San Diego State University Cyberinfrastructure Plan

Introduction
San Diego State University's Cyberinfrastructure Plan is guided by SDSU’s 2020-2025 strategic plan: “We Rise We Defy: Transcending Borders, Transforming Lives.”[1] The strategic plan serves as the primary guide for SDSU’s growth and commitment to teaching, research, and creativity. Of the five priorities in the strategic plan, our Cyberinfrastructure Plan is most influenced by the priority to “Become a Premier Public Research University: A New Kind of HSI.”

In support of the strategic plan, SDSU formed a Cyberinfrastructure committee, co-chaired by the VP for Information Technology, and the VP for Research and Innovation, in addition to representatives from all colleges and campuses to assess the Cyberinfrastructure needs of faculty, researchers, and staff. These needs will be used as the basis for our overall strategic direction providing guidance on investments, organization and collaboration efforts with peers and private partnerships. Our Cyberinfrastructure Plan reflects the existing work and funding that has taken place and strategic work that must continue in order to support SDSU’s strategic goals and continued growth.

Several key areas of focus are at the heart of our campus Cyberinfrastructure discussions, and influence our actions to support the broader strategic plan:

- Investment in local compute and storage, with cloud bursting capabilities
- Continued investment, use, and promotion of national resources
- Focus on security, with an emphasis on compliance to support evolving requirements
- Structured research IT support and facilitation
- Sustainability of existing and future investments
- Making Cyberinfrastructure accessible to underserved populations

SDSU continues to grow, not only its student body and academic programs, but its footprint. SDSU includes several campuses, including its San Diego, Imperial Valley, Brawley, and Georgia campuses. As of 2020 SDSU began the transformation of SDSU Mission Valley[2]. The Mission Valley Campus will include an Innovation District, including roughly 1.6 million square feet of office, technology, and research space located adjacent to the stadium to activate the space and create an incubator-like feel to the area. In partnership with public-private partners, the Innovation District will provide collaborative research partnerships and create more opportunities for public engagement and interaction with public and private industry partners. The State of California has announced an $80 million in funding in the 2022/2023 budget to support a STEM facility at SDSU Imperial Valley Brawley campus which will dramatically expand STEM education and research, tying into regional plans for major economic development as California’s “Lithium Valley.”
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Current Infrastructure

Local Facilities

Networking

Access Layer Networking

SDSU has redundant connections to SDSU’s Internet Service Provider, CENIC[9]. The primary connection is a dark fiber that directly connects to the CENIC POP at the San Diego Supercomputer Center (SDSC) located at University of California, San Diego. The fiber is connected with an Enhanced Wave-Division Multiplexer (EWDM). This allows SDSU to provide high-speed connectivity to the campus/administrative network and the Research Network. The campus network has a 20 Gbps connection to CENIC CalREN-DC ("Digital California") network, with plans to upgrade to 100 Gbps in Q4 of 2022. The campus network also has a redundant 20 Gbps connection over AT&T infrastructure to CENIC/Riverside. The EWDM allows the Research Network to support a separate 10 Gbps connection on the CENIC CalREEN-DC network and another 100 Gbps connection on the CENIC CalREN-HPR ("High-Performance Research") network. SDSU Imperial Valley has a 10 Gbps connection to IVTA (Imperial Valley Telecommunications Authority) network that provides connectivity to education and government agencies in Imperial Valley. The SDSU Imperial Valley Brawley location has a 1 Gbps connection to the IVTA network. The IVTA network has a direct 100 Gbps connection to CENIC POP.

Wireless Connectivity

SDSU wireless networks consist of 4,200 access points and four Aruba 7240XM controllers. All access points are 803.11ac or newer. The controllers are designed for a highly redundant environment. The controllers run AOS 8.7 which allows for clustering, increased reliability, and security. The controllers are both physically and logically redundant. Encrypted wireless access is controlled through radius authentication for campus affiliated users and Eduroam users and an unencrypted guest network for visitors. SDSU will expand the coverage of 802.11ax in high usage areas.

Science DMZ

SDSU research environment has a Science DMZ ("SDMZ")[6] which was funded through the NSF Office of CyberInfrastructure[10]. The network consists of Alcatel-Lucent OS10K and Brocade MLXe-4 routing and switching infrastructure. Connectivity is achieved through a 10 Gbps uplink to the CENIC CalREN-DC ("Digital California") network and a separate 100 Gbps uplink to the CalREN-HPR ("High-Performance Research") network. The SDMZ is run by researchers and available to researchers upon request with a physical presence in several buildings on campus, including the campus data center.

The SDMZ has promoted high-speed remote usage of computing resources at SDSU, cultivated development of collaborative tools for sharing data with the broader scientific community, established new research partnerships, and has fostered new mentorship opportunities between faculty and students engaged in computational science.

IPv6

SDSU currently owns two Class B IPVv4 ranges. SDSU also has an IPv6 range that will be implemented in the future. SDSU network is currently configured to support IPv6 ranges from outside, but has not deployed IPv6 to the campus users. SDSU does plan to deploy IPv6 on campus in the future. SDSU will
design and create an implementation strategy to deploy IPv6 to the campus users base in the next 1-2 years. The design will include a review and change in how we provide our security today. Implementation time will be based on the changes that are needed after the design is complete.

Security
SDSU utilizes Next Generation Firewalls to monitor, detect and block access to resources. Firewalls are deployed at the border, data center, and at the departmental level. Data center networks can not exist outside the physical data center. SDSU uses a tiered access system for administration. Tier 0 access to systems such as identity systems (e.g. Active Directory) is restricted and performed from standalone virtual machines. The campus has deployed Microsoft endpoint management services, including anti-virus, to faculty and staff university-owned devices.

Monitoring
SDSU utilizes PRTG to monitor its network and compute resources. All campus network equipment is monitored and alerts are sent to staff to investigate issues. In addition, perfSONAR is deployed on the Science DMZ[5] and monitored by researchers.

Campus Data center
SDSU’s campus data center houses systems for business and academic purposes and was recently updated in 2020/2021 to increase capacity, efficiency, and security. The 5,000 square foot facility offers secure colocation services for departments and colleges. Cooling is provided by four Liebert units with built in capacity for redundancy and expansion as well as environmental monitoring. Racks are supplied with two power sources backed by two MGE UPS systems as well as a diesel generator for extended power outages. The data center also has a Halon fire suppression system. The data center includes several security measures including biometric palm readers, secure key box checkout as well as security camera coverage.

Special Facilities
Computational Sciences Research Center
The Computational Science Research Center (CSRC)[8], located at SDSU, is to promote development and advancement of the interdisciplinary subject of computational science. This is accomplished by fostering research, developing educational programs, and promoting industrial interaction, outreach, and partnership activities. The Computational Science Research Center provides an excellent environment for scientific research at SDSU. The center facilitates the interaction between applied mathematics, computer science, and the sciences by providing the necessary infrastructure for productive research efforts.

Alvarado and External Sites
SDSU provides wired and wireless service and support to the Alvarado complex. The complex supports campus researchers and other campus services. The uplink to the complex is dual 40Gbps connection to the Alvarado distribution point site. All but one Alvarado buildings have a dual 10Gbps connection, and one small building has a 1Gbps connection. All buildings in the complex have WiFi 6 (802.11ax) wireless access points. The building has full coverage with overlapping AP's for redundancy.
Remote Facilities

National Research Platform
Made possible by NSF funding, SDSU participates in the National Research Platform (NRP)[4]. NRP enables region-wide virtual co-location of data with computing resources, and with Nautilus allows researchers to run containerized research workloads. In 2022, SDSU funded the purchase of 15 nodes, containing both CPU and GPU resources, to be added to and managed by the NRP. These nodes will primarily support instruction with spare capacity available to researchers at SDSU, CSU, and the broader NRP community.

National Resources
In addition to the Pacific Research Platform, SDSU makes use of national resources such as those available through ACCESS.

Cloud
SDSU utilizes cloud technology from several vendors including Google, Microsoft, and Amazon. Our collaboration platform for faculty, staff and students is Google Workspaces. This environment allows campus users to securely collaborate and communicate. Globus has been deployed with the Google Drive Storage Connector to take advantage of its robust and secure file transfer and sharing capabilities. All campus users can take advantage of Globus to share files both internally and externally. A 1.25 Gb VPN connection is in place to Azure to provide secure connectivity for workloads that require secure, non-public access.

Microsoft Azure, Amazon Web Services (AWS), and Google Cloud Platform are available to researchers under existing campus contracts and integrated with campus single sign-on systems. AWS GovCloud is also available for workloads with increased compliance needs.

Collaboration

Identity Access Management / Incommon Federation
SDSU provides a campus identity known as SDSUid. SDSUid is the primary ID used for authentication across campus and external resources.

There are 3 main authentication methods for both on-premise systems and applications as well as those housed in the cloud or as SaaS: 1. Active Directory for on-premise applications, 2. Azure Active Directory (AAD), 3. Shibboleth for InCommon federation member resources. Both Azure Active Directory and Shibboleth support SAML2 integrations. Shibboleth supports the InCommon federation, of which SDSU is a member. This InCommon membership allows for collaboration with other organizations that are also part of the InCommon federation and who require authentication services to access resources. SDSU also releases attributes to Research and Scholarship (R&S)[7] Service Providers registered by InCommon.

Security
Over the past two years, SDSU has increased funding for security staff. This increased funding has allowed the addition of three new roles to support operations, risk, and compliance. In addition, in 2021 SDSU began a NIST 800-171 assessment. The assessment focused on research projects known to
require DOD or DOE with DFARS clauses specific to NIST SP 800-171 and CMMC. Results from the assessment will be used to influence policy, design and compliance for researcher environments.

Sustainability
SDSU's investments in Cyberinfrastructure rely on investments from campus as well as those made available through federal funding opportunities. For the budget year 2022/2023, a new line item has been added to the central budget to include Cyberinfrastructure which will be informed by faculty and researcher needs. Additional investments have also been made in personnel, including the creation of a Chief Technology Research Officer and Cyberinfrastructure Engineer role within the Information Technology Division.

Future
SDSU’s success begins with understanding the needs of students, faculty and staff. Current activities will continue to inform Cyberinfrastructure needs which will influence budgetary requests for infrastructure and personnel. Security and compliance will continue to be a focus as we assist researchers with meeting compliance requirements. SDSU will continue its use of national resources as well building out local resources that can contribute back to the community. In the fall of 2022, SDSU received a sub award to participate in a NSF funded Cybertraining grant[11]. This award will fund a Cyberinfrastructure trainee and faculty fellow to participate in an immersive CI training program in conjunction with several other institutions including UC San Diego and CSU San Bernardino. The trainees will spend half their time learning and the other half applying their skills with the ultimate goal to move to a permanently funded Cyberinfrastructure professional appointment.

The California State University with 23 campuses is in a unique position to collaborate on projects serving a diverse population with varying needs. SDSU will continue collaboration efforts with other research-focused CSU campuses, including grant submissions, to build on the collective strengths of our individual campuses.

References
[8] Computational Science Research Center (CSRC), http://www.csrc.sdsu.edu/