



2022

OFFICE OF INFORMATION TECHNOLOGY
ACCOMPLISHMENTS REPORT

Be Boulder.



Office of Information Technology
UNIVERSITY OF COLORADO **BOULDER**



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RESEARCH COMPUTING LEADS \$10 MILLION NSF-FUNDED CYBERINFRASTRUCTURE INITIATIVE

In May 2022, the CU Boulder Research Computing team was selected to lead a five-year, \$10 million National Science Foundation-funded initiative to reimagine cyberinfrastructure user support services and delivery to keep pace with the evolving needs of academic scientific researchers.

The initiative known as MATCH, or Multi-tier Assistance, Training and Computational Help, is part of a larger program called Advanced Cyberinfrastructure Coordination Ecosystem: Services and Support (ACCESS). ACCESS aims to establish a suite of cyberinfrastructure coordination services in support of science and engineering research and education through five independently managed yet tightly cooperative service tracks supported by a coordination office.

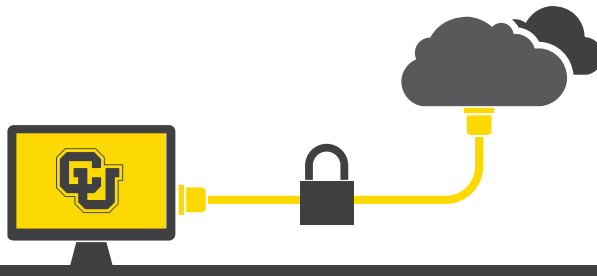
As one of the five ACCESS tracks, MATCH proposes a new model for cyberinfrastructure (CI) support services that reflect significant changes in the size and composition of the user group community. It will:

- Leverage modern information delivery systems and simplify user interfaces to provide cost-effective scaled support to a broader community.
- Leverage experts from the community to develop training materials and instructions that can reduce the user learning curve for an expanding range of systems, applications, and computational techniques.
- Employ a matchmaking service that will maintain a database of specialist mentors and student mentees that can be matched with projects that provide the domain-specific expertise needed to leverage ACCESS resources.



Other organizations participating in MATCH include the Massachusetts Green High Performance Computing Center (MGHPCC), the University of Southern California Information Sciences Institute, the Ohio Supercomputer Center, and the University of Kentucky.

“CU Boulder and our MATCH collaborators will lead this groundbreaking effort nationally by leveraging existing tools, interfaces, and community experts to assist researchers using NSF-funded cyberinfrastructure to most effectively conduct their research,” says Dr. Shelley Knuth, assistant vice chancellor for Research Computing and MATCH principal investigator. *“This project will have a transformative impact on the national research cyberinfrastructure.”*



RETAINING A COMPETITIVE EDGE IN SECURE COMPUTING

In the fall of 2020, campus compliance and information technology leadership recognized the significance of the impending roll-out of the new Department of Defense (DoD) Cybersecurity Maturity Model Certification (CMMC) framework. This program requires that all DoD vendors acquire a third-party certification of compliance with CMMC requirements. In anticipation of this new requirement, CU Boulder's [Center for National Security Initiatives](#) (CNSI) drove the purchase of the Office 365 Government Community Cloud (GCC) High tenant for handling information under CMMC compliance requirements for the CU Boulder campus.

To further support this effort, CU system decided to fund the creation of a new CMMC service that would provide messaging and collaboration services leveraging O365 GCC High and research computing services (VMS, storage, software, and data processing) through a managed environment in Azure government. Investment in these services will allow CU to retain a competitive edge in the hundreds of millions of dollars in future DoD awards.

[The Preserve](#) officially launched as the new umbrella service in June 2022. Many groups worked diligently to navigate the subtleties of compliance and the stringent security requirements of the CMMC controls. OIT's Research Computing, Productivity & Collaboration, IT Security, and Project Management teams worked in collaboration with CNSI, the CU Office of Export Control, and the CU Office of Contract and Grants to establish agreements, develop new cross-functional procedures, and create additional roles and responsibilities across multiple teams to support the latest compliance requirements.

This effort constitutes a significant shift in how we think about OIT enterprise services as they apply to researchers working in a highly controlled environment that requires a higher intensity level of user support, monitoring, and process documentation.

The teams continue to seek ways to improve and refine the services and provide the needed infrastructure for research projects and proposal work involving Controlled Unclassified Information (CUI) and/or contractual clauses such as [DFARS 252.204-7012- Safeguarding covered defense information and cyber incident reporting](#).



FASTER SPEEDS, GREATER SCALABILITY, **AND FLEXIBILITY IN OUR DATA CENTERS**

As a top research institution, CU Boulder strives to provide its researchers with the resources necessary to fulfill their technological needs and allow them to focus on their work. CU Boulder's data centers were suffering from aging network infrastructure that limited our ability to deliver the high-performance computing experience that CU expects and requires. With that in mind, Cisco's Application Centric Infrastructure (ACI) was deployed this year in the Space Science Center (SPSC) and Computing Center data centers. The new ACI infrastructure has allowed CU Boulder to move from aging hardware onto a more robust Software Defined Networking (SDN) platform capable of faster speeds, greater scalability, and flexibility at about one-third of the power consumption of the old network equipment.

Previously, most network connections in the data centers were limited to 10 gigabits per second. Now they deliver connections at 40 and 100 gigabits per second to systems that require higher levels of performance, along with additional flexibility in the network topologies in the data centers.



Image of DKIST from <https://nso.edu/gallery/>

OIT SUPPORTS **THE WORLD'S MOST POWERFUL SOLAR TELESCOPE**

Near the summit of Haleakala in Maui, sits the [Daniel K. Inoué Solar Telescope](#) (DKIST), the most powerful solar telescope in the world. In December, information from the telescope was [released to the public](#), enabling scientific communities to utilize this data for future exploration and innovation.

OIT's Networking and Data Center teams were part of the team of individuals that made this achievement possible. All of the data storage and processing that supports this telescope occurs on systems hosted on the CU-Science Network in the [SPSC Data Center](#). OIT collaborated with the National Solar Observatory (NSO) to design and support our network to ensure data gets to these servers and ensure the data center infrastructure meets NSO's needs. DKIST deployment at the SPSC data center is currently outfitted to support 6.3 Petabytes of storage/data which will also continue to grow, if not double, within the next two years.



PROTECTING UNIVERSITY DEVICES

The complexity, speed, and number of cyber threats are ever increasing and colleges and universities continue to be targeted by aggressive cyberattacks. It is crucial to protect data that has been entrusted to the care of the university. This year, OIT published campus baseline security standards for all [university-owned computers](#) and [servers](#). By setting minimum requirements, we aim to ensure the integrity and security of university data and the shared information technology environment, including networks, services, and systems.

These standards help to

- Increase the security of university computing assets, including data.
- Reduce the time to identify and respond to security incidents.
- Reduce risk to university intellectual property.
- Drive enterprise effectiveness and reduce the risk of software audits.
- Maintain employee flexibility in their technology to conduct their teaching, research, and creative work.

The standards were built upon security safeguards outlined in [APS 6001](#) and [APS 6005](#), as well as the NIST 800-53-based [Systemwide Baseline Security Standards](#) and [Highly Confidential & Highly Critical System Information Security Standard](#).

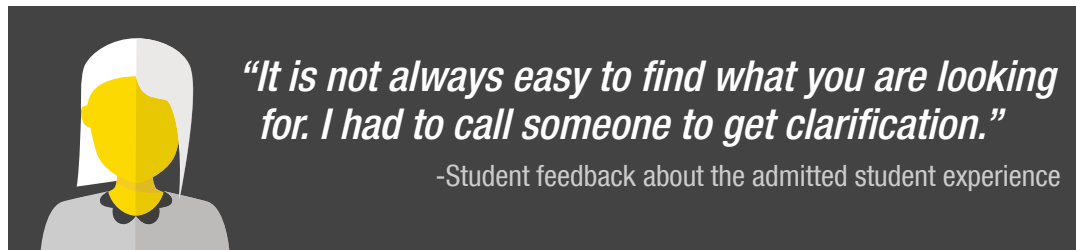
A core component of the new standards protects university-owned devices and proactively keeps them safe from threats. Microsoft Defender is an anti-malware component of Windows that gives OIT the ability to prevent, identify, and respond quickly to malicious actions. Those threats can and do include nation-states, large and small criminal organizations, hacker collectives, lone-wolf actors, and our own curious, but misguided students and staff.

This tool provides a single location where insight into concerning or malicious activities occurring across different systems (Windows servers, workstations, laptops, and IdentiKeys) can be identified and addressed early to limit the impacts of those malicious activities. It is a significant foundational step in securing CU Boulder's information technology landscape. Currently, Microsoft Defender is deployed on over 8,300 CU Boulder Dedicated Desktop Support devices, servers, and Active Directory domain controllers. This capability has already allowed OIT to detect and remediate a number of compromised devices and user accounts on the CU Boulder network and further deployment of this tool to non-OIT managed systems is underway.

IMPROVING THE BUFF PORTAL EXPERIENCE FOR ADMITTED STUDENTS

Getting admitted to CU Boulder is an exciting moment for future students. After the initial excitement passes, these students often have a number of questions that need to be answered before they confirm their attendance at CU Boulder, like *“What financial aid and scholarships are they eligible for?”* and *“What transfer credits will be applied to their future degree program?”*. Upon confirming attendance, a whole host of other questions around housing, advising, and registering for classes begin to arise.

Prior to this year, it was not easy for newly admitted students to find this information in CU Boulder’s online student portal, known as the Buff Portal, and many had to call the IT Service Center or Buff Info to get help.



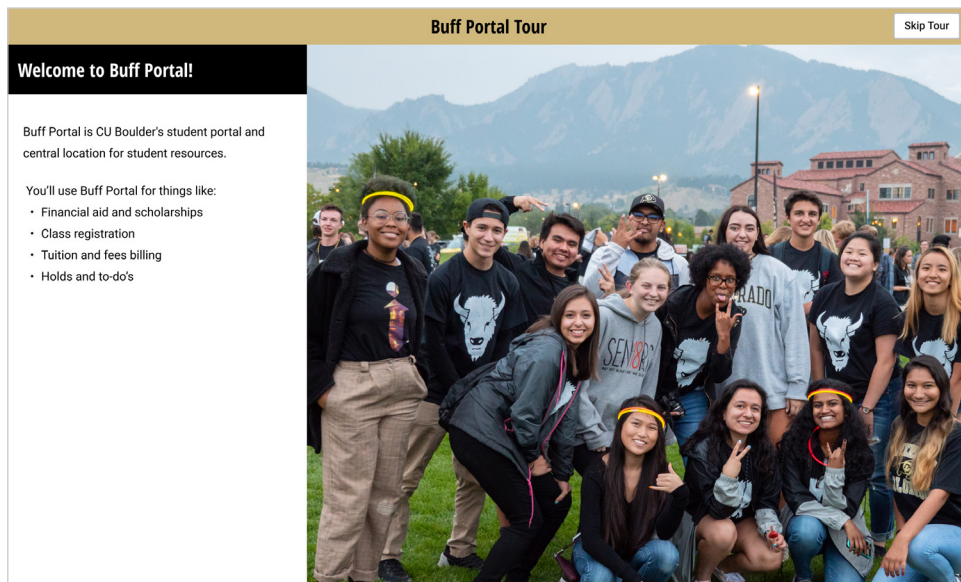
To provide a better experience for admitted students, OIT did extensive business analysis work with stakeholders across CU Boulder and OIT, paired with thorough user research involving recently admitted and new students. This analysis and research identified the following needs:

- **Improved Information:** Students needed to understand which tasks are for now and which are for later, which are required vs. optional, and which tasks have dependencies on others.
- **Dates and Deadlines for Required Tasks:** Students struggled with the lack of clarity around when tasks had to be completed, and in what order.
- **Clarity on the Role of Buff Portal vs. Canvas:** Students wanted to understand when they’d use Buff Portal and when they’d use Canvas (CU’s learning management system).
- **To Feel Celebrated and Proud About Their Admission to CU:** Students reported feeling a lack of fanfare/excitement from CU when they accepted admission.

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To create a seamless transition as a student undergoes this journey from being admitted to being ready to start classes, our team not only needed to understand all the Admissions processes (Undergraduate, Graduate, Leeds, Law, and Continuing Education) but also:

- Provisioning and systems access from Identity Access Management
- Admitted and New Student communications across departments (Admissions, Student Affairs, Financial Aid, OIT, etc.)
- Pain points around the Admissions/New Student processes from students and ITSC (everyone, really)
- Advising & registration processes with Undergraduate Education and the Registrar's office
- Housing applications and New Student Welcome with Student Affairs
- Financial Aid processes with the Office of Financial Aid



The team spent over six months asking questions to students and staff, mapping processes, negotiating requirements, and weaving together a new experience for admitted students. The end result within the portal is now a smooth transition from admission through confirmation and orientation, tailoring the experience for each kind of student including transfer vs. first-year, domestic vs. international, grad vs. undergrad, etc. In addition, there is a new onboarding experience for first-time and returning users that explains how to navigate the Buff Portal and celebrates their achievement of becoming a CU Buff.

This was a pinnacle moment in portal development from a data perspective. From this journey, the team gained a deeper knowledge of Campus Solutions, so that they could begin utilizing data to create a much more fine-tuned and personalized experience in the portal. This concept has been expanded in the New Student Welcome experience and aspects of financial aid (scholarships specifically), and will only continue to grow over time throughout Buff Portal.

DEMANDS FOR ONLINE AND HYBRID TEACHING AND LEARNING CONTINUE

During the pandemic OIT responded by offering several online solutions for both synchronous and asynchronous teaching and learning. OIT's streaming media services saw exponential growth in utilization. As our campus transitions back to 'normal', online and hybrid teaching and learning modalities have been established as mainstays, expanding how the university offers courses. The streaming media services, Zoom and Classroom Capture continue to see high demand.

Zoom Yearly Usage

	Pre-Pandemic	Pandemic	Pandemic	Current
	2019	2020	2021	2022
Licensed Users	11,945	47,848	53,700	55,885
Meetings	104,581	1,301,238	1,433,177	983,420
Meeting Participants	425,449	9,589,895	9,765,670	5,331,944
Meeting Hours	336,306	8,238,642	8,492,907	4,055,813

With classes being mostly back to pre-pandemic in-person mode, the amount of time the campus community spent in online Zoom meetings in 2022 remained tenfold the pre-pandemic times, with 336,306 meeting hours across campus in 2019 and 4,055,813 in 2022.

Classroom Capture Yearly Usage

	Pre-Pandemic	Pandemic	Pandemic	Current
	2019	2020	2021	2022
Courses	409	358	288	539
Class Recordings	10,574	5,623	7,827	13,474
Users	16,000	12,460	9,287	19,636

Classroom Capture saw a decline in usage during the pandemic when many classes were remote. In 2022, utilization has rebounded and surpassed pre-pandemic numbers with the number of courses using Classroom Capture increasing by 31% (from 409 to 539 courses).

IClicker USAGE AT AN ALL-TIME HIGH

COVID changed the way online materials are used in the classroom and instructors have become increasingly reliant on online services such as Canvas to teach and test. The demand for fast and reliable Wi-Fi while teaching is rapidly increasing and iClickers is one of the services that escalates that need.

iClicker is an interactive polling software that enables students to participate in polls and respond to questions during class. It greatly enhances student engagement. Before the pandemic, instructors were utilizing physical iClickers in the classroom. With the shift to online learning, instructors implemented an iClicker polling app, enabling students to participate from remote locations.

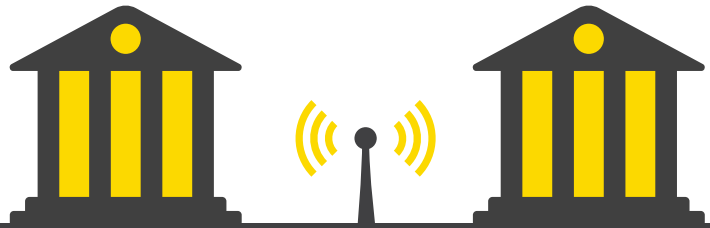
- This new version of iClicker brought a surge in service usage. This past academic year the number of students using the CUClickers service reached a record high of **18,000-19,000 per semester**. Now that many classes are back in person, both iClicker options (physical iClickers and iClicker polling app) are available to instructors and can be used exclusively or side-by-side.



To ease the financial burden of obtaining a physical iClicker, more than **350** clickers were made available for checkout from the Norlin library. All **350** were checked out by the third day of school this fall semester.

However, to use the iClicker polling app, students need to connect to Wi-Fi or use their personal data plan. Wi-Fi capability in classrooms can be limited due to certain factors. It can be difficult to connect to a cellular network in basement classrooms and the legacy wireless infrastructure in non-upgraded buildings struggles to provide sufficient wireless coverage for larger classes.

To help instructors make an informed decision as to whether to permit mobile polling in their courses, the Academic Technology team collaborated with OIT's wireless networking group to assess the wireless capacity for clicker-enabled rooms. Together they published a searchable table listing Wi-Fi strength and iClicker frequency codes for instructors. Frequency codes are the codes the classroom uses to allow the clickers to work for that room. Using this table, instructors are able to determine whether or not to utilize the iClicker polling app in their course. This assessment also prompted nine Wi-Fi classroom upgrades with additional classroom upgrades planned for 2023.



WI-FI ENHANCEMENTS

Keeping up with Wi-Fi demands can be an arduous journey. More and more items continue to become Wi-Fi enabled and it's hard to keep up with all the new devices; however, OIT is working to rapidly address the needs of our campus community.

Based on various determining factors, including student and faculty input, OIT identifies the buildings in most need of upgrades and enhancements and implements a high-density design featuring the latest Wi-Fi technology in these spaces. Over the past year, OIT completed fifteen buildings. Three of those upgrades were a partnership with Housing (Kittredge West, Kittredge Central, and Baker Hall). In these residence halls, special Wi-Fi access points known as hospitality APs, which offer enough signal density to allow students to connect multiple devices with sufficient bandwidth for both studying and recreation, were installed resulting in significant cost savings to Housing.

Wi-Fi enhancements across campus are ongoing with ten full building renovations planned for the rest of 2023. The networking team continues to upgrade additional campus buildings based on needs and priority.

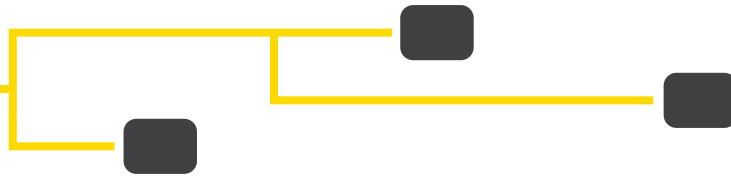


PREPARATION FOR THE FUTURE OF NETWORKING

Much of the internet today runs on Internet Protocol version 4 (IPv4). IPv4 is limited to approximately 4.3 billion connected devices. Over time, the size of the internet has grown to far exceed that number through a variety of workarounds that will not scale well into the future.

Internet Protocol version 6 (IPv6) is a technology that allows the internet and the CU Boulder network to scale far beyond the capabilities originally envisioned by the creators of the internet . The federal government has been pushing for IPv6 adoption to ensure that the country is ready for the future of networking.

In 2018, The Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) approached Network Engineering and Operations (NEO) and asked for assistance meeting the federal requirements to support both IPv4 and IPv6 in order to be able to sell their RiverWare software to the US Bureau of Reclamation. The project charter was completed at the end of 2018, and work began in 2019. The pandemic slowed progress but in April 2022, the project was declared complete. NEO was able to deliver IPv6 to meet the needs of CADSWES, and in the process, build out the infrastructure necessary to meet the needs of future students, researchers, and grant writers.



NEW POLICY HELPS WITH **EFFICIENCIES AND STANDARDIZATION**

The campus Architecture Review Board (ARB) is a team of senior IT professionals from OIT and other campus areas with specific domain and/or campus IT architecture knowledge that ensures technical decisions made by campus IT service providers and project teams appropriately consider important contextual factors.

The ARB facilitates and assists with technical design and implementation decisions. They also develop technology standards that optimize the overall campus and university system IT ecosystem by maximizing interoperability, creating a consistent end-user experience, eliminating redundancies, and reducing single points of failure. To reinforce these standards, the campus has rolled out the CU Boulder IT Standards and Foundational Services Policy this year.

This policy was developed with substantial input and support from campus leadership to fulfill the following needs:

- Improve efficiencies through standardization that is deliberate and provides campus-wide governance.
- Provide a high-level policy that ensures the work of the Architecture Review Board (ARB) has maximal value.
- Ensure campus IT providers have documented standards and best practices that can be used internally and provided to vendors, including Request For Proposals (RFPs)

This policy created new processes for working with the ARB by developing standards and establishing foundational services that include communication and refinement with the campus and the IT Community of Practice. Other efficiencies of this policy include:

- The use of common services by creating economies of scale for operations and licensing.
- Ensuring new IT systems can be easily deployed and are a good fit for the campus IT environment.
- Maximizing the value of existing systems by using standards for services (e.g., data integration and management) and reducing one-off customizations of any system.

In addition to efficiencies and reduction of redundant services that will come from this policy, it reduces complexity for students and employees who use campus IT services.



THANK YOU FOR YOUR EFFORTS!

These achievements are a testament to the unwavering commitment, exceptional abilities, and collaborative spirit of both OIT staff and our valued partners. I am consistently inspired by our team's hard work and dedication, and deeply appreciate everyone's efforts and contributions toward advancing the CU Boulder mission.

Marin Stanek
Vice Chancellor for IT and CIO



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