Proposal for the 2016 Unidata Community Equipment Awards

A Prototype Cloud-Based Visualization System for Unidata Applications

Date:	**21 March 2016**
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Title:	**Director of Meteorology Computing and Senior Research Associate**
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A Prototype Cloud-Based Visualization System for Unidata Applications

Project Summary:

Graphical visualization is a critical tool used for meteorological study. Whereas graphical representations in years past were made with paper and ink, today they are almost exclusively produced by computers using advanced analysis and display software run on workstations. In the case of a classroom, the cost of installing and maintaining these systems can be prohibitive, making widespread use of advanced applications such as the Unidata IDV difficult to accomplish economically. The goal of this project is to reduce this hardware and software overhead by installing a cloud platform from which multiple instances of graphical analysis and display packages such as the IDV can be run and interacted-with from thin-client desktop or laptop computers.

Project Description:

One of the primary obstacles to deploying advanced graphical display packages such as the IDV into classrooms or for general use is the requirement for a high-performance computer with sophisticated graphics hardware. While possible in a classroom context with sufficient funds, such deployments still require installation and administration of specialized workstations in a dedicated lab. This also requires users to travel to this facility, which is often inconvenient. With the arrival of new cloud technologies that allow the shifting of desktop hardware functions onto server platforms, new possibilities exist for utilizing thin clients for advanced visualization capabilities while easing infrastructure and administrative burdens. This project attempts to capitalize on these new technologies through the creation of a prototype cloud-based visualization system.

The base platform for this proposed, prototype system is a simple OpenStack cloud consisting of a control node and a compute node (Figure 1). The control node serves as the nerve center for controlling cloud instances and communications within the cloud infrastructure. The compute node, on the other hand, is the workhorse providing compute resources for cloud instances to end users. For this project, the cloud instances will consist of the IDV application packaged in a Docker image using

the Docker platform. To shift the requirement for accelerated hardware from the display to the server, VirtualGL and TurboVNC software will be utilized in tandem with nVidia hardware graphics on the server. In operation, the end user will simply connect to this cloud-based system with a VNC viewer installed on the thin-client and begin using the IDV. Bandwidth requirements are relatively low since only compressed screen images are updated over the network while the 3-D acceleration and computation takes place on the server.

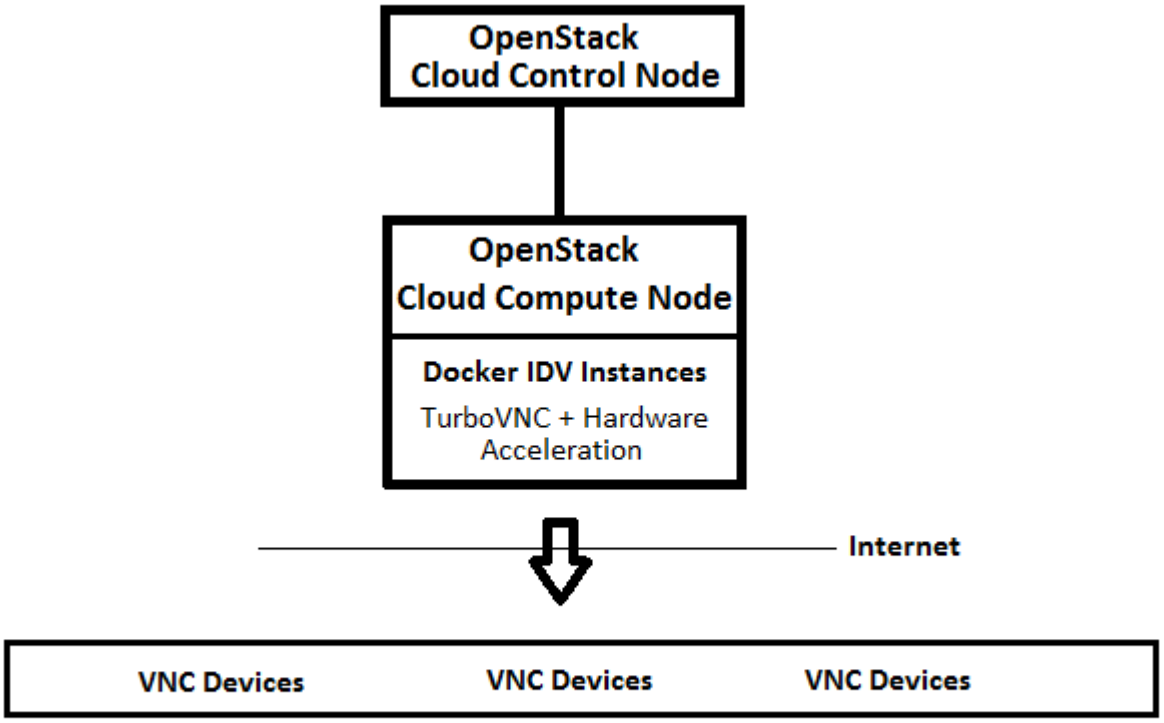


Figure 1. Prototype Cloud-based Visualization System

The advantages of using the cloud are several: Management is much simpler, only requiring the upkeep of the cloud control and compute nodes and the IDV Docker image; the system can be easily expanded for more users by adding additional compute servers; and access to advanced graphical capabilities is now within the reach of anyone using a browser, whether on a desktop PC or a laptop over wifi. The primary limiting factor is the server hardware, especially the 3-D graphics hardware. It is estimated that 4-8 concurrent users will be able to reasonably use the system, but that depends how heavily the graphics acceleration is used. With an average enrollment of 250 undergraduate and 60 graduate students in diverse disciplines ranging from weather forecasting and broadcast meteorology, to weather risk management, environmental meteorology, and weather modeling, the Penn State

Department of Meteorology will provide an excellent testbed for this cloud-based visualization system.

Penn State brings significant infrastructure resources and talent for the implementation of this proposal including recently acquired 10 Gbit access to Internet 2. Penn State is a long-term Unidata participant and provider of IDD relay services, THREDDS data services, and RAMADDA data services to the Unidata community and an AWIPS II test partner. If funded, this project will allow Penn State to continue its commitment to the advancement and implementation of Unidata resources for the benefit of the Unidata community.

Proposed Budget:

We propose using Unidata Community Equipment Award funds to purchase prototype cloud-based visualization system hardware to develop the above-specified system. The following hardware would be purchased:

Cloud Control Node:

Silicon Mechanics R133.v6:

Intel E3-1270v5 (4-cores)
32 GB RAM
4 x 1 Gbit NIC
1 x 1 TB Samsung 850 EVO SSD
Cost: $2,041

Cloud Compute Node:

Silicon Mechanics R331.v5:

2 x Intel E5-2680v3 (12-core)
256 GB RAM
2 x 10 Gbit NIC's
1 x 1 TB Samsung 850 EVO SSD
Cost: $7,937

nVidia M4000

Cost: $784

Total Cost: $10,762

Matching support from Penn State will be provided in terms of funding appropriate personnel salary time and any unanticipated hardware needs in support of this project.

Project Milestones:

By end of June 2016 - Award in-house and ready for implementation.

By end of September 2016 - Acquire hardware, configure with cloud software and begin installation and testing of IDV images.

By end of December 2016 - Installation and testing of the IDV in the prototype cloud-based visualization system is completed.

Meteorology (Earth & Mineral Sciences) / The Pennsylvania State University
A Prototype Cloud-Based Visualization System for Unidata Applications
Unidata Program Center
Project Dates: 06/01/2016 - 05/31/2017

	06/01/2016 - 05/31/2017	Total
Direct Costs		
Salaries (Category I)		
Pavloski, Charles Frank (Principal Investigator)	0	0
No salary being requested		
Person, Arthur August (Co-Investigator)	0	0
No salary being requested		
Stensrud, David Jonathan (Co-Investigator)	0	0
Total Salaries	0	0
Total Salaries and Wages	0	0
Fringe		
Category I @ 37.90%	0	0
Total Fringe	0	0
Total Salaries, Wages and Fringe	0	0
Other Direct Costs		
Cloud-based Visualization System	10,762	10,762
Total Other Direct Costs	10,762	10,762
Total Direct Costs	10,762	10,762
F&A Costs		
F&A Rate: 57.20%	0	0
Total Requested From Sponsor	10,762	10,762
University Participation		
Pavloski, Charles Frank (Principal Investigator)	1,387	1,387
Person, Arthur August (Co-Investigator)	2,211	2,211
Stensrud, David Jonathan (Co-Investigator)	2,122	2,122
Fringe		
Category I @ 37.90%	2,168	2,168
University Participation F&A		
F&A Rate: 57.20%	4,512	4,512
Total University Participation	12,399	12,399
Total Project Costs	23,161	23,161

CLONED from Unit Budget ID: 19542

Proposal: 34318
Generated by jlg28 on: 03/22/2016

THE PENNSYLVANIA STATE UNIVERSITY

BUDGET JUSTIFICATION

The Pennsylvania State University Support (Approved):

Personnel - The principal investigator is budgeted at the percentage of time shown using his/her actual salary in the calculation. The principal investigator's time includes both technical and project management functions. Any other individuals/positions shown are technical staff with the percentage of time shown and actual salaries used. For project time occurring after July 1 of any given year, the salaries have been adjusted at the University approved rate of 2.5%.

Principal Investigator – Dr. Charles Pavloski, 1% effort / 12 months

Co-Principal Investigator – Dr. Arthur Person, 3% effort / 12 months

Co-Principal Investigator – Dr. David Stensrud, 1% effort / 12 months

Recovery of Fringe Benefits - Fringe benefits are computed using the fixed rates of 37.9% applicable to Category I Salaries, 15.1% applicable to Category II Graduate Assistants, 8.0% applicable to Category III Salaries and Wages, 0.3% applicable to Category IV Student Wages, and 25.1% for Category V, Postdoctoral Scholars and Fellows, for fiscal year 2016 (July 1, 2015, through June 30, 2016). If this proposal is funded, the rates quoted above shall, at the time of funding, be subject to adjustment for any period subsequent to June 30, 2016, if superseding Government approved rates have been established. Fringe benefit rates are negotiated and approved by the Office of Naval Research, Penn State's cognizant federal agency.

Recovery of F&A - F&A rates are negotiated and approved by the Office of Naval Research, Penn State's cognizant federal agency. Penn State's current provisional on-campus rate for research is 57.2% of MTDC from July 1, 2015, through June 30, 2016. New awards and new competitive segments with an effective date of July 1, 2016, or later shall be subject to adjustment when superseding Government approved rates are established. Per 2 CFR 200 (Appendix III, Section C.7), the actual F&A rates used will be fixed at the time of the initial award for the duration of the competitive segment.

Unidata Program Center Support (Requested):

Equipment - Prototype cloud-based visualization system hardware that includes the following: Silicon Mechanics R133.v6, Silicon Mechanics R331.v5, and nVidia M4000. Equipment quotes are attached, see below.

Export Control

The Pennsylvania State University employs individuals and accepts students and graduate research students from a multitude of national backgrounds. As an entity, the University is subject to, and works diligently to obey, federal regulations regarding the export of controlled technologies and data. Sponsor, as an independent entity, is individually responsible for ascertaining its compliance with federal export laws and procedures. If Sponsor anticipates disclosure or provision of controlled technology or data to University as part of the proposed sponsored project, Sponsor should inform University, in writing, of the existence of, and information concerning the scope and extent of, such anticipated disclosures or provisions.

Silicon Mechanics
22029 23rd Dr SE
Bothell, WA 98021-4410
(425) 424-0000

Quote

Date	Quote #	Confirmation #
03 / 11 / 2016	307208	942455860

Bill To:	Ship To:
psuinvoices@psu.edu or invoices@arl.psu.edu for Applied Research Lab orders	Arthur aap1@psu.edu

Description	Control Node
Notes	

Quantity	Description	Price Each	Amount
1	**Rackform R133.v6** CPU: Intel Xeon E3-1270v5, 3.6GHz (4-Core, HT, 8MB Cache, 14nm) 80W RAM: 32GB (2 x 16GB DDR4-2133 ECC Unbuffered 2R DIMMs) Operating at 2133 MT/s Max NIC: Four Gigabit Ethernet Controllers (Intel i210) - Integrated Management: Integrated IPMI 2.0 & KVM with Dedicated LAN Controller: 8 Ports 6Gb/s SATA via Intel C236 Chipset NOTE: CacheVault Module can be mounted in HS Drive Bay 4 PCIe 3.0 x8 (x16): No Item Selected SATA DOM: No Item Selected M.2 Drive: No Item Selected NOTE: Drives will be connected to onboard SATA controller unless otherwise specified Hot-Swap Drive - 1: Intel 800GB DC S3510 Series MLC (6Gb/s, 0.3 DWPD) 2.5" SATA SSD Hot-Swap Drive - 4: No Item Selected Front Input: Front Serial / USB Ports Panel Optical Drive: No Item Selected Power Supply: Redundant 400W Power Supply with PMBus and I2C - 80 PLUS Gold Certified Rail Kit: 1U Sliding Rail Kit, 26 - 33.5 inches OS: Customer declined OS Management SW: Supermicro Update Manager (SUM) Out-of-Band Management Software Standard Warranty: 3 Year Silicon Mechanics Standard Warranty Advanced Parts Replacement: 3 Year Advanced Parts Replacement Expanded Services: No Item Selected **Configured Power:** **Total Power Solution Requirement:** 147 W, 153 VA, 501 BTU/h, 1.4 Amps (110V), 0.7 Amps (208V) **Total rackmount units:** 1U x 1 = 1U	2041.00	2041.00
Total Configured Power			

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Total Configured Power

1 x Rackform R133.v6:
Sub-total Configured Power: 147 Watts, 153 Volt-Amps, 501 BTU/h, 1.4 Amps(110V), 0.7 Amps(208V)

Total Configured Power: 147 Watts, 153 Volt-Amps, 501 BTU/h, 1.4 Amps(110V), 0.7 Amps(208V)

Total Rackmount Units

1 x Rackform R133.v6:
Sub-total Rackmount Units: 1U

Total Rackmount Units: 1U

Subtotal	2,041.00
Sales Tax (0%)	0.00
Total	USD 2,041.00

Orders shipped to WA, CA, ID, CO, GA, NC, and TX are subject to the appropriate tax rate. The quoted tax amount is subject to change.

Subject to Silicon Mechanics' Warranty Terms and Conditions - http://www.siliconmechanics.com/terms-and-conditions.php

Silicon Mechanics
22029 23rd Dr SE
Bothell, WA 98021-4410
(425) 424-0000

Quote

Date	Quote #	Confirmation #
03 / 11 / 2016	307211	761187338

Bill To:	Ship To:
psuinvoices@psu.edu or invoices@arl.psu.edu for Applied Research Lab orders	Arthur aap1@psu.edu

Description	Compute Node
Notes	

Quantity	Description	Price Each	Amount
1	**Rackform R331.v5** CPU: 2 x Intel Xeon E5-2680v3, 2.5 GHz (12-Core, HT, 30MB Cache, 120W) 22nm RAM: 256GB (8 x 32GB DDR4-2133 ECC Registered 2R 1.2V LRDIMMs) Operating at 2133 MT/s Max NIC: Intel Dual-Port X540 10GbE Controller - Integrated Management: IPMI 2.0 & KVM with Dedicated LAN - Integrated Controller: 10 Ports 6Gb/s SATA (Intel C612 Chipset) NOTE: For RAID with Cachevault, please select both controller and CacheVault kit below unless noted PCIe 3.0 x16 - 1: No Item Selected NOTE: Hot-swap and fixed drives will be connected to SATA3 controller (C612) unless otherwise specified Hot-Swap Drive - 1: Intel 800GB DC S3510 Series MLC (6Gb/s, 0.3 DWPD) 2.5" SATA SSD Optical Drive: Blanking Panel - No Optical Drive Front Panel: Blanking Panel - No Front Inputs Power Supply: Redundant 700W / 750W Power Supply with PMBus & I2C - 80 PLUS Platinum Rail Kit: Quick-Release Rail Kit for Square Holes, Outer Slide Extendable Length 25.6 - 33.05 Inches OS: Customer declined OS Management SW: Supermicro Update Manager (SUM) Out-of-Band Management Software Standard Warranty: 3 Year Silicon Mechanics Standard Warranty Advanced Parts Replacement: 3 Year Advanced Parts Replacement Expanded Services: No Item Selected **Configured Power:** **Total Power Solution Requirement:** 402 W, 419 VA, 1372 BTU/h, 3.8 Amps (110V), 2.0 Amps (208V) **Total rackmount units:** 1U x 1 = 1U	7937.00	7937.00
Total Configured Power			

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Total Configured Power

1 x Rackform R331.v5:
Sub-total Configured Power: 402 Watts, 419 Volt-Amps, 1372 BTU/h, 3.8 Amps(110V), 2.0 Amps(208V)

Total Configured Power: 402 Watts, 419 Volt-Amps, 1372 BTU/h, 3.8 Amps(110V), 2.0 Amps(208V)

Total Rackmount Units

1 x Rackform R331.v5:
Sub-total Rackmount Units: 1U

Total Rackmount Units: 1U

Subtotal	7,937.00
Sales Tax (0%)	0.00
Total	USD 7,937.00

Orders shipped to WA, CA, ID, CO, GA, NC, and TX are subject to the appropriate tax rate. The quoted tax amount is subject to change.

Subject to Silicon Mechanics' Warranty Terms and Conditions - http://www.siliconmechanics.com/terms-and-conditions.php

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Currency in US Dollars

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$783.93

Mfg Part# VCQM4000-PB

1

Provantage# PNY91HN

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In Stock. This item will be shipped directly to you from the nearest available regional warehouse.

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REMOVE ALL ITEMS

Shipping Destination

USA Pennsylvania

Shipping Options

Ground Service : $5.95

About shipping charges

Subtotal:	783.93
Shipping:	5.95
Total Order:	**$ 789.88**

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