$0**
F.	**OTHER DIRECT COSTS**						
	1. Materials & Supplies						
	PTZOptics HuddleCam-Speakerphone Combo						$607
	Subtotal Materials & Supplies						**$607**
	TOTAL OTHER DIRECT COSTS						**$607**
G.	**TOTAL ALL DIRECT COSTS (A. ~ F.)**						**$17,582**
H.	**INDIRECT COSTS**						
	SDSM&T Facility & Administration Cost Base Calculations						
	Total Direct Costs						$17,582
	Less Exclusions*						($16,975)
	Net SDSM&T Indirect Cost Base						$607
	SDSM&T Indirect @ 42.0%						$255
	SDSM&T Unrecovered Indirect @ 0.0%						$0
	SDSM&T Indirect Recovered @ 42.0%						$255
	TOTAL ALL INDIRECT COSTS						**$255**
I.	**TOTAL DIRECT + INDIRECT (G. + H.)**						**$17,837**
	* Subcontract amounts above the $25,000 allowable base; Tuition Remission						
J.	**SPECIFIED INDIRECT COST**						**$0**
K.	**TOTAL REQUEST**						**$17,837**

SOUTH DAKOTA MINES
Research Affairs
Office of Sponsored Programs

Budget Justification

Reimagining SD Mine's Weather and Climate Program's Cyberinfrastructure

A. PERSONNEL: No funds are allocated for Senior Personnel. Dr. William Capehart, PI of the SD Mines project is an Associate Professor in Civil and Environmental Engineering (CEE) and Director of the Atmospheric and Environmental Sciences Program. Dr. Capehart will supervise the transition of the existing AES computer lab into the redesigned AES Weather and Climate Lab and upgrades to AES cyberinfrastructure.

B. EQUIPMENT: Funds of $16,975 are allocated for two primary components of this proposal. Funds of $665 are allocated for upgrades to the Weather and Climate Lab. Funds of $16,310 are allocated for upgrades to high-performance computing.

C. OTHER DIRECT COSTS:
1. Materials & Supplies: Funds of $607 for PTZOptics HuddeCam-Speakerphone Combo.

D. INDIRECT COSTS (F&A): The latest indirect cost rate approved by the cognizant government audit agency for the SD Mines is 42.0% of the modified total direct costs. Per our federal agreement, no indirect costs are charged on Capitol Equipment Purchases.

The requested HPC Servers, their Hard Disk Drives (which are not included in the Server Units), and the teaching lab's Wireless Router to connect student and faculty mobile laptops to the new HPC servers are considered a single integrated system. Total indirect costs are $255.

The cognizant government audit agency for the institution is:

Director, Division of Cost Allocation
DCA Western Field Office
Department of Health and Human Services
90 7th Street, Suite 4-600
San Francisco, CA 94103-6705

HHS Representative: Jeanette Lu,
Telephone Number (415) 437-7820



NO IMAGE AVAILABLE

PTZOptics HuddleCamHD HuddlePair USB 2.0 Webcam & Speakerphone Combo

Mfg.Part: HC-HUDDLEPAIR | CDW Part: 5645822 | UNSPSC: 45111902

Availability: • In Stock
Ships same day if ordered before 2 PM CT
Order fulfilled by a CDW partner.

$607.47 Advertised Price

Lease Option ($17.92/month)

Product Details

- Resolution: 1920x1080
- USB Powered(USB 2.0)
- 106deg. Field of View
- Omnidirectional Microphone
- USB Power Adapter
- Video CMOS Sensor: 1/3" CMOS
- Material: Aluminum,Plastic

Product Details

Main Features

- Resolution: 1920x1080
- USB Powered(USB 2.0)
- 106deg. Field of View
- Omnidirectional Microphone
- USB Power Adapter
- Video CMOS Sensor: 1/3" CMOS
- Material: Aluminum,Plastic
- Color: Black

The PTZOptics HuddleCamHD HuddlePair Webcam and Speakerphone Combo combines wireless USB speakerphone technology and a wide-angle webcam to create a simple, affordable, wireless, video collaboration solution. This webcam and speakerphone combination is ideal for video conferencing and recording with any software application. The webcam features a wide 106-degree field of view capable of capturing multiple meeting room participants even in close proximity to the camera, and the wireless speakerphone features an omnidirectional microphone designed to provide a 360 degree pick up range for your meeting spaces. Using a single USB 2.0 cable, your meeting rooms can be set up in a matter of minutes with a wireless speakerphone that can be placed on your meeting room table and camera that can easily mount to any LCD.

Tech Specs

Specifications are provided by the manufacturer.

Header	
Manufacturer :	PTZOptics
Brand :	HuddleCamHD
Product Line :	HuddleCamHD
Model :	HuddlePair
Packaged Quantity :	1

System	
Conferencing System Type :	Video conferencing kit

Kit Content :	Speakerphone, Camera

Video Input

Type :	Digital video camera
Form Factor :	External
Camera Mechanical Design :	Fixed
Color Support :	Color
Optical Zoom :	3
Digital Video Capture Resolution :	1280 x720, 1920 x 1080, 1280 x 720
Video Modes :	1080/25p, 1080/30p
Interface Type :	USB 2.0
Features :	WebEx compatible, Manual 300° pan / 60° tilt, Skype compatible, 106° field of view, Echo reduction, Zoom compatible, Microsoft Lync compatible, Intelligent Noise Reduction system, Google Hangouts compatible

Audio Output

Type :	Speaker(s)

Audio Input

Type :	Microphone
Microphone Operation Mode :	Omni-directional
Form Factor :	External

Interface Provided

Interfaces :	USB 2.0, Headphones - mini-phone 3.5 mm

Cable Details

Cables Included :	1 x USB charge cable

Power Device

Type :	Power adapter
Form Factor :	External

Miscellaneous

Compliant Standards :	Plug and Play

Dimensions & Weight Details

Dimensions & Weight Details :	Speakerphone - Width 7 in Depth 7 in Height 1.5 in Weight 12.7 oz, Camera - Width 4.1 in Depth 5.5 in Height 4.9 in Weight 17.6 oz

Service & Support

Type :	3-year warranty

Service & Support Details

Service & Support :	Limited warranty – 3 years

Quotation/Offer

DRH2004424-2 (v2) - SDSMT

Date: 3/25/21

Expiration Date 4/24/21

Prepared For:	**Project Name:**	**Remit To:**
South Dakota School of Mines & Technology 501 East Saint Joseph Street Rapid City, SD 57701 Jason Erickson (605) 394-6800 jason.erickson@sdsmt.edu	Fortinet U433F Model **Project Description:**	Aercor Inc. 14033 Commerce Ave NE #300-361 Prior Lake, MN 55372 www.aercor.com

Hardware	$665.00
Total:	**$665.00**

Derrick R. Hoffmann
Regional VP of Sales - Central US
Phone: 651-289-4211
Email: drhoffmann@aercor.com

Proposal Comments:

***** Please reference the quote number on your purchase order. Thank you. *****
******Credit Card payments will be subject to a convenience fee where applicable and must be paid at time of order******

Customer Name: South Dakota School of Mines & Technology
Quote/Offer ID: DRH2004424-2 (v2) - SDSMT
Date: 3/25/21

Line	Product Number	Description	Qty	Customer Unit Sale Price	Customer Extended Sale Price
		Hardware			
1	FAP-U433F-A	Indoor Wireless Universal AP - Tri radio (2x 802.11 a/b/g/n/ac/ax, 4x4 MIMO and 1x 802.11 a/b/g/n/ac Wave 2, 2x2 MU-MIMO), external antennas included, 1x 10/100/1000/2500 Base-T RJ45, 1x 10/100/1000 Base-T RJ45, BT/BLE, 1x Type A USB, 1x RS-232 RJ45 Serial Port. Ceiling/wall mount kit included.For power order: 802.3at PoE injector GPI-130 or AC adapter SP-FAP400-PA. Region Code A	1	$665.00	$665.00
		Hardware Total:			**$665.00**
				Customer Total:	**$665.00**

Note: The information in this Proposal is considered PROPRIETARY and CONFIDENTIAL to Aercor.
By review of this information, you agree to maintain its confidentiality and use it for internal business purposes only.
Any variation in quantity, description or delivery may result in price changes.
Prices are valid for 30 days from date of this Proposal unless otherwise stated.
Delivery dates can, and do, change frequently and at very short notice. The estimated delivery date on this Proposal is only valid from the date of acceptance via signature. Once we receive this signed Proposal, we will confirm a new estimated delivery date. Shipping and taxes are added at the time of invoice. Shipping charges are subject to additional handling fees for specifying carriers and/or expedited shipments.
This Proposal is subject to (a) the Terms and Conditions attached hereto and (b) credit and finance approval.
Opened boxes are not eligible for return.

Proposal Comments:

Exhibit A

PRODUCT PURCHASE AGREEMENT

TERMS AND CONDITIONS

1. **Product**

Aercor Wireless Inc (Aercor) will provide to the other party hereunder ("Client"), the product or products specified in the sales proposal (the "Document") to which these Terms and Conditions are attached and made a part of (individually and collectively, the "Product"), by sale, license or sublicense, as provided under and upon the terms and conditions of this Agreement. These Terms and Conditions, along with the Document and all appendices thereto, are collectively the "Agreement".

2. **Invoicing and Payment**

The purchase price for the Product will be due and payable as indicated in the attached Document. If Client's account is past due and Aercor has notified Client verbally or in writing of the past due balance, it may, without advance notice, immediately cease any and all Product sales hereunder, or revoke any and all Product licenses hereunder, without any liability for breach of this Agreement. If Client's account, after default, is referred to an attorney or collection agency for collection, Client will pay all of Aercor's expenses incurred in such collection efforts including, without limitation, court costs and reasonable attorney's fees.

3. **Taxes**

The customer agrees that they are responsible for payment of any sales or use tax arising from its purchase of product under this agreement.

4. **Limitations on Warranty**

Aercor MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT. Aercor EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE. Client should refer to the Product license, documentation and other information provided by the manufacturer of the Product for warranty and any other information regarding any Product.

5. **Limitation of Liability**

Client's exclusive remedy, and Aercor's sole liablility to client, for any cause whatsoever will be limited to any purchase price or license fees, as applicable paid to Aercor by client under this agreement. The foregoing limitation will apply regardless of the form of action, whether contract or tort, including without limitation, negligence. In no event will Aercor be liable for any loss of profit, revenue, data, use, or other commercial injury, or any special, incidental, indirect or conseqential damages, suffered by client or any third party, whether or not Aercor has been advised of the possibility of such loss, injury, damages or third party claim, under any cause of action arising out of or relating to this agreement.

6. **Enforceability**

If any provision, or any part of any provision, of this Agreement will be held void, voidable, invalid, or inoperative, no other provision of this Agreement will be affected as a result thereof and accordingly, the remaining provisions of this Agreement will remain in full force and effect as though such void, voidable, invalid or inoperative provision or part thereof had not been contained herein.

7. **Relationship**

This Agreement does not create an agency, employment, partnership joint venture, trust or other fiduciary relationship between the parties. Neither party shall have the right to bind the other to any third person or otherwise to act in a way as a representative or agent of the other.

8. **Entire Agreement**

This Agreement sets forth the entire agreement between the parties with respect to the subject matter herein, superseding all prior agreements, negotiations or understandings, whether oral or written, with respect to such subject matter. To the extent that any of the terms and conditions of the Document or any appendices thereof conflict with these Terms and Conditions, these Terms and Conditions will control. This Agreement may not be changed, modified or waived in whole or part except by an instrument in writing signed by both parties. Unless otherwise defined in the Document, all defined terms will have the definitions set forth in these Terms and Conditions.

Aercor Authorized Signatory	**Customer Authorized Signatory**
By:_____	By:_____
Name:_____	Name:_____
Title:_____	Title:_____
Date:_____	Date:_____

Quote Ref:
DRH2004424-2 (v2) - SDSMT



Hewlett Packard Enterprise

HPE ProLiant DL360 Gen10 – rack-mountable – Xeon Gold 5220 2.2 GHz – 64 GB

Mfg.Part: P19771-B21 | CDW Part: 6424478

Availability: • 2–4 Days
Orders placed today will ship within 2–4 days

Warranties

None

Include: HPE Foundation Care 24x7 Service – extended service agreement – 3 years – o – **$1,673.80**

View All Warranties View Accessories

~~$11,287.00~~ **SAVE $6191.77**

$5,095.23 Advertised Price

Lease Option ($143.13/month)

Product Details

- Server
- rack-mountable
- 1U
- 2-way
- 2 x Xeon Gold 5220 / 2.2 GHz
- RAM 64 GB
- SAS

Product Details

Main Features

- Server
- rack-mountable
- 1U
- 2-way
- 2 x Xeon Gold 5220 / 2.2 GHz
- RAM 64 GB
- SAS
- hot-swap 2.5" bay(s)
- no HDD
- GigE
- 10 GigE
- 25 Gigabit LAN
- no OS
- monitor: none

Does your data center need a secure, performance driven dense server that you can confidently deploy for virtualization, database, or high-performance computing? The HPE ProLiant DL360 Gen10 server delivers security, agility and flexibility without compromise.

Tech Specs

Specifications are provided by the manufacturer.

Header

Manufacturer :	HPE Smart Buy Express
Brand :	HPE
Product Line :	HPE ProLiant
Model :	DL360 Gen10
Packaged Quantity :	1

System

Type :	Server
Hard Drive Capacity :	0 GB
OS Certified :	SuSE Linux Enterprise Server 11 SP4, VMware vSphere 6.0 (ESXi), CentOS, Red Hat Enterprise Linux 6.9, Microsoft Windows Server 2012 R2, ClearOS, SuSE Linux Enterprise Server 12 SP2, Microsoft Windows Server 2016, Red Hat Enterprise Linux 7.3, VMware vSphere 6.5 (ESXi)

Chassis

Form Factor :	Rack-mountable
Manufacturer Form Factor :	Rack-mountable
Server Storage Bays :	Hot-swap
Server Swappable Drive Form Factor :	2.5"
Server Swappable Drive Form Factor (metric) :	6.4 cm
Server Swappable Drive Interface :	SAS
Hot-Swap Bays Qty :	8

Processor

Type :	Xeon Gold
Number of Cores :	18-core
Processor Number :	5220
Installed Qty :	2
Max Supported Qty :	2
Server Scalability :	2-way
Upgradability :	Upgradable
Manufacturer :	Intel
Clock Speed :	2.2 GHZ
Max Turbo Speed :	3.9 GHZ
Processor Main Features :	Hyper-Threading Technology, Intel Turbo Boost Technology 2

Mainboard

Processor Socket :	FCLGA3647 Socket
Chipset Type :	Intel C621

Cache Memory

Type :	L3 cache
Installed Size :	49.5 megabyte

RAM

Form Factor :	DIMM 288-pin
Technology :	DDR4 SDRAM
Installed Size :	64 GB
Max Supported Size :	1.5 TB
Configuration Features :	2 x 32 GB
Data Integrity Check :	Advanced ECC
Slots Qty :	24
Empty Slots :	22
Memory Speed :	2666 megahertz
Rated Memory Speed :	2933 megahertz
Features :	HPE SmartMemory, Registered

RAM Supported

RAM Supported :	3 TB Load-Reduced - ECC, 1.5 TB registered - ECC, 192 GB Non-Volatile - ECC

Storage Controller

Type :	RAID
Interface Type :	Serial ATA-600 / SAS 3.0
Storage Controller Name :	HPE Smart Array P408i-a
Channel Qty :	8
Buffer Size :	2 GB
RAID Level :	RAID 50, RAID 6, RAID 0, RAID 1, RAID 10 ADM, RAID 10, RAID 1 ADM, RAID 5, RAID 60

Storage Controller (2nd)

Type :	None

Hard Drive

Type :	No HDD

Hard Drive (2nd)

Type :	None

Hard Drive (3rd)

Type :	None

Hard Drive (4th)

Type :	None

Optical Storage

Drive Type :	No optical drive
Type :	None

Optical Storage (2nd)

Drive Type :	No optical drive
Type :	None

Card Reader

Type :	Card reader
Supported Flash Memory Cards :	microSD

Storage Removable

Type :	None

Display

Type :	None.

Video Output

Video Interfaces :	VGA

Video Memory

Installed Size :	16 megabyte

Printer

Type :	None

Networking

Ethernet Controller(s) :	HPE 640FLR
Remote Management Controller :	Integrated Lights-Out 5
Data Link Protocol :	10 Gigabit Ethernet, Gigabit Ethernet, 25 Gigabit Ethernet
Ethernet Ports :	2 x 10/25 Gigabit Ethernet SFP28
Remote Management Protocol :	IPMI 2.0, SMASH CLP, SNMP 3
Features :	Wake on LAN (WoL), PXE support

Expansion Bays

Bays :	8 (total) / 8 (free) x hot-swap 2.5" SFF, 1 (total) / 1 (free) x external Universal Media Bay

Expansion Slots

Slots :	1 (total) / 1 (free) x PCIe 3.0 x16 - three-quarter-length, full-height, 1 (total) / 1 (free) x PCIe x16 - full-height, 1 (total) / 1 (free) x microSD Card (internal), 1 (total) / 1 (free) x PCIe 3.0 x8 - low-profile, 1 (total) / 1 (free) x FlexibleLOM - three-quarter-length, full-height (low-profile)

Interface Provided

Interfaces :	1 x HPE iLO - Type A (1 in front), 1 x HPE iLO - RJ-45 (1 rear), 2 x LAN (10/25 Gigabit Ethernet) (SFP28), 5 x USB 3.0 (1 front, 2 rear, 2 internal), 1 x VGA (1 rear)

OS Provided

Type :	No operating system

Software

Type :	HPE Server UEFI

Power Device

Type :	Power supply - hot-plug
Power Redundancy :	Optional
Power Redundancy Scheme :	1+1 (with optional power supply)
Installed Qty :	2
Max Supported Qty :	2
Power Provided :	800 watt
Nominal Voltage :	AC 120/230 V
Frequency Required :	50/60 hertz
80 PLUS Certification :	80 PLUS Platinum

Miscellaneous

Color Category :	Silver, Black
Included Accessories :	7 x standard hot plug fans
Height (Rack Units) :	1
Compliant Standards :	PCI DSS, FIPS 140-2, AES, IPv6 Ready, WEEE 2002/95/EC, ASHRAE Class A3, ACPI 6.1, ASHRAE Class A4, TLS v1.2

Environmental Standards

ENERGY STAR Certified :	Yes
ENERGY STAR Version :	2.1

Dimensions & Weight

Width :	17.1 inch
Depth :	27.8 inch
Height :	1.7 inch
Weight :	28.75 lbs

Service & Support

Type :	3-year warranty
On-Site Warranty :	On-site

Service & Support Details

Service & Support :	Limited warranty - parts and labor - 3 years - on-site

Environmental Parameters

Min Operating Temperature :	50 degree Fahrenheit
Max Operating Temperature :	95 degree Fahrenheit
Humidity Range Operating :	8 – 90% (non-condensing)
Sound Emission :	38.1 dBA



Hewlett Packard Enterprise

HPE Dual Port Enterprise – hard drive – 600 GB – SAS 12Gb/s

Mfg.Part: J9F46A | CDW Part: 3760864 | UNSPSC: 43201803

Availability: • In Stock
Get it **Monday, March 29** to 57701 by a CDW partner

View Accessories

~~$600.00~~ SAVE $258.86

$341.14 Advertised Price

Product Details

- Hard drive
- 600 GB
- 2.5" SFF
- SAS 12Gb/s
- 10000 rpm
- for Modular Smart Array 1040
- 2040

Product Details

Main Features

- Hard drive
- 600 GB
- 2.5" SFF
- SAS 12Gb/s
- 10000 rpm
- for Modular Smart Array 1040
- 2040
- 2040 10Gb
- 2042

HP Serial Attached SCSI (SAS) Dual Port Enterprise hard drives deliver high performance solutions for hosting high transaction based applications. The SAS interface was designed and engineered for high availability, enterprise-class data storage where performance, reliability and data integrity are crucial.

Tech Specs

Specifications are provided by the manufacturer.

Header	
Manufacturer :	HPE Smart Buy Express
Brand :	HPE
Product Line :	HPE Dual Port
Model :	Enterprise
Packaged Quantity :	1

Storage	
Type :	Hard drive

Hard Drive

Form Factor :	2.5" SFF
Form Factor (metric) :	6.4 cm SFF
Form Factor (Short) :	2.5"
Form Factor (Short) (metric) :	6.4 cm
Storage Interface :	Serial Attached SCSI 3
Interface :	Serial Attached SCSI 3
Capacity :	600 GB
Data Transfer Rate :	1.2 GBps
Spindle Speed :	10000 revolutions per minute
Features :	Dual Port

Interface Provided

Interfaces :	1 x SAS 12 Gb/s

Bay Required

Compatible Bay :	2.5" SFF

Service & Support

Type :	3-year warranty

Service & Support Details

Service & Support :	Limited warranty - 3 years

Compatibility

Compatible With :	HPE Modular Smart Array 1040 Dual Controller SFF Bundle, 1040 Dual Controller SFF Storage, 2040 10Gb iSCSI Dual Controller SFF Bundle, 2040 Dual Controller SFF Bundle, 2040 FC Dual Controller SFF Bundle, 2040 SAN Dual Controller SFF Bundle, 2040 SAN Dual Controller SFF Storage, 2040 SAN w/o SFP SFF Bundle, 2040 SAS Dual Controller SFF Bundle, 2040 SAS Dual Controller SFF Storage, 2040 SFF Chassis, 2040 SFF DC-power Chassis, 2042 SAN Dual Controller SFF Storage, 2042 SAN Dual Controller with Mainstream Endurance Solid State Drives SFF Storage, 2042 SAS Dual Controller SFF Storage, 2042 SAS Dual Controller with Mainstream Endurance Solid State Drives SFF Storage

Compare Similar Items

CURRENT ITEM			

	This Item: HPE Dual Port Enterprise – hard drive – 600 GB – SAS 12Gb/s	Tripp Lite DisplayPort 1.2 to VGA DVI HDMI Converter Adapter 4K x 2K @ 60Hz	Tripp Lite 3000VA 2250W UPS Smart Rackmount AVR 120V USB DB9 SNMP 2URM
			
Availability	• In Stock	• In Stock	• In Stock
	$600.00 SAVE $258.86	$88.28 SAVE $50.38	$1,810.80 SAVE $716.55
	$341.14	$37.90	$1,094.25
Customer Ratings	Not Yet Rated	(2)	(15)
	Advertised Price	Advertised Price	Advertised Price
Device Type	Hard drive	–	–
Form Factor	2.5"	–	–
Interface	Serial Attached SCSI 3	–	–
Hard Drive Capacity	600	–	–
Installation Type	–	–	–

TRIPP·LITE



Tripp Lite 2200VA UPS Smart AVR Sine Wave LCD USB DB9 Energy Star 2URM

$1,551.60 SAVE $613.96

$937.64

Advertised Price

• In Stock

(14)

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