Date: **2/24/2015**

A proposal to the

**Unidata Community Equipment Awards Program**

for support of a

**Flash I/O Network Appliance (FIONA) connected to the 40Gb/s PRISM network at UC San Diego for worldwide access to the IDD**

Using the AWIPS2, EDEX, CAVE and other LDM filter applications, it will be used to produce data for visualizations and assimilation into wildfire models for UCSD's WIFIRE project.

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| Name and Address of Institution | University of California, San Diego<br>9500 Gilman Drive #0436<br>La Jolla, CA 92093-0436 |
| Institution Identifiers | DUNS: 804355790<br>Cage Code: 50854<br>TIN: 95-6006-144 |
| Desired Starting Date | 04/01/2015 |
| Proposal Duration | 1 Year |
| Amount Requested | $19,790.55 |

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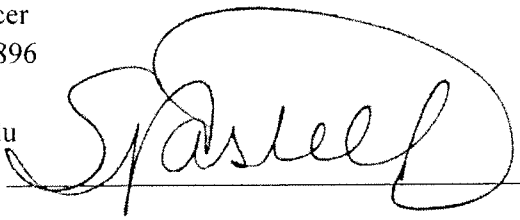
Signature of University Official: 

**Project Summary:**

The goal of this proposal is to engage and collaborate with the Unidata community by installing a Flash I/O Network Appliance ("FIONA")-based AWIPS2 / EDEX server on the 40Gb/s PRISM Network (NSF Award #OCI-1246396) to make the data available to researchers worldwide. John Graham, Senior Development Engineer will be the main builder and integrator of this equipment into the ultra-high-speed networks.

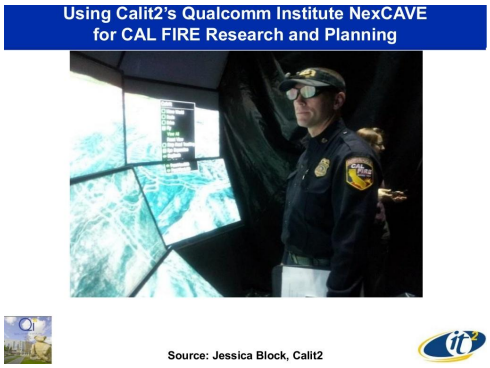
As weather models become higher resolution (e.g., GFS and HRRR most recently), computers, networks and storage must keep in step to maintain accessibility to the data. With the speed of access that we can provide, new ways of observing, interacting and forecasting with this data will emerge. Speeding up accessibility makes the data available for weather visualizations to UCSD's large format displays (see: http://ivl.calit2.net/wiki/index.php/Infrastructure) that include both 2D and 3D walls, and virtual reality CAVEs. For instance, UCSD's VROOM wall resolution is made of 64 megapixels (15,360 x 4,320 pixels). Observing high-resolution model output has so far been difficult because the pixel count of a standard HD display (2 megapixels) is not high enough to support the very high-resolution visualizations of these weather models. Weather systems and events lasting months or years will be possible to visualize on our big display walls. With continued improvements to our visualization display environments, we expect to achieve and communicate a greater understanding of our global atmospheric processes.

These challenges must be approached with cloud convergence and cost savings in mind. This project actively promotes sustainable services without sacrificing performance, a goal of UCSD's Integrated Digital Infrastructure Program (IDI).

**Project Description:**

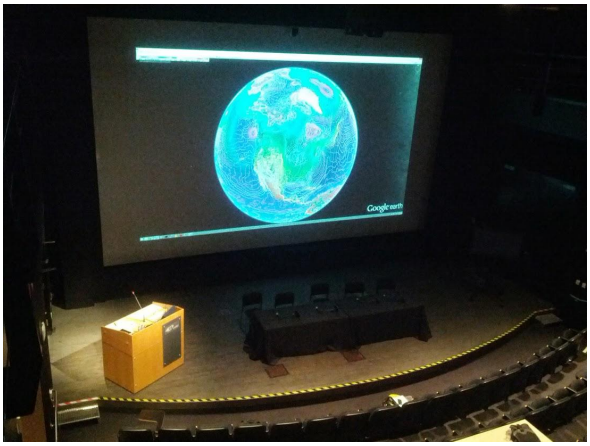
*Technical Merit and Contribution to Unidata Community Capabilities*

Our initial research pipeline will run the WRF-SFire computational fluid dynamics (CFD) model initialization products. This will be in support of the NSF-funded WIFIRE program http://wifire.ucsd.edu/ (WIFIRE is funded by NSF Award #1331615 under CI, Information Technology Research and SEES Hazards programs). This grant aims to build an end-to-end cyberinfrastructure (CI) for real-time and data-driven simulation, prediction and visualization of wildfire behavior.


*Contribution to the advancement of Technology*

We have also been developing a LDM weather visualization pipeline for the 4K (4192x2160) and 8K (8384x4320) UDHTVs and projectors we have for seamless interaction with the data. Google Earth animations can be interactively viewed using the open source libraries libNDIS for NEXRAD radar, libGENI for satellite and grib_countour for NCEP model output. We plan on rewriting parts of the code to enable integration into the EDEX or to operate as a stand-alone LDM pipeline. These open source components are already available to the Unidata community from the public github repository (https://github.com/winkey?tab=repositories)

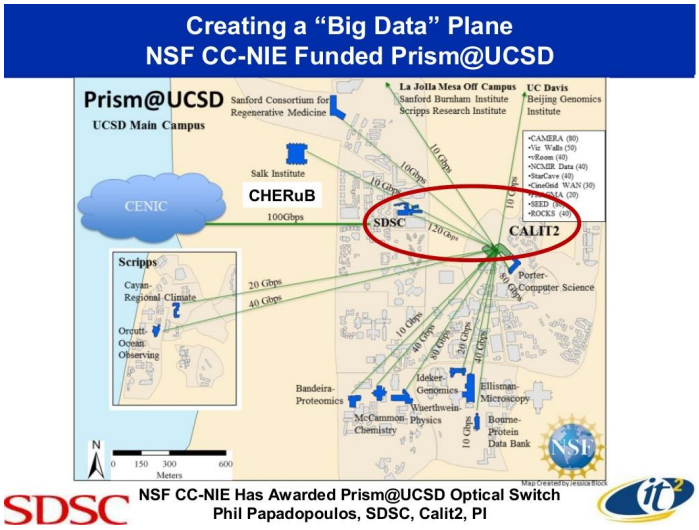


*Broadening the Unidata Community and Enhanced Participation in the IDD*

Access to the Unidata EDEX cloud server has recently been shut down due to funding issues. Our system will be able to replace this service to global users. We intend on making the EDEX server with FULL NEXRAD radar feed available to remote users who want to use the CAVE thin client. We are also pursuing the virtualization of an AWIPS2 EDEX server on the Comet supercomputer at the San Diego Supercomputer Center (SDSC) by running it in a Centos 6.6 Virtual Machine with an XSEDE allocation currently under consideration. This system will be able to provide a fully functioning EDEX server to the world at no cost to Unidata, with the resilient support of SDSC.

We currently run the CAVE thin client using VNC remote desktop to a Centos 6.6 Virtual Machine in our TelaScience XenServer stack in the Terascale data center at UCSD and will use this as another way of accessing the AWIPS2 software including the LDM and EDEX software for experimental visualization products. Researchers will be able to spin up the same Centos 6.6 Virtual Machine fully configured with the AWIPS2 software repository on the new Comet Supercomputer that is being installed at SDSC.

The FIONA system will be directly connected to the PRISM network with dual 40G network connections, which will enable us to optimally use the UCSD Production Network, XSEDE Resources (https://www.xsede.org/), and other off-campus, high capacity networks like 100Gb/s ESNET and 100Gb/s Internet2.




We will be able to access the cloud based storage on the San Diego Supercomputer Center (SDSC) Data Oasis, Cloud and Project storage systems as both a source and destination of custom products we will produce via the EDEX LDM connection to the IDD feed at atmos.ucsd.edu.

**Sustainable Model for Cyberinfrastructure:**

*Contribution to education and Research*

The UCSD Integrated Digital Infrastructure Program (IDI) http://idi.ucsd.edu/ is an initiative to provide campus researchers and students the facilities, data curation, computing, networking, and expertise to support their research using shared cyberinfrastructure services across campus. As an IDI-connected project through WIFIRE, the AWIPS2 service will be an essential element to

streamline the access to these emerging technologies and data sources and will promote innovation in our research community.

Another project that is active at UCSD/QI is SunLight SDX Software Defined Network Exchange, using OpenFlow and other Software Defined Networking (SDN) services. We plan on using SDN technology to define pathways between Unidata IDD and LDM / EDEX and CAVE Thin Clients running on Virtual Machines and connecting to other SDN attached resources like storage compute and GPGPUs.

The TelaScience XenServer 6.2 stack is using the Citrix Distributed Virtual Switch (DVS) Controller. Introduced in version 6.0, XenServer uses Open vSwitch (OvS) as the default network stack. This allows the use of OpenFlow controllers to control XenServer hosts, and access to SDN services. This system can be used to host Virtual Machines running other processing and visualization pipelines like MODIS Landsat and NPP multi-spectral satellite pipelines and serving up global high resolution elevation data. These products are time critical for initializing wildfire models in an automated workflow.

**Budget:**

**Requested Hardware:**
The equipment we are requesting is based on a recent deployment of 10 perfSONAR FIONA dual 40Gbps Haswell CPU architecture servers. These have been placed all across California on the CENIC network to measure the performance of this new infrastructure. This FIONA configuration is known to be capable of sustained dual stream flows of nearly 40Gbps, which removes bandwidth bottlenecks in the networking and storage system and allows us to optimize the data production and dissemination to the research community.

**University Technical Support:**
If successful in this application to Unidata, UCSD's IDI program will provide colocation and dual 40Gb/s connections to the PRISM network. Other requests will be made for the SDSC Cloud and Project storage allocations teams. Funds to support the admins' and researchers' time will come from internal and external sources attracted to this new capability.

**Hardware Details:**

| Item | Specific Part | Qty | Price | Total |
|---|---|---|---|---|
| Motherboard | SUPERMICRO MBD-X10SRL-F Server Motherboard LGA 2011 R3 | 1 | $270.00 | $270.00 |

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|---|---|---|---|---|
| Processor | Intel® Xeon® Processor E5-2687W V3 10 core CPU | 1 | $2,149.99 | $2,149.99 |
| CPU Cooler | SUPERMICRO SNK-P0048PS Heatsink for Supermicro X9DR3-F Motherboard | 1 | $20.00 | $20.00 |
| 256GB RAM | Crucial 32GB 288-Pin DDR4 SDRAM ECC DDR4 2133 (PC4-17000) Model CT32G4LFQ4213 | 8 | $734.99 | $5,879.92 |
| Chassis | Supermicro SC836TQ-R800 3U Chassis 16x3.5-in SAS/SATA Hot-Swap R800W CSE-836TQ-R800B | 1 | $834.00 | $834.00 |
| SAS Cables | LSI LSI00410 0.6m Internal Cable SFF8643 to x4 SATA HDD (mini SAS HD to SATA data port) | 4 | $19.99 | $79.96 |
| 7.2TB 10K RPM Drives | WD Xe WD9001HKHG 900GB 10000 RPM 32MB Cache SAS 6Gb/s 3.5" Internal Hard Drive | 8 | $599.99 | $4,799.92 |
| 3.84TB Flash Cache | Intel 530 Series SSDSC2BW480A401 2.5" 480GB SATA 6Gb/s MLC Internal (SSD) | 8 | $249.99 | $1,999.92 |
| 1.92TB PCIe SSD | Mushkin Enhanced MKNP44SC1920GB-DX 1920GB PCI Express x8 Internal (SSD) | 1 | $1,548.95 | $1,548.95 |
| SSD Boot Drives | Intel 530 Series SSDSC2BW120A4K5 2.5" 120GB SATA III MLC Internal (SSD) | 2 | $74.99 | $149.98 |
| 2.5 to 3.25 drive bay converter | ICY DOCK EZConvert Pro MB982SP-1S Full Metal 2.5" to 3.5" SATA 6Gbps SSD & HDD | 8 | $32.99 | $263.92 |
| 2.5 Mount in FDD bay | Supermicro MCP-220-83601-0B - Black FDD dummy tray, supports 1x 2.5" slim HDD | 1 | $11.00 | $11.00 |
| 2.5 Mount in DVD bay | Supermicro MCP-290-00036-0B - Black DVD dummy tray, supports 1x 2.5" slim HDD | 1 | $13.00 | $13.00 |
| LSI HBA | LSI LSI00244 (9201-16i) PCI-Express 2.0 x8 SATA / SAS Host Bus Adapter Card | 1 | $379.99 | $379.99 |
| 40G QSFP+ | APPROVED ARISTA AOC-40G-Q- | 2 | $320.00 | $640.00 |

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|---|---|---|---|---|
| cables | Q-5M | | | |
| 40GbE NIC | Mellanox ConnectX-3 Pro EN Single-Port 40/56 Gigabit Ethernet Card - Part ID: MCX313A-BCCT | 2 | $375.00 | $750.00 |
| | | | | |
| Total | | | | $19,790.55 |

**Total Direct Costs: $19,790.55  This is a fabricated single computer system made of the above parts.**

**Total Indirect Costs: Indirect cost is not assessed on equipment over $5000.**

**Total Project Costs: $19,790.55**

**Project Milestones:**

- Order equipment by the end of May 2015
- Assemble and install the purchased equipment in the PRISM network by mid June 2015
- Configure and Test basic AWIPS / EDEX / CAVE software by early July 2015
- Test remote CAVE thin client software by mid July 2015
- Expand testing to local research partners San Diego State University, Scripps Institution of Oceanography by August 2015
- Enlist Unidata members to test performance under multiple simultaneous user load September 2015
- Begin production of WIFIRE WRF-SFire model initialization products in October 2015
- Experiment with 4k and 8K UHDTV resolution visualization products by November 2015
- Attach to SDSC Cloud and Project storage over the PRISM 100GBASE network in December 2015
- Encourage the Unidata community to use the UCSD PRISM EDEX to complement operating EDEX in the Azure and Amazon clouds by January 2016.