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University at Buffalo Campus Cyber infrastructure Master Plan

University at Buffalo (UB) is the largest and most comprehensive university center in the State University of New York (SUNY) system and has been a member of the Association of American Universities (AAU) since 1990. The university is guided by its ambitious UB 2020 vision which seeks to enhance the university's distinction and relevance among the world's foremost research universities and position UB as a recognized leader in responding to broadly defined societal challenges. With one of the nation's largest international enrollments and affiliation agreements with over 80 universities in Asia, Europe, Latin America, and Africa, UB is a global university in scope and impact, recognized around the world as a leading center for groundbreaking research and discovery.

UB's computing and information technology (CIT) division is charged with providing vision, leadership, and long-range direction for the delivery of a robust and innovative cyber infrastructure to advance the university's research and educational missions as a globally prominent 21st century university. CIT provides oversight of information technology, computing services, and administrative information systems across the university and serves as the university's principal technology leader with responsibility for UB's overall technology environment, including essential support for the research and teaching activities of faculty and students and oversight of all applications and infrastructure related to administration and academics, information security and telecommunications. With research being one of the pillars of UB's mission, significant investments have been done to build robustness in the infrastructure that supports the research activities at the university. The three components of the infrastructure that the cyber infrastructure plan focuses on are advanced networking, high performance computing and identity management.

Advance Networking

UB has access to high capacity fiber optic networks connecting the three campuses. UB has constructed and owns an extensive regional fiber infrastructure that provides robust inter-campus connectivity needs and has ample capacity for growth. The available capacity on this strategic asset can be easily leveraged to support special purpose dedicated circuits for high bandwidth connections.

UB maintains redundant connectivity to the Commodity Internet via dual redundant 5Gbps links to separate providers. This connectivity is distributed to the campus via a highly redundant 10Gbps backbone network with dual building aggregation links, 10Gbps connectivity for

servers, and 1Gbps connections to the desktop as a standard. Wi-Fi connectivity is provided throughout the campus and supports eduroam federated access for visiting researchers.

Support for the network is provided by our robust and highly trained network engineering staff. The UBIT Help Center serves as a single point of contact with extended business hours. The Network Operations Center monitors the network infrastructure 24x7 to ensure service continuity and minimize downtime. Planned changes are announced in advance and emergency alerts are provided during unplanned outages.

Collocated access to State research network backbones, national and international facilities are also available to support advanced research and education initiatives. UB currently has a 10Gbps connection to the NYSERNet Research and Engineering network through which we connect to Internet2. NYSERNet operates a wavelength division multiplexed network across the state interconnecting all of the major research Universities in New York. The western terminus of the R&E network is collocated on our campus. NYSERNet is currently connected to I2 at 100Gbps.

UB can leverage the NYSERNet network to provide dedicated wavelength high capacity circuits between Buffalo and other locations across the state. NYSERNet also operates a major national/international network peering point at 32 Avenue of the Americas in NYC.

High Performance Computing

The University at Buffalo's Center for Computational Research (CCR; www.ccr.buffalo.edu), a leading academic supercomputing facility maintains a high-performance computing environment, high-end visualization laboratories, and support staff with expertise in computing, visualization, and networking. The Center's extensive computing facilities, which are housed in a state-of-the-art 4000 sq ft machine room located in the new NYS Center of Excellence in Bioinformatics and Life Sciences building in downtown Buffalo, include a generally accessible (to all UB researchers) Linux cluster with more than 8000 processor cores and QDR Infiniband, a subset (32) of which contain (64) NVidia Tesla M2050 "Fermi" graphics processing units (GPUs). Industrial partners of the University have access to a cluster with more than 3400 processor cores and FDR Infiniband. The Center maintains a 3PB IBM GPFS high-performance parallel file system. The computer visualization laboratory features a tiled display wall, and a VisDuo passive stereo system. A leading academic supercomputing facility, CCR has more than 170 Tflops of peak performance compute capacity. CCR additionally hosts a number of clusters and specialized storage devices for various specific departments, projects, and collaborations, interested researchers should contact CCR staff.

In addition to its computing and visualization resources, CCR has a support staff consisting of computational scientists, programmers, and database administrators with expertise in all areas of

computing, including scientific and parallel computing, (big) data analytics, custom software development, database engineering, and scientific visualization.

CCR helps scientists at UB, the Roswell Park Cancer Institute, the Hauptman-Woodward Medical Research Institute, and other research organizations in western New York conduct leading-edge research in a wide range of fields in science and engineering, including bioinformatics, chemistry, physics, computational fluid dynamics, cancer research, medical imaging, pharmaceutical drug design, medical informatics, and civil engineering.

In terms of the application of advanced cyber infrastructure in support of economic development, UB/CCR is a member of NYSTAR's **High Performance Computation Consortium (HPC²)**. HPC² (<https://hpc2.org/>) is a partnership between NYSERNet and supercomputing centers at RPI, Stony Brook, Brookhaven, and UB. Its goal is to increase New York State's competitiveness and foster economic development by providing industry and academic institutions with high performance computing resources, including staff with expertise in modeling and simulation. This includes access to CCR's 3400 core Linux cluster

Identity Management

UB's identity management systems are highly integrated with all the applications that are provided to the campus along with network access capabilities. The identity management layer is seamlessly integrated from the operating system layer all the way to the desktop layer. The university has made significant investments for single sign on capabilities through Shibboleth and federated authentication through the InCommon federation. A robust system of provisioning and de-provisioning accounts from the system of record is managed through a common identity management system which provisions all the downstream resources needed to provide access to the various resources that an individual researcher requires to do business at the university. Appropriate layers of authentication are provided via active directory, LDAP, Kerberos, and radius per the application requirements. UB also uses two factor authentication via RSA software and hardware tokens to administrative systems that hold sensitive privately identifiable information. Password resets are done through a self-service mechanism by answering questions selected by the individual users. UB currently meets the Bronze level of assurance according to the InCommon participation standards.