



2015-16

Clemson Computing &
Information Technology
Annual Report

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CLEMSON[®] BY THE NUMBERS

COMPUTING AND INFORMATION TECHNOLOGY

4th

Palmetto ranks as the 4th-fastest supercomputer at a US public university.

820

Research Computing environment users, an increase of 6.6% from FY15

22,770

Customers walked into the CCIT Support Center for help

42,350

Unique URLs blocked monthly for users by anti-virus malware services to protect against malware

\$19.3M

Amount of sponsored research awards in FY16, a 48% increase from FY15

2,850

University-owned servers, a 29% increase (with 2,094 virtual servers)

2,814

New 1GB/s data jacks added to the Clemson network in 2015-16

2,507

Wireless access points available, a 22.2% increase from FY15

Executive Summary

Clemson Computing and Information Technology continued to adapt and innovate in fiscal year 2016, rising to meet a number of initiatives and projects centered around its five core areas: Infrastructure, Research, Collaboration, Shared Services, and Teaching and Learning. The diligent work of nearly 400 dedicated employees of CCIT remained constant in meeting the organization's five IT goals.

In the development of these strategic goals, CCIT has focused on five core tenets: Build and maintain a robust infrastructure, maintain and support mission-critical systems, provide appropriate learning technologies to support academics, provide the adequate customer support needed for the university and state, and leverage existing and develop new core competencies to drive future innovation.

Within infrastructure, Clemson's investment in research computing continued to pay dividends. CCIT's Palmetto performance computing cluster once again took its customary ranking within the top five of all public institutions nationwide. CCIT also added the new Cypress cluster, working in parallel with Palmetto and dedicated to Big Data research projects that could provide the next breakthrough in a wide range of fields from genomics to social science. CCIT also invested in Disaster Recovery pods, strategically located both in and outside of the geographic area to help provide campus and CCIT customers with best-of-breed technology architectures.

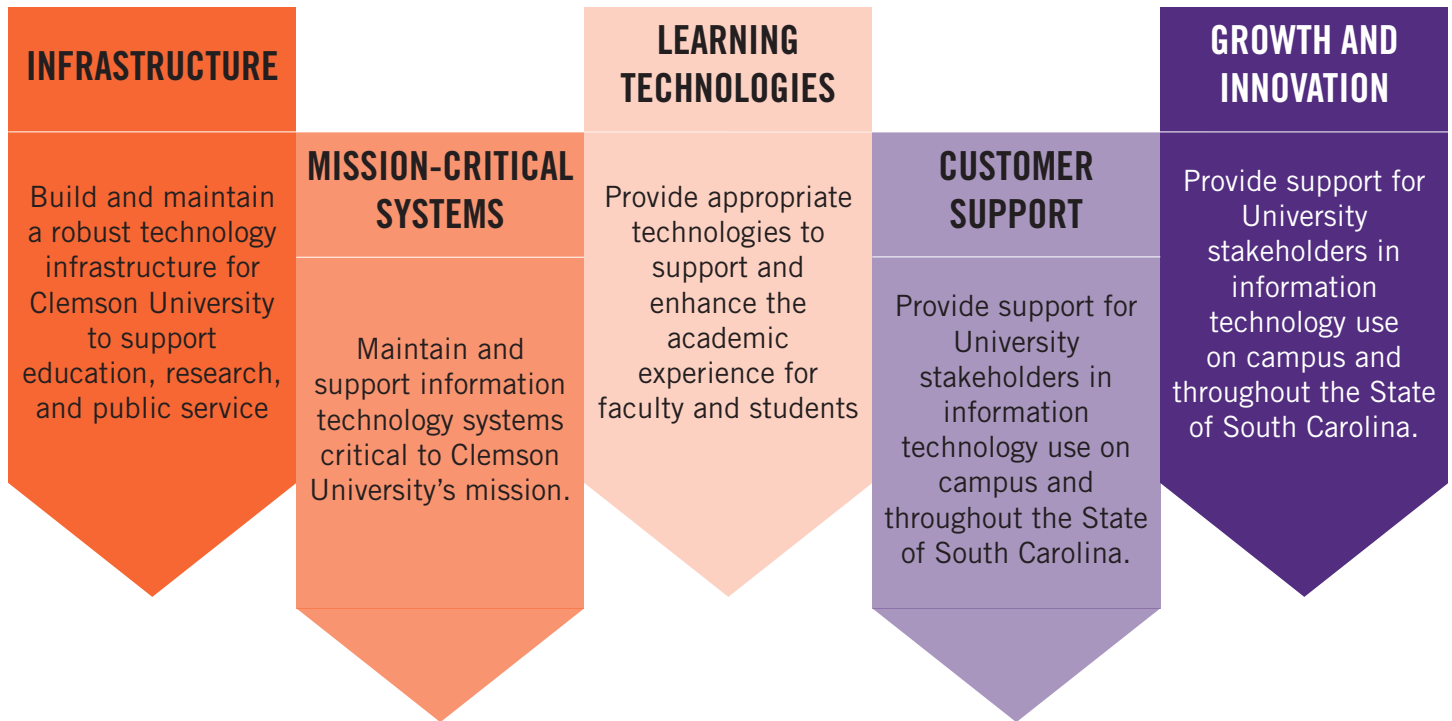
FY16 was also a productive research year for CCIT. Through our research staff, and through faculty partnerships, CCIT was party to over \$1.7 million in new sponsored research awards in FY16. This includes partnerships with ECE and the Department of Biophysics and Bioinformatics, and also includes a new \$750,000 National Science Foundation grant to fund a Research Coordination Network to set up a national forum for the exchange and dissemination of best practices, expertise, and technologies to enable the advancement of campus-based research computing activities. Members in this effort included 28 institutions from around the nation in setting up this important forum.

CCIT strengthened its partnerships both on and off campus through creative collaboration in 2015-16. From a Spirit Communications gift that will connect Clemson and other schools to the South Carolina LightRail optical network, to hosting several nationwide workshops and engaging in leadership development, Clemson's ties continued to grow. The school's partnership with Adobe saw the opening of the innovative and student-focused Adobe Digital Studio and the growth of the Creative Cloud on campus. CCIT's work with its faculty, staff and student advisory groups yielded several exciting projects and substantial investment in the campus network. After months of feedback from around the Clemson community, CCIT also launched its new website, designed to easily connect visitors with support, services, training, news and information.

CCIT listened to its customers and delivered in 2015-16, with a portfolio of 73 projects—67 percent led by the department's Project Management Office, totaling an estimated 70,385 man hours of work. The release of Office 365 moved email to the cloud while providing the latest in Microsoft's storage and app suite. CCIT's Enterprise Systems and Applications (ESA) and Customer Relations groups turned in another strong year, launching PeopleSoft HR 9.2 and successfully transitioning CUBS financials to the new college reorganization plan while also updating the my.Clemson app and improving the TigerOne ID card system. The Software Development team worked on a host of projects and developed several key applications used daily across campus. The Cybersecurity Operations Center launched and reviewed more than 75,000 security events as well while the Center of Excellence worked to connect campus resources while promoting creativity. Students, staff and faculty also continued to take advantage of CCIT's Support Center, receiving help by way of more than 33,000 calls and nearly 23,000 visits.

Lastly, CCIT continued to facilitate teaching and learning on campus, upgrading equipment in 40 central classrooms, two video conferencing lecture halls and one auditorium while enhancing a slew of other locations. CCIT groups also offered more than 700 training courses for nearly 7,000 attendees on a wide range of topics including cyberinfrastructure, Microsoft and Adobe. Clemson's CCIT-sponsored cybersecurity team took first place at a regional event and the department also participated in GIS Day, offering more than a dozen speakers and showcasing the revamped Geospatial Laboratory to more than 160 faculty, staff and student visitors.

Strategic Goals



In support of these goals, CCIT seeks to contribute to the overall university mission and vision. In doing so, CCIT contributes to the following President's Report Card metrics:

- Measure the effect of high performance computing on productivity.
- Leverage enhanced infrastructure for partnerships and shared cloud services.
- Increase the number and quality of technology-enhanced classrooms.
- Increase government, university, and industry partnerships.
- Increase research expenditures by 50 percent.
- Continue to support economic development through job growth and capital investment in South Carolina through innovation and research.
- Increase the number of undergraduate and graduate students presenting papers/posters at national meetings.
- Increase the number of external internships & co-ops.
- Increase the number of internal (campus) internships to engage 500 students annually.
- Deploy new student and research information systems successfully.
- Enhance business system capabilities to decrease transaction costs.

Palmetto Cluster



Palmetto ranked as the 4th-fastest supercomputer at a US public campus

The Palmetto Cluster is Clemson’s high performance and research computing cluster designed to support faculty and student research and education needs and to increase the competitiveness of the university in advanced computing. This resource, developed and funded collaboratively through IT contributions, faculty contributions, and sponsored research, provides a shared ‘condominium’ platform that

optimizes compute resources for all users. The Palmetto Cluster appeared once again on the Top500 list—a biannual ranking of the world’s fastest supercomputers—clocking in at No. 134 worldwide and ranking in the top five fastest supercomputers on a public university campus in the United States. In achieving this, the system benchmarked at 745 teraflops – or 745 trillion mathematical operations per second.

Disaster Recovery Pods

In an effort to provide advanced services and technologies to end-users, CCIT has invested in Disaster Recovery Pods (DR Pods); which in the event of service interruption at our local Compute Pods, will allow technology services to continue to run effectively. The DR Pods, which are strategically located both in and outside of our geographic area, are a major step towards providing campus and CCIT customers with best-of-breed technology architectures. Launch of the DR Pods took place

in FY16 with the stand-up of the infrastructure necessary to run the DR Pods. These DR Pods mirror the infrastructure of CCIT’s production pods to allow for a seamless transition in the event they need to be activated. FY17 goals and priorities include the continued testing of the DR Pods to ensure interoperability of mission critical applications for both campus and external customers, as well as the continued introduction and education of disaster recovery capabilities that CCIT offers.



Disaster Recovery Pods are a major step towards providing campus and CCIT customers with best-of-breed technology architectures

Clemson University Cloud



Clemson University Cloud is an initiative that will continue to be at the forefront for FY17 as customers’ needs continue to grow

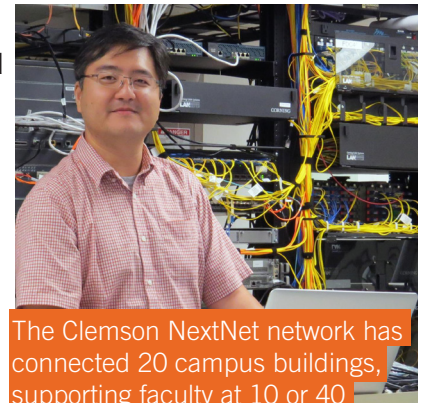
The Clemson University Cloud proved to be an area of great advancement and accomplishment for FY16. Compute Pods, which the Clemson University Cloud is comprised of, are housed at Clemson’s Information Technology Center, and host many of the applications and services that students, faculty, and staff use daily. The Clemson University Cloud compute pods include

hardware from industry-leading vendors Lenovo, NetApp, F5, BigSwitch and others. Clemson University Cloud is an initiative that will continue to be at the forefront for FY17 as customers’ needs continue to grow. Expansion of the Clemson University Cloud could prove necessary as popularity and use between campus and external customers rise.

Clemson NextNet

In 2012, the National Science Foundation awarded Clemson University, under the direction of Dr. Kuang-Ching Wang from Electrical & Computer Engineering, a \$1 million award to model an evolutionary next-generation campus network to provide advanced network connectivity for research and education. Named Clemson NextNet, the network's mission is to enhance science discovery across broad disciplines by enabling agile and high throughput connections inside and beyond Clemson. The project concluded in October 2015, by which time the network has connected 20 campus buildings, supporting faculty at 10 or 40 Gbps connectivity. The project has spawned new research projects in genomics, bioengineering, and computer science, and received national spotlight with its collaboration with NCBI/NIH and University of Utah to explore the data transfer performance limits between Clemson and these partners. Clemson

NextNet also established CCIT's network team among the nation's pioneering experts in operating software defined networks at production, leading to the formal adoption of software defined networking technologies inside Clemson's data center and campus core networks. Students from this projects have entered the industry as leaders in the technology. Beyond the project, Clemson continues to be seen as among the thought leaders for the evolution of advanced campus networks and computing infrastructure that was bootstrapped by this project.



The Clemson NextNet network has connected 20 campus buildings, supporting faculty at 10 or 40 Gbps connectivity



Classrooms and laboratories were some of the upgrades addressed in FY16

Life Cycle Replacement Strategy

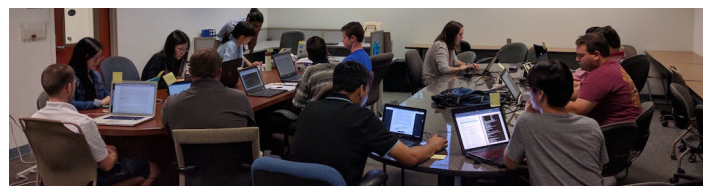
CCIT continues its strategic focus on long-term life cycle replacement (LCR) for aging infrastructure in an effort to maintain environment stability and provide technological advances to students, faculty, and staff. FY16 accomplishments include the purchase and installation of hardware that support the major areas of the LCR

focus: classrooms and laboratories, the Palmetto Cluster, Cloud and datacenter infrastructure, as well as network-wireless and building rewiring. This was funded by the \$3.6 million investment into the life cycle replacement fund during FY15. FY17 priorities include the continued update and upgrade of aging infrastructure.

Cypress Cluster

Parallel to Palmetto Cluster, Clemson's high performance computing cluster, the University runs Cypress cluster. Cypress is a standalone data analytics system dedicated to research projects that employ technological components of the Hadoop Big Data Ecosystem for the analysis of large amounts of data and very large storage space supporting all stages of the analysis. Cypress cluster is based on 40 nodes and 3.6PB of storage space while using the Hortonworks Data Platform distribution of the Hadoop ecosystem to support data intensive computing and analytics. This distribution includes components critical to the lifecycle of big data analytics such as MapReduce for large scale batch processing, Pig and Hive for SQL infrastructure, HBase and Accumulo

for NoSQL infrastructures, Spark for in-memory data processing, and Storm and Kafka for streaming data infrastructures. Cypress' storage relies on the underlying distributed file system (Hadoop Distributed File System - HDFS) and its redundancy for data protection. CITI's Data Science group is currently working with several research groups on campus on porting their work to Cypress cluster including research from genomics to social science.



CloudLab

CloudLab, the groundbreaking National Science Foundation project that started in October 2014 has come to full steam this year. As a collaborative project among Clemson University, University of Utah, and University of Wisconsin-Madison, the project builds a future data center - distributed across three universities but operating as one system - that would allow researchers nationwide to explore the possibilities of future cloud architectures by flexibly reconfiguring almost all aspects of the system from the bare metal servers up. This year, Clemson CloudLab, under the lead of Dr. Kuang-Ching Wang and the CCIT team, has completed its build-out and has continued to be used at near full capacity. In addition to the build and operation, the Clemson team applied its networking leadership within this project to push the envelope of CloudLab's networking and data I/O capabilities, including integration of a software

defined networking high throughput data transfer software with the OrangeFS parallel file system inside CloudLab. Clemson CloudLab also added NVIDIA GPUs upon researcher demand. In addition to researchers, CCIT staff across divisions - system, networking, security, etc. - has started to leverage CloudLab to envision innovative cloud use cases. The \$10 million project is led by the University of Utah and includes Clemson, the University of Massachusetts-Amherst, the University of Wisconsin, Raytheon BBN Technologies and the US Ignite foundation as partners. CloudLab has drawn national and international attention as the forefront of cloud technologies research platform and increasingly have been engaged in the envisioning and planning of future campus cyberinfrastructure.

The Clemson team applied its networking leadership within this project to push the envelope of CloudLab's networking and data I/O capabilities

CloudLab

3D Ad Content with Adobe

Clemson's Center of Excellence partnered with Adobe to explore the Adobe Creative Cloud suite for developing 3D content, with an eye on developing a creative SDK for virtual reality ads. Clemson's Advanced Visualization group wants to explore ad placement in virtual reality in more subtle ways than simply placing ads on a billboard in a gaming environment, perhaps encouraging users to take part in novel marketing and awareness campaigns using VR/AR as a medium that allows them to place their brands within the environment. The research will

explore ways to help customers build personal campaigns and manage 3D contents and assets for virtual reality experiences. Clemson's Center of Excellence aims to build on its partnership with Adobe to leverage the full capabilities of its recently acquired Mixamo suite, a 3D Character creation and animation tool that is being incorporated into the Creative Cloud. The award will also aim to create a monthly training program on the use of Adobe Creative Cloud for 3D object/character creation, rigging and animation for the students and staff at Clemson.

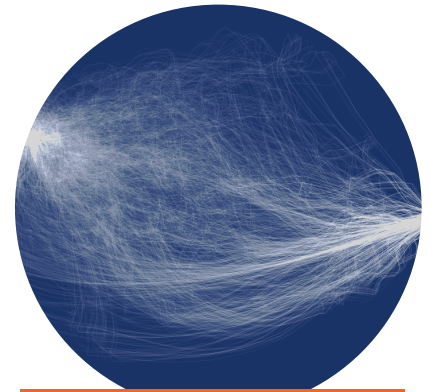


The Center of Excellence's partnership with Adobe will explore the possibilities of marketing in a 3D environment

Open Science Grid

FY15 saw the integration of the Open Science Grid (OSG) with Clemson's Palmetto Cluster and OSG Connect. OSG, sponsored by the National Science Foundation and the US Department of Energy, is a freely accessible distributed computing resource for scientific calculations designed to handle a large number of computational tasks. OSG provides common service and support for resource providers and scientific institutions using a distributed fabric of high throughput computational services, and provides

software and services to users and resource providers alike to enable the opportunistic sharing of resources. CCIT's Cyberinfrastructure Technology Integration group (CITI) hosted the annual Open Science Grid All Hands Meeting from March 14-18 at the Madren Conference Center. Topics included an overview of the Open Science Grid and the research it supports, usability challenges and solutions for distributed high throughput computing applications, training and education, broadening participation and more.



Clemson PhD student Paul Kilgo used OSG to compute his data, resulting in the visualization of the paths his algorithms produced

Clemson Visualization



Clemson's Advanced Visualization department showed off work done in its revamped lab at the IEEE Virtual Reality conference in March 2016

Clemson's Advanced Visualization Department continued to build on its Barre Hall 2004 lab under Dr. Oyewole Oyekoya, giving Clemson researchers better insight into their data using cutting-edge equipment and high-performance visualization. The lab installed six 46" tiled displays, a multitouch table and several computer workstations connected to head-mounted Oculus Rift, HTC Vive, Samsung Gear VR and Microsoft

HoloLens devices. A group of students worked on projects that included a virtual driving simulator, an anti-bullying demonstration and a walkthrough model of Clemson's new Littlejohn Coliseum. In March, Oyekoya and Clemson researchers showcased their work at the Institute of Electrical and Electronics Engineers (IEEE) Virtual Reality conference in Greenville, hosted by Clemson University.

CCIT Research Productivity

FY16 was also a productive research year for CCIT. Through our research staff, and through faculty partnerships, CCIT was party to over \$1.7 million in new sponsored research awards in FY16. This includes partnerships with ECE and the Department of Biophysics and Bioinformatics, and also includes a new \$750,000 National Science Foundation grant

to fund a Research Coordination Network to set up a national forum for the exchange and dissemination of best practices, expertise, and technologies to enable the advancement of campus-based research computing activities. Members in this effort included 28 institutions from around the nation in setting up this important forum.



CCIT was party to over \$1.7 million in new sponsored research awards, including advancement of research computing activities

ACI-REF

In 2014, the National Science Foundation awarded Clemson, under the direction of Jim Bottum, a \$5.3 million award to enable a national network of Advanced Cyberinfrastructure Research and Education Facilitators (ACI-REFs) to broaden the impact of advanced computing resources on Clemson's campus and across the nation. Built on the successful facilitation structure and organization within CCIT – the Cyberinfrastructure Technology Integration group – the consortium of institutions is committed to the vision of advancing scientific discovery and maximizing investments made

by campuses in research computing. Since that time, facilitators on six campuses – Harvard University, Clemson University, University of Wisconsin-Madison, University of Utah, University of Southern California, and University of Hawai'i – have come together to assist hundreds of researchers and research groups across the nation. Facilitators in the ACI-REF network have conducted over 2,000 individualized interactions in the past two years, and have held at least 164 training sessions over the last year, training at least 2,653 researchers at multiple campuses.



Facilitators in the ACI-REF network have conducted over 2,000 individualized interactions in the past two years



Fedushare aims to make it easier to share resources on one campus with collaborators at other institutions

Fedushare

FeduShare, an environment for researchers to provision and manage collaborations, moved ahead in FY16. Partners in the NSF-Funded endeavor include Clemson, the University of Utah, BBN, and the University of Illinois. FeduShare uses the InCommon consortium to make it easier to share resources on one campus with collaborators at other institutions. Internet2's Shibboleth software

is used to authorize access to these resources based on a faculty member's self-managed list of collaborators, in accordance with local campus policies. The group's demonstration at the Internet2 the Internet2 Technology Exchange in October 2015 showed a person from the University of Utah logging in to the Palmetto HPC cluster at Clemson using their Utah logon and password.

Southern Partnership in Advanced Networking

The NSF-funded Southern Partnership in Advanced Networking (SPAN) project is aimed at facilitating the creation of a regional network of expertise distributed across multiple institutions in support of faculty-led research and education that benefits from advanced networking, computing, and other cyberinfrastructure support capabilities. The project has helped to create new collaborations within distributed science communities across the region that can leverage advanced networking and computing solutions to make new science discoveries. During the last year, the SPAN program included two workshops - one at the University of Alabama at Huntsville from November 3-4, 2015 and one at the

University of Central Florida on March 9-10, 2016. A particular focus was given in these workshops to broaden the topics to include the entire spectrum of cyberinfrastructure - from researchers' perspective, networking perspectives, computing perspectives, and data needs. For the most recent workshop, there were 35+ attendees from 15+ institutions, mostly in the state of Florida, attending.



The SPAN Program included two workshops featuring presentations from Clemson researchers

Spirit Communications & SCLR



Spirit's gift of services valued at \$1.4M will connect Clemson and others to the South Carolina LightRail

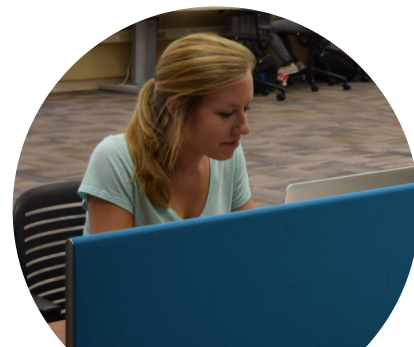
Spirit Communications donated broadband services valued at \$1.4 million to Clemson University in September, which will connect South Carolina's premier research universities with a state-of-the-art fiber optic backbone. The gift allows Clemson University, the Medical University of South Carolina and the University of South Carolina access to the South Carolina LightRail (SCLR), a high-speed optical network.

The access provides network connectivity for research and education between the three major research universities and other entities, both private and public. It is a public-private partnership to provide a broadband, high-speed optical network that will extend throughout the state and link to regional and national networks, such as Southern Light Rail, National Lambda Rail, Internet2 and SURAGrid and TeraGrid.

CCIT Intern Program

CCIT has developed a highly successful student intern program focused on training the next generation of IT practitioners in 21st century cyberinfrastructure through hands-on operational and strategic projects within the organization. CCIT hosted 60 interns in 2015-16 through the University Professional Internship/Co-Op Program (UPIC) in all areas of IT – including software development, high performance

computing, business operations, cybersecurity, mobile innovation, geospatial data, GIS, visualization and storage architecture. CCIT interns have gone on to receive job offers from a number of Fortune500 companies including Dell, Google, and Oracle, and many have received offers from highly competitive start ups. Interns are also frequently offered priority review for highly competitive internships at these organizations.



CCIT hosted 60 interns in FY16 in all areas of the department, ranging from software development to cybersecurity



Over two days, CCIT hosted the collaborative workshop series aimed at how universities can better support data-intensive research and science

OIN Workshop at Clemson

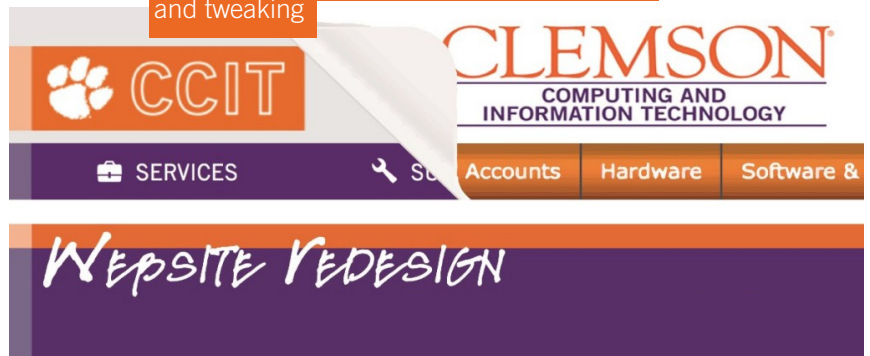
On September 23-24, CCIT hosted guests at the Madren Center from around the country at a workshop focused on optimizing infrastructure for science and research. The workshop was part of the Operating Innovative Networks workshop series put on by ESnet, Indiana University's Global NOC, and Internet2. CIO Jim Bottum opened the event by welcoming the attendees to Clemson and highlighting top research and technology projects

at Clemson. At that point, the organizers and attendees dove straight into topics such as Science DMZ, Data Transfer Nodes, perfSONAR, Science Engagement, and Software Defined Networks, and using Globus as a data transfer tool. It was a full two days of technical deep dives into the principles and best practices universities can use to support the data-intensive research and science happening on their campuses.

New CCIT Website

FY15 saw the end of pre-production and beta release of CCIT's new website. A customer-facing Wordpress home for CCIT, the site gives visitors a helpful and visually clean experience to find what they need. Aimed at connecting the Clemson community with support, services, training, news and information, CCIT solicited feedback for months during its beta phase to maximize efficiency.

CCIT's new home on the web will launch after months of feedback solicitation, design and tweaking



The ITSAB funded a host of projects in 2015-16, included hardware and network upgrades and a Makerspace in the Watt Family Innovation Center

IT Student Advisory Board

The IT Student Advisory Board (ITSAB) is a group of students representing all seven colleges as well as graduate and undergraduate student senates that advises CCIT on all strategic, student-facing IT issues. Additionally, the ITSAB, along with CCIT, collaboratively manages the Student Technology Fee and posts a yearly call for proposals which request funding for strategic student-facing IT

projects. In 2015-16, the ITSAB chose to help fund residence hall printers, CU Mobile (new devices and training of my.Clemson mobile team), hardware repair, bus tracking, a solar-based Creative Inquiry project and others. The board allocated substantial funds to fund CORE campus and network upgrades as well. The board also added a new chair, Biology student Dory Askins.

Big Data Hubs

The National Science Foundation (NSF) unveiled the Big Data Regional Innovation Hubs (BD Hubs) program in November to bring together academia, the private sector, non-governmental organizations and other interested parties to solve big data problems and accelerate innovation. Clemson joined the South Big Data Regional Innovation Hub (South BD Hub), managed jointly by Georgia Tech and UNC-Chapel Hill as one of four Regional BD

Hubs. The new initiative brings together researchers and industries to work together on big data problems in different areas and underlying cyberinfrastructure. The university already maintains multiple major Big Data research projects in genomics, connected transportation, smart grid and smart cities along with its leadership role in advancing the cyberinfrastructure necessary for big data computing through multiple NSF initiatives.



BD Hubs will engage regional businesses and research organizations as well as develop governance structures and "spoke projects" based on regional priorities and partnerships



Clemson & Adobe

CCIT, along with partners from the Department of English, the Libraries, Undergraduate Studies and Creative Inquiry, and Development, continued its first-of-its-kind flagship partnership with Adobe Systems, Inc. The past year saw the grand opening of the collaborative Adobe Digital Studio space in Clemson's Cooper Library. The University also began plans to implement Adobe Marketing Cloud and Adobe Campaign to further advancement initiatives and complement the successful Adobe Creative Cloud project, entering its third year.

MOR Associates Staff Development

During 2015-16, CCIT continued to invest in the MOR Associates national IT leadership program to advance their professional development and further their leadership skills. Participation in this program is indicative of CCIT's ongoing commitment to staff professional development, and complements ongoing internal professional development opportunities for the next generations of IT leaders at Clemson. February saw the graduation for the MOR Associates first-ever CCIT Emerging Leaders

program as Randy Apon, Andrew Carson, Bobby Clark, Steve Fullerton, Tracey Hare, Matthew Garrett, Nancy Griffis, Sam Hoover, Barry Johnson, Sudie Johnson, Teresa Johnson, Timothy Moon, Linda Nelms, Wole Oyekoya, Amanda Powell, Bindu Rangaraju, Jacob Richardson and Michele Wood-Thomas completed their matriculation. Clemson also hosted the new national cohort of the MOR program in early March. A CCIT contingent offered a multimedia presentation complete with history, trivia and cadence count.



MOR Emerging Leaders demonstrated the leadership skills and management training they learned in a presentation to CCIT employees



CCIT Project Portfolio

The CCIT project portfolio included seventy-three projects for fiscal year 2016. Project Management Office (PMO) staff led sixty-seven percent of these projects totaling an estimated 70,385 man hours of work or 54% of all project man hours. Twenty-nine percent of the FY2016 projects were campus wide initiatives which were led by the PMO. Forty-five projects were CCIT sponsored initiatives – forty-two percent of these were network installs and upgrades for capital projects on campus. Overall project cost estimates total \$91,879,718.17. Key

campus initiatives lead by the PMO in FY2016 include Adobe Marketing Cloud Implementation, Banner XE Implementation for Registration, Business Objects 4.0 Upgrade, Canvas Implementation, College ReOrg – Technology/ Systems and Access, CUBS HR 9.2 Upgrade, Disaster Recovery and Pod Installs for DHHS and Campus, File Services Migration, Network Installs and Upgrades, Office 365 Implementation, and Space Planning for the Geospatial Support Center, Charleston Design Center, and MITS at CU-ICAR.



The CCIT Project Portfolio spanned work around the state (including CU-ICAR, seen here) and estimates total over \$91 million

CU-CAT



CU-CAT's work helped faculty and recruits identify research computing resources

The Clemson University Computational Advisory Team (CU-CAT) is a research computing interface between faculty who use high-performance computing (HPC) resources and IT staff who design and maintain experimental and production HPC systems at Clemson. In this highly technical open discussion forum, faculty voices from multiple science domains mix with those from key corners of the HPC enterprise. In addition to advisory input, faculty vote on complex computing issues that affect the global CU research computing community including the approval of exceptional resource allocations. These allocation decisions ensure that special projects get done with minimal impact to the extensive user base of the Palmetto cluster. CU-CAT met seven times during FY16. In these meetings, the most important accomplishment

was to provide a dialog between faculty users and CCIT (including CITI). The group provided a faculty perspective on many issues and help provide CCIT with a broader voice. Accomplishments include vetting and approved seven special resource allocations; created an environment for resource explanation for faculty and recruits, such as a new comprehensive website that explains research computing resources (including training); disseminated the evolving role of the Center of Excellence in Next Generation and Computing & Creativity to a group of faculty and CCIT staff and provided two advisors; met with ATC to help voice from additional faculty about the importance of the campus network upgrade; resolved concerns that users had with the scatch1 filesystem and high costs of storage.

TigerOne Services Support



TigerOne Card upgrades included better photo submissions and an enhanced customer experience

Clemson's TigerOne Card Services office, led by the Division of Student Affairs, is one of the major application areas that CCIT supports to provide services to campus. The TigerOne service support team rolled out a housing summer programs application that enhanced customer experience when managing summer programs

meal plan cards. The TigerOne service support team implemented a series of enhancements to increase the success rate of new student photo submissions and provide greater administrative controls for managing submissions. The TigerOne services support team also kicked off the CSGold 7.0 upgrade project.

CCIT Monthly Updates

In September, CCIT launched a revamped monthly internal newsletter for its nearly 400 employees in five South Carolina counties. With the goal of communicating department news, successes and upcoming events, the monthly updates now feature engaging art and content to keep CCIT informed. Stories include features from Clemson Newsstand, internal meetings and events, staff and intern spotlights, kudos from department heads, and volunteer requests for upcoming pilot projects.



Happy New Year from CCIT!



Over 400 CCIT employees receive the Monthly Update



The ESA Data Warehouse completed all security and report changes due to Clemson's reorganization

ESA Data Warehouse

Clemson's Enterprise Services and Applications (ESA) implements and maintains University applications and manages institutional data in support of business processes and decision making for the university's strategic initiatives. In the past year, the Data Warehouse team upgraded the Business Objects reporting software including the ETL tool (Data Integrator). This upgrade delivered new software including dashboards and visualization tools. The project was completed on-time and below budget. Additionally,

the Banner ODS was extended with customization for several student functional areas. The Data Warehouse also worked with student and financial areas to create requested reports, completed an internal audit, completed all security changes and report changes due to the college reorganization, maintained current patch levels for application software and conducted ongoing report training across various departments.

Center of Excellence

CCIT's Center of Excellence (CoE) for Next Generation Computing and Creativity sparked to life in FY16. Through digital creativity, geospatial technologies and next generation computing, the Center aims to push the boundaries of discovery and innovation, transforming research, education and creative communication. Through creativity partnerships that include Clemson athletics, Adobe and Creative Services, the Center of Excellence provided the Clemson community with the latest tools and technologies in

digital creativity and marketing. In FY16, the CoE unveiled its Digital Faculty Scholars program, an eight-member group from three colleges that shared methods on teaching and research related to digital creativity. CoE also assisted the admissions department in the development of a digital-focused recruiting arm, advised faculty with creative and marketing development of a project, offered impactful opportunities to both undergraduate and graduate students, and spoke around the country at various conferences.



The Center of Excellence's Digital Faculty Scholars program met monthly to share ideas on how to implement creativity in various curricula



The CCIT Support Center saw an increased number of phone calls and walk-in visits in FY16

CCIT Support Center

The CCIT Support Center, located on the second floor of Cooper Library, offers the Clemson community a bevy of free support solutions to technological issues. In FY16, the Support Center helped by way of 33,492 phone calls (a five percent increase) and 22,770 walk-in customers (up 3.9 percent from FY15).

Office 365

CCIT planned and executed an ambitious implementation of Office 365 over the course of the 2015-16 school year. The project, in partnership with Oxford Computer Group, began by bringing Office apps and OneDrive onboard before switching over 4,000 faculty and staff accounts from Exchange to Microsoft's secure cloud environment, a move that included email and calendaring to eliminate the need to repurchase

infrastructure. The switch took place from February through April after an exhaustive pilot phase by CCIT, staggered by department and college to minimize disruption. The effort included extensive messaging and support, giving users lead time and knowledge about where to turn for help. The end of FY15 saw planning for a campus-wide publicity effort aimed at students returning in the fall to raise awareness of the Office 365 app suite.



CCIT handed out T-shirts, screen cleaners and flash drives as part of a campus-wide publicity effort

Clemson University Business Systems

Clemson University Business Services provides implementation and maintenance support for strategic administrative applications at Clemson and customers include the University's Business Offices, including the Registrar's Office, Controller's Office, Human Resources, Payroll, Office of Sponsored Programs and Students Affairs.

FINANCIALS

CUBS Financials successfully transitioned to the new College Re-Org structure. The year saw improvement and optimization to processes for procurement card, Housing, and the Budget Office. Much of the financial service support team's focus was on service improvements to allow customers to take ownership of the processes that improve business workflow and reduced time spent. A few examples that represent the larger body of work completed are: allowing procurement card administrators to directly manage their liaisons resulting in the reduction of wait times for updates to liaison data; development of interfaces between PeopleSoft Financials and the Housing application StarRez that automated a process whereby end-users manually entered StarRez data directly into PeopleSoft Financials; development that allowed the loading of initial budgets by the Budget office thereby eliminating the need of IT involvement and allowing budget users to load their data at their

convenience; and development of an interface for job posting charges that replaced the manual entry of interdepartmental journal entries. In addition, CUBS successfully completed yearly budget loads and fiscal year-end processing.

HUMAN RESOURCES

In December 2015, CUBS kicked-off a successful launch of PeopleSoft HR 9.2. The project featured a new staff recruitment module

as well as performance gains and optimizations that improved availability while reducing system processing time and related activities. The project was completed on-time, within budget and testing by external vendor CherryRoad showed "the current configuration is fully capable of handling transaction volumes well in excess of those expected at peak" and "reliability execution showed that the existing setup can support in excess of 19,000 transactions over a twenty-four-hour period." Quality assurance designed and executed over 800 test cases resulting in a reduction for defects and verification of product before go-live. CUBS also successfully completed yearly IRS W2 and ACA 1095 reporting.

PeopleSoft

CUBS kicked off a successful launch of PeopleSoft HR 9.2, executing more than 800 test cases

Cybersecurity Operations Center

In FY16 CCIT's Office of Information security and Privacy (OISP) continued working with the University's Internal Audit group on several audits of critical IT systems supporting university operations. Coordinating these efforts require OISP to engage resources across many different groups within CCIT as well as others across the university. Clemson's Cybersecurity Operations Center (CSOC) in Barre Hall opened in February. Spanning nearly 600 square feet, the CSOC serves as a command center where student interns work with Clemson's IT security professionals to monitor activity on Clemson's

network, perform forensic investigations on past events and create predictive analyses. The CSOC investigated and reviewed more than 75,000 security events and used Stealth Watch monitoring to mitigate approximately 1,184 automated shuns each month (countermeasures to external entities who have demonstrated malicious activity against one of Clemson's systems). Additionally, the CSOC experienced 10,379 various port scans for the network from external entities on a given month occurrences avoiding problems for Clemson faculty, students, and staff.



The CSOC investigated and reviewed more than 75,000 security events since opening

Software Development & Integration

WEB DEVELOPMENT

The SDI Web development team supports both core University systems as well as independent applications supported by SLA's. This year, the team worked on various projects funded by internal recoveries. Some of the projects are the AAH Diversity web, the STEMLinx upgrade, CUCourse Upgrades, Faculty and Staff Awards, Student Locator, and Best Room On Campus. SDI provided support to core Academic and core Business systems on areas not covered by current ERP's. The past year, under core Academic support, SDI upgraded the Federal Work Study job application website, completed the Discover Clemson and Experience Clemson sites, developed the UCC Workflow application, and continued to maintain over twenty academic related sites. In the area of Business systems, SDI developed the Departmental Asset Tracking system that is being rolled out campus-wide for auditing and tracking. In addition, SDI developed applications such as the Java Version Check, Commitments Reporting, iPrint Web Interface, ACA reporting support, and eSignature support.

IDENTITY MANAGEMENT

The SDI Identity Management team continued its strong work with several new systems. Updates included Genetec card access integration, Canvas integration, ZFS Home Directory and Quota Management Integration. Additionally, the team added many new features to HDTools to integrate user management into one tool.



The SDI Web development team upgraded several academic sites, including the Discover Clemson campus visitation site

MOBILE TEAM

CCIT's Mobile Innovation Team

is responsible for developing, maintaining, and supporting the my.Clemson mobile application for iPhone and Android devices. This year, the Mobile Team implemented a host of new features for the app, including a preferred first name feature, the addition of Clemson's academic calendar (including automatic sync to devices), employee features like travel reimbursement and human resource quick links, bike racks, stations and roads, more complete athletics schedules, CATBus tracking and my.Clemson map integration with Watt Family Innovation Center kiosks. In addition to the my.Clemson app work, the team SDI Mobile Innovation Team reviewed the code for and published several new apps, including CU Public Art, Mix My Sprayer, Clemson University Historic Properties and RoboMonitor. The team also updated the CU Events (Guidebook) app and transitioned the Fike Survey Tool from Digital Ocean to AWS Docker.



ESA's numerous academic system upgrades included conversion to the new university structure

Academic Services

Over the past year, the Academic Services team within Enterprise Systems and Applications undertook a host of Banner improvements. The team upgraded the student registration system to Banner Registration XE, implemented Banner Student Advising Profile XE, implemented Banner eTranscripts, implemented

Display Name features for use in class rolls, and converted Banner and other academic systems to the new university structure as part of the 2016 College Reorganization. Additionally, two team members were asked to present at Ellucian Live 2016, where they discussed paperless workflows and single sign-on integration with Banner.



CU Cyber beat seven other South Carolina schools to avenge a rare loss in the 2015 competition

CU Cyber

CU Cyber, the Clemson University competitive cybersecurity team, won first place at the Palmetto Cyber Defense Competition in April. Team captain MacKenzie Binns also earned MVP honors as the team took home its third title in four years. CU Cyber bested seven other schools from the state, including the University of South Carolina, College of Charleston and The Citadel. The Palmetto Cyber

Defense Competition is held by the Space and Naval Warfare Systems Center Atlantic in collaboration with the South Carolina Lowcountry Chapter of the Armed Forces Communications and Electronics Association (AFCEA).

GIS Day

In November, CCIT's Center for Geospatial Technologies participated in a nationwide GIS Day at their newly-renovated GIS laboratory in Clemson's R.L. Cooper Library. Guests took in presentations from 13 speakers that touched on multiple topics from public health to geology, history, economics and more. More than 160 faculty and student

visitors played a "Where in the World" map-guessing contest, shared their favorite spot on campus and voted for their favorite research posters while checking out the renovated Center. The event also helped showcase the GIS team's new training lab, augmented reality sandbox and assortment of GIS technology.



More than 160 faculty and student visitors took in a full day of GIS Day presentations, posters and games



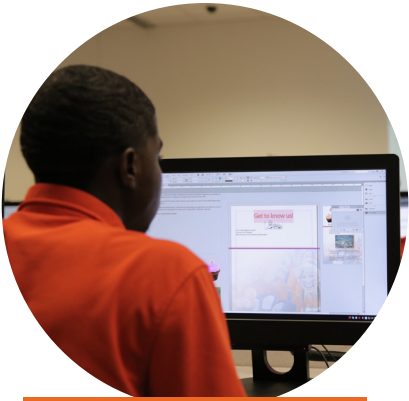
The Studio opened with a ribbon-cutting ceremony on October 15, featuring speakers from Clemson and Adobe

Adobe Digital Studio

In October, the Adobe Digital Studio opened on the fifth floor of Clemson University's R.M. Cooper Library. The new studio has given the Clemson community a place to work together, using technology powered by the entire Adobe Creative Cloud and Digital Publishing Solution, the industry-leading solution for creating engaging mobile

apps. The studio features a soundproof audio production studio, a video production studio, collaborative workstations, a high-resolution scanner and a nine-display Behance wall that serves as a focal point for inspiration. Student interns also staff the studio, offering guidance and inspiration to visitors.

Training Opportunities



CCIT's Software Training and Cyberinfrastructure Technology Integration groups both broadened the number of courses and number of attendees for their training sessions

CCIT's mission of offering free training continued to strengthen and grow in FY 16. CCIT offers a multitude of training and professional development opportunities for Clemson faculty, staff, and students who want to advance their skills in technology applications—ranging from basic training courses to advanced programs in software applications, high performance computing, and visualization. In FY16, Clemson's CITI group

gave 70 training courses (20 more than the previous year), educating 1,094 students, staff and faculty. CCIT's software training group also more than doubled its number of training, custom, consulting, coordination and assisting sessions from FY15 to FY16, offering 659 in total from 269 the year before. Attendance grew from 1,834 to 5,774, with the biggest gains coming in Microsoft, Adobe and miscellaneous classes.

Classroom Facility Upgrades

CCIT supports the technology found in many classrooms around campus, and this support is critical to the learning environments in which faculty interact with students in their courses. In FY16, CCIT upgraded equipment in over 40 central classrooms, two video conferencing lecture halls and one auditorium. CCIT continued to build on its 100 percent technological enhancement of

the classrooms it maintains for a total of 372. Upgrades included focused enhancements in central classrooms in the Academic Success Center, Long, Lowry, Olin, Poole, Riggs and Newman Halls. Additionally, CCIT worked with capital projects staff to standardize installations in new buildings including Douthit Hills, Campus Core, Zucker Center and other locations throughout the state.



CCIT worked with capital projects staff to standardize installations in new buildings like Douthit Hills (pictured)



CCIT Software Training sessions taught nearly 6,000 attendees in 2015-16