



The University of California and CENIC

CENIC connects The University of California to support innovation and collaboration that create California's future.

CENIC is a nonprofit organization created in 1996 by California's research and education community to provide themselves with the most advanced networking and support designed to meet their unique needs. We connect California's research and education institutions to one another and to resources and colleagues around the globe, with an estimated 20 million Californians using our services.

CENIC is governed by our Charter Associates, which include the University of California system, the California State University system, California's Community Colleges, the California K–12 system, California Public Libraries, and independent universities Caltech, Stanford University, the University of Southern California, and the Naval Postgraduate School. Other members include scientific and cultural institutions, hospitals and specialized medical institutions, space and environmental research organizations, and Tribal nations.

The University of California in Action with CENIC

The University of California (UC) system is the most prestigious and accomplished public research and education system in the world, with 71 Nobel Prizes awarded to its faculty and researchers since the creation of the awards in 1901. Its ten campuses, off-campus sites, and supercomputing and medical centers all require best-in-class networking and services to support this level of world-leading achievement, motivating the UC system's co-founding of CENIC in the mid-1990s.

That first concept—an advanced fiber-based network to serve the state's research and education communities—has since grown into a profound partnership enabling California to create a research and education community capable of changing society itself for the better in the coming century. Thanks to that partnership, all ten UC campuses, off-campus sites, and supercomputing and medical centers enjoy future-facing networking, support, and services via CENIC's California Research and Education Network (CalREN), specially designed by and for the state's research and education community.

And thanks to CalREN's connections to ESnet and other national and regional networks, both directly and via the Pacific Wave distributed peering exchange which CENIC co-owns and manages with the Pacific Northwest Gigapop, the UC system also enjoys world-class connectivity, services, and support for the national facilities it manages—or co-manages with the US Department of Energy—Lawrence Berkeley, Lawrence Livermore, and Los Alamos National Laboratories, as well as connectivity with colleagues and research facilities around the world.

UC campuses are also a central part of the CENIC AI Resource (CENIC AIR) in terms of contributing to it and making use of it for research and education. CENIC AIR provides California's research and education communities a platform to enable

Did you know?

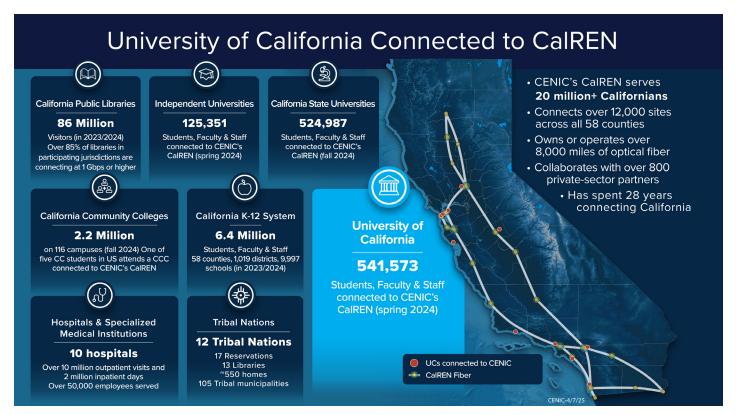
Network Solutions Designed for Your Needs

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their faculty and students to contribute constructively to the global transformation promised by Artificial Intelligence and Machine Learning. UC faculty and students, along with those in all segments, now have access to training, research, and class lab facilities in a persistent, sustained infrastructure that will continue to evolve well into the future.

To forestall network-based volumetric cyberattacks and other threats, CENIC Charter Associates can access Radware's on-demand, cloud-based DDoS Mitigation Service (DMS). Thanks to our partnership with Internet2, CENIC obtains for its members an extremely attractive "bulk" pricing for this service that they would not otherwise enjoy along with high-capacity direct connections through Internet2 to Radware.

Thus, the University of California contracts with CENIC to obtain for its campuses, Office of the President, and sites connected behind them, self-managed DDoS attack detection and mitigation services that are far more responsive and cost-effective than any currently available from commercial providers.



Positioning California for the Future through Research and Innovation

Many pressing problems confronting humanity in the coming decades will require focused study and cooperation from all of society to solve, and the University of California plays an essential role in this, as it has since its 1866 designation as one of the country's first land-grant universities. Thus, ensuring a healthy future for humanity and the world means meeting the ever-increasing networking needs of the UC system now and in the years to come.

An excellent example of this is a collaborative public-private partnership involving UC San Diego's ALERTCalifornia, the California Department of Forestry and Fire Protection (CAL FIRE), and industry partner DigitalPath. Together, they developed a powerful Al-enabled fire detection tool that was honored with CENIC's 2024 Innovations in Networking Award for Public Safety.

UC researchers also study changes in the global climate, which requires powerful compute resources and large amounts of complex data from weather satellites, ground-based

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Around-the-Clock Network Support Tailored for You

The University of California also enjoys support from CENIC's 24/7 Network Operations Center, staffed by highly trained network engineers with over 25 years of experience working with our segments to create bespoke solutions that address and scale to their unique needs, including campuses, health and supercomputing centers, and major scientific facilities.

Did you know?

CENIC Peers Directly with Major Cloud Providers

CENIC offers direct connections to AWS Direct Connect and Oracle FastConnect at CalREN's Los Angeles and San Jose backbone node sites. These direct connections offer increased resiliency and performance for access to cloud resources across all of California. In addition, there is also a 10 Gbps connection to AWS made possible by CENIC's interconnection to Internet2 at San Jose.

measurements, and numerical model data stored at facilities around the world. The computing power required to transmit, analyze, store, and display that data is now available through CENIC AIR and the National Research Platform (NRP). It is also fueled by the high-performance infrastructure of Pacific Wave, a joint project of CENIC and the Pacific Northwest Gigapop.

Many daunting societal challenges, such as the COVID-19 pandemic, are medical in nature, and thanks to CalREN and CENIC's many peering relationships, UC campuses and health centers can access vast genomic and imaging databases and collaborate with colleagues around the world on research, treatments, and cures for maladies of all kinds.







The California State Universities and CENIC

Supporting the California State Universities in changing the trajectory of students' lives and creating California's workforce.

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The California State Universities in Action with CENIC

In the mid-1990s, CENIC began as a project of the state's research and education community, with the California State Universities among its founders. That first concept—an advanced fiber-based network to serve the state's research and education communities—has since grown into a profound partnership enabling California to create a workforce that can better the lives of hundreds of thousands of students each year and society itself in the coming decades.

Thanks to that partnership, all 22 CSU campuses and offcampus sites enjoy future-facing networking and services via CENIC's California Research and Education Network (CalREN), specially designed by and for the state's research and education community. Fifteen CSU campuses have at least 100 Gbps connectivity to CalREN and, through that, to all CSU campuses, CENIC member institutions, and resources and colleagues around the world.

Connectivity to a single, shared statewide infrastructure also enables the CSU to fulfill a central role in higher education. Currently, 51% of CSU graduates begin their academic careers at a community college, many of whom then obtain graduate degrees at a UC campus or independent universities.

The interconnectivity provided via CalREN has also enabled the CSU's recent Technology Infrastructure for Data Exploration (TIDE) project. A partnership between San Diego State University (SDSU) and the San Diego Supercomputer Center (SDSC), TIDE extends the CENIC AI Resource (CENIC AIR), the California portion of the National Research Platform (NRP), beyond SDSU to three additional CSU campuses: CSU San Bernardino, Cal Poly Humboldt, and CSU Stanislaus. Participating institutions can also "burst" to more extensive national resources through integration into the 1,200 GPU nodes and 21,000 CPU cores of the NRP.

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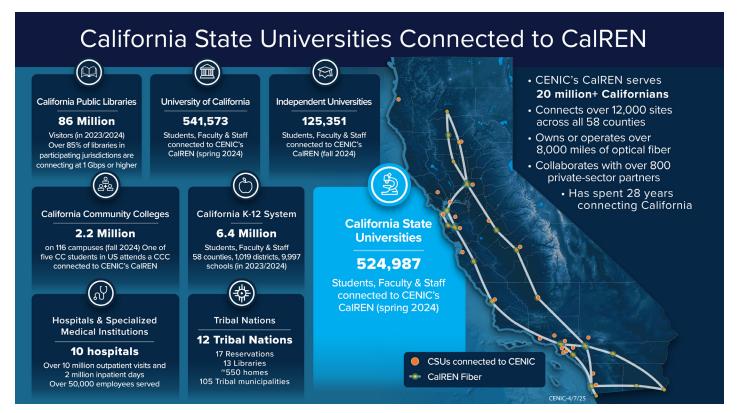
Network Solutions Designed for Your Needs

CENIC's Engineering team thoroughly understands the requirements of campus networking and works together with the California State University system to craft the most cost- and time-efficient solutions (networking and services) that support your mission now and in the future.

CENIC AIR participants can also easily access commercial cloud offerings as well as NSF HPC centers, should they need to scale beyond NRP resources and have the allocations, funds, or cloud credits to use these services. Thus, via TIDE, CENIC AIR, and NRP—interconnected by CalREN—students and faculty at a growing number of participating CSU campuses are shaping the transformations promised by Artificial Intelligence and Machine Learning.

To forestall network-based volumetric cyberattacks and other threats, CENIC Charter Associates can access Radware's on-demand, cloud-based DDoS Mitigation Service (DMS). Thanks to our partnership with Internet2, CENIC obtains for its members an extremely attractive "bulk" pricing for this service that would not otherwise be available, along with high-capacity direct connections through Internet2 to Radware.

Thus, many California State Universities contract with CENIC to obtain DDoS attack detection and mitigation services that are far more responsive and cost-effective than any currently available from commercial providers.



Positioning California for the Future through Digital Education

Many pressing problems confronting humanity in the coming decades will take cooperation on the part of all of society to solve, and the California State University is an essential part of these solutions. The CSU's interests are intimately tied to digital education, particularly since this segment plays such a central role in the state's higher education system.

One recent example of network-enabled instruction is SDSU's computing cluster for instructional use, the Visionary Education Research Network Environment (VERNE), which offers advanced graphics processing and storage made available via JupyterHub, an easy-to-use web-based environment for accessing these resources.

Part of and operating over CENIC AIR, VERNE usage has steadily increased each semester since launching in

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Spring 2023, beginning with two courses, then six in Fall 2023, thirteen in Spring 2024, nineteen in Fall 2024, and fifteen in Spring 2025.

"SDSU's institutional investment in VERNE is one element of its AI and machine learning strategy," said James Frazee, SDSU interim Vice President for Information Technology and Chief Information Officer.

"VERNE provides faculty and students with access to these resources to support teaching and student-based research, equipping students for career success."







California's Community Colleges and CENIC

The network that helps California Community Colleges provide life-changing opportunities and a path toward future goals for over two million students.

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California's Community Colleges in Action with CENIC

California's Community Colleges are uniquely and deeply integrated with every other segment. Many of their students arrive from the state's K–12 system, while 51% of California State University graduates and 29% of University of California graduates began their academic career at a community college. They also welcome many returning, working, and other nontraditional students, and prepare them for a wide variety of careers. For example, in California, seven out of 10 nurses and eight out of 10 firefighters, police officers, and EMTs received their training at a California Community College.

Together, California's Community Colleges and CENIC have built a profound partnership to ensure that the country's largest higher education system meets its mission of putting students first. Thanks to that partnership, all 116 community colleges, along with their off-campus sites, enjoy future-facing networking and services via CENIC's California Research and Education Network (CalREN), specially designed by and for the state's research and education community.

These benefits include substantial cost savings since 80% of data traffic on CalREN does not transit the commercial Internet but travels directly between member institutions and other network destinations. This traffic uses settlement-free peering connections that incur no usage fees.

An excellent example that illustrates how CENIC membership enables the community colleges to fulfill their central role in research and education is the connection of the San Diego Community College District to the CENIC AI Resource (CENIC AIR), a distributed compute and storage infrastructure interconnected by CaIREN and designed for AI and machine learning research and instruction, and to which CENIC members contribute resources voluntarily. As the California portion of the National Research Platform, CENIC AIR provides California's research and education communities a means to

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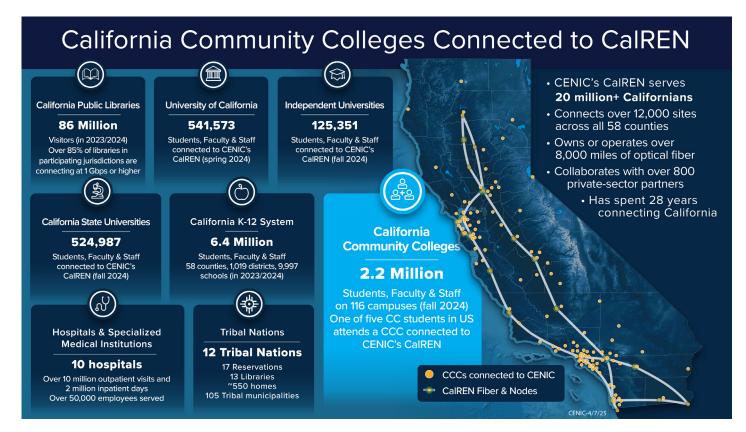
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enable their faculty and students to collaborate nationwide on the transformations promised by Al and machine learning.

CENIC AIR participants can also access cloud offerings, such as AWS, Oracle, Google Cloud Platform, and Microsoft Azure, as well as NSF HPC centers, should they need to scale beyond NRP resources and have the means to use these services. The San Diego Community College District is only the first district to connect to CENIC AIR, and other districts are discussing participation.

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Thus, many of California's Community Colleges contract with CENIC to obtain DDoS attack detection and mitigation services that are far more responsive and cost-effective than any currently available from commercial providers.



Positioning California for the Future through Access and Resiliency

California's greatest challenges will enable community colleges to do their greatest work in the coming decades. The California Community Colleges' Vision 2030 Roadmap envisions a higher education system available and accessible to all Californians, which ensures access points for every learner and exit points to transfer, complete a community college baccalaureate, or obtain a job with family-sustaining wages.

A major part of this is the expansion and optimization of educational technologies, both existing and emergent, that will enable the community colleges to engage with and develop the next generation of Al tools and build the next wave of solutions to many of the world's pressing problems.

Did you know?

CENIC Peers Directly with Major Cloud Providers

CENIC offers direct connections to AWS Direct Connect and Oracle FastConnect at CaIREN's Los Angeles and San Jose backbone node sites. These direct connections offer increased resiliency and performance for access to cloud resources across California. In addition, a 10 Gbps connection to AWS made possible by CENIC's interconnection to Internet2 at San Jose.

Did you know?

Around-the-Clock Network Support Tailored for You

California's Community Colleges also enjoy support from CENIC's 24/7 Network Operations Center, staffed by highly trained network engineers with over 25 years of experience working with our segments to create bespoke solutions that address and scale to their unique needs, including campuses and off-campus education centers.

To address bandwidth demand for the near future, the CCC Technology Center is working with CENIC to upgrade the majority of circuits connecting community colleges to CaIREN to 10 Gbps. In addition, approved college centers will receive 1 Gbps primary and 1 Gbps secondary circuits. These upgrades are expected to be in place by fiscal year 2025–26 and provide sufficient capacity for at least five to ten years.

Other ongoing projects starting in 2024–25 through 2025–26 include replacing end-of-life routers and reviewing college, district, and education centers to improve network resiliency and thus ensure minimal impacts on student learning and daily college business.







The California K–12 System and CENIC

California schools connect to CENIC's California Research and Education Network in all 58 counties.

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California's K-12 System in Action with CENIC

California's complex K–12 system encompasses millions of students, from pre-schoolers to young adults, all with varying needs, interests, and talents. Nearly a fifth of students are English language learners, and almost two-thirds are eligible for free or reduced-price meals—and the K–12 system's dedicated educators and administrators work daily to help them all become future leaders, scholars, and entrepreneurs.

To meet these needs and more, CENIC is contracted by the K12 High Speed Network (K12HSN) to provide future-facing networking and services via the California Research and Education Network (CalREN), specially designed by and for the state's research and education community. Thanks to this close two-decade relationship, 100% of county offices of education, 89% of school districts, 81% of schools, and over 5.8 million students statewide enjoy the benefits of world-class connectivity, network services, and support.

These benefits include substantial cost savings since 80% of data traffic on CalREN does not transit the commercial Internet but travels directly between member institutions and other network destinations. This traffic uses settlement-free peering connections that incur no usage fees. This makes possible learning opportunities such as live streamed high-definition concerts from CENIC member SFJAZZ in San Francisco to K–12 schools, and enables students to produce and share bandwidth-intensive materials of their own, like videos focusing on their studies or their location's unique history, with none of the cost or performance issues associated with inadequate connectivity. Many districts use their connection to bring the latest technology to students and teachers in classrooms, replacing computer labs with innovation rooms, maker spaces, and technology fairs equipped with advanced digital tools.

Direct access to the California Assessment of Student Performance and Progress (CAASPP) testing servers is another

Did you know?

CENIC Helps Connect You to the Funding You Need

CENIC facilitates federal E-Rate discounts, ranging from 20% to 90%, on both one-time and recurring costs for Internet access and upgrades for K–12 schools. CENIC also applies for the California Teleconnect Fund discount for monthly recurring costs, which is 50% after applicable E-Rate discounts.

benefit provided by CENIC, particularly as CENIC helped design and implement a technical solution that provided this access, ensuring that California students can take on-line tests without experiencing the technical challenges common to students in most other states. Thanks to this, California's K–12 system has gone from being able to test only 20 students at a time in some areas—or not being able to perform online testing at all—to testing over half a million students at once.

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Thus, the Imperial County Office of Education contracts with CENIC to provide schools connected to the K12HSN with DDoS attack detection and mitigation services that are far more responsive and cost-effective than any currently available from commercial providers.



Digital Teaching and Learning: Positioning California for the Future

With thousands of schools in both rural and urban areas throughout California—a state with more people in its rural counties, which include large swaths of remote and geographically challenging areas, than the total populations of more than two dozen other states—the interests of California's K–12 system are intimately tied to broadband access and the ubiquity of broadband service. This is especially true given that schools rely heavily on reliable broadband to educate students, conduct testing, and connect with peers in all segments.

In 2019, the Broadband Infrastructure Grant (BIG) program was funded to provide fiber broadband connectivity to California's most poorly connected schools to promote digital learning opportunities. BIG builds on the success of an earlier effort: the Broadband Infrastructure Improvement Grant (BIIG) project, funded in 2014, which has delivered broadband services to more than 430 sites

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statewide to address the need for sufficient broadband capacity for online testing.

Through the BIG program, CENIC has connected 43 school sites, providing 1 Gbps connectivity to approximately 14,000 students, teachers, and staff in 14 different counties. As it continues, the BIG program aims to expand to more counties across California and support thousands more students, teachers, and staff.

Updates about the BIG program and each school's connectivity can be found at **cenic.org/initiatives/big**.







California Public Libraries and CENIC

Libraries in more than 80% of California library jurisdictions connect to CENIC's California Research and Education Network.

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Libraries in Action with CENIC

Libraries are unique among knowledge-driven institutions in that they serve people of all walks of life and of all ages—from preschoolers to senior citizens—by connecting them with resources they need to participate in and contribute to society, such as job searches, online classes and training, telehealth, cultural events, and other assets that improve their lives.

Before joining CENIC, three-quarters of California's libraries had very slow Internet connections—at or below 20 Megabits per second (Mbps), far slower than many private homes. For two-thirds of libraries, these connections would fill to capacity soon after opening their doors for the day.

Now, after a decade of CENIC membership, many libraries are connected to the Internet at game-changing speeds 10 to 100 times faster than before that would not otherwise be affordable to them. Of the 968 libraries connected to CaIREN either directly or behind a directly connected main branch, most connect at speeds between 1–5 Gbps, with over 80 connecting at 10 Gbps and three at 100 Gbps. In fact, the Los Angeles Public Library was the first public library in the world with a 100 Gbps connection.

Without CENIC, this level of connectivity would simply not be possible for libraries without tough or even impossible trade-offs.

CENIC membership also allows libraries to overcome any limitations presented by their physical infrastructure. In some library systems, older buildings make it difficult to maintain reliable, on-site network infrastructure. However, improved connectivity through CENIC has opened the door to cloud-based solutions that provide greater flexibility and resilience.

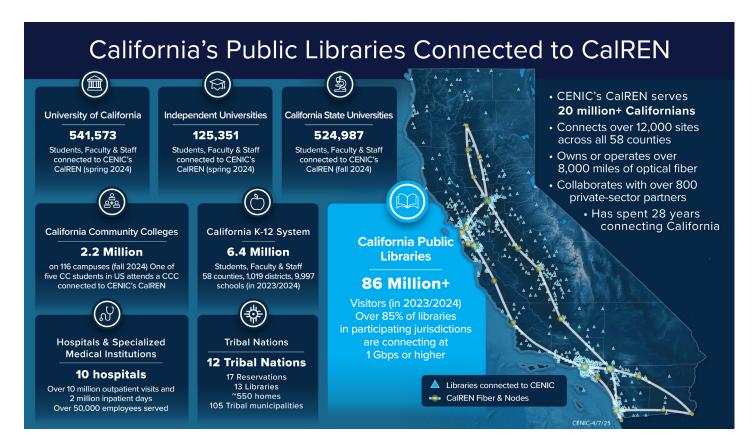


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CENIC Helps Connect You to the Funding You Need

Before CENIC, over half of libraries were not taking full advantage of federal and state telecommunications discounts: E-Rate and the California Teleconnect Fund. Now, CENIC facilitates E-Rate discounts from 20% to 90% on one-time and recurring costs for Internet access and upgrades. CENIC also applies for the California Teleconnect Fund discount for monthly recurring costs, which is 50% after applicable E-Rate discounts.

With these improvements, Californians of all ages can trust their libraries to provide a high level of connectivity to online resources worldwide as well as a robust, best-in-class network path to California K–12 schools, institutions of higher learning, cultural and healthcare institutions, and more.



Positioning California for the Future

California's leaders are dedicated to solving many pressing issues confronting the world, and California's Public Libraries in partnership with CENIC are critical to this. Libraries play a part by connecting all socio-economic groups with digital assets of all kinds and increasing online literacy through digital navigator programs that teach people how to make the most of these resources. To achieve this, robust, future-facing broadband connectivity, uniquely responsive network support, opportunities for collaboration across segments, and a meaningful voice in governance and policy are a necessity.

Digital Education and Broadband Access: A Shared Mission

Libraries connect everyone in California to resources that enable full participation in modern society, making broadband access, and adoption a central part of their missions. It's a central part of the CENIC mission as well. CENIC offers many opportunities for all members to learn from one another and collaborate on programs that promote broadband adoption and impactful use of digital resources. We design and create broadband solutions for all Californians including those with little to no broadband access, and we represent broadband access and related policy interests at the state and even federal level as well.

Did you know?

CENIC is Governed by its Members

As Charter Associates, libraries are represented on the CENIC Board of Directors along with other Charter Associates and participate extensively in decision-making. All members may choose to participate in committees, advisory councils, and events that spur collaboration with other segments on not only networking but also educational and research opportunities, broadband adoption program development, funding, last-mile connectivity solutions, and more.

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