San Francisco Scientific and Cultural Institutions and High-speed Networks

A White Paper by the **Corporation for Education Network Initiatives in California**

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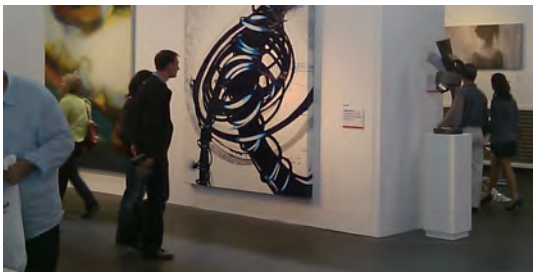
San Francisco is home to both technological and cultural innovation.



San Francisco is one of the most technologically sophisticated cities in the world, home to many top technology companies, and the technology workers that they attract are drawn to San Francisco from around the world. The city's vibrant history of creativity and innovation along multiple frontiers has made it a global mecca for all things high-tech and cultural, and it has developed many strategies for maintaining this leadership position in an increasingly competitive world. Free Wi-Fi is available in all public libraries and at an array of publicly accessible mobile hotspots, including city-owned parks and recreation centers currently being equipped by Google with free Wi-Fi.

San Francisco is also widely considered one of the most culturally rich and diverse cities in the world and is home to a broad array of cultural organizations and museums. On any given day, a city resident or visitor can see opera, dance, jazz, folk music, classical music, and theater as well as visit dozens of galleries and museums, large and small. San Francisco is also recognized as one of the most important centers for new media and is home to the Lucasfilm's Letterman Digital Arts Center as well as the San Francisco Film Society.

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But these high-tech and cultural worlds do not intersect.

Unfortunately, most of the city's cultural institutions and museums are unable to take advantage of the presence of advanced technologies in their city to distribute art and science from San Francisco to a worldwide audience and to bring art and science from around the world to San Francisco. Networking speeds for these institutions are limited by their budgets, and the lack of high-speed networking impedes the development of artistic and educational programs that could engage millions of viewers and participants.

San Francisco is home to innovative cultural and high-tech worlds that have made the city a global leader in all fields

What might be possible if these worlds could be brought together?

High-speed broadband can make many innovations possible.

Scientists from the **California Academy of Sciences** could collaborate in real time with scientists around the world using state of the art video-conferencing.

Live productions by the world class **San Francisco Opera** can be streamed to every library in San Francisco as well as to theaters around the world.

Musicians from the **San Francisco Symphony** could conduct masterclasses for students from around the country.

Every museum in San Francisco could develop a mobile app that took advantage of cutting-edge technologies like GPS and 3D imaging to provide audio and video content, interviews with curators and artists, access to maps, and paperless ticketing.

The **AXIS Dance Company** could work with a guest choreographer from New York without having to bear the expense of the choreographer traveling to San Francisco for an entire rehearsal period.

Real-time cultural exchanges could take place between San Francisco and its 18 sister cities including Osaka, Japan; Sydney, Australia; and Taipei, Taiwan.

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San Francisco's cultural institutions are a priceless and unique resource.

The collections, research, artists, scientists, performances, staff, and facilities currently in use by the cultural institutions of San Francisco constitute a vast and unique resource that could be used to enrich and educate people all around the globe. The possibilities are endless, from museum curators as virtual guest lecturers in arts administration classes at a state university, to opera singers conducting masterclasses for high school choirs, to plays for children broadcast into K-12 classrooms across California and beyond.

New knowledge is also created in cultural institutions just as it is created in universities. Museums conduct scientific experiments and fund expeditions. Theaters conduct historical research on plays and past productions of these plays. Dance companies build archives, and many museums have built digital archives of the majority of their holdings, which are not currently on display.

Cultural institutions have always had a dual mission: an artistic or scientific mission and an educational mission. If these institutions are to fulfill their missions to their maximum potential, interactive access to these irreplaceable resources must be worldwide, but the barriers to this vision – geographic and otherwise – are daunting.

High-speed broadband can break down these barriers, bring people together with one another and priceless far-flung resources in new and innovative ways, and bring San Francisco and the world closer to the vision of access for all.

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Artistic and educational innovations that could only be imagined are possible right now.

This is not a science-fiction vision for the distant future. It is happening right now. Technology and collaboration software have evolved to the point where it is possible to distribute live events and support live, interactive artistic and scientific collaboration, coaching, and teaching.

However, these activities require more than the current Internet speeds within reach of most cultural and scientific institutions in San Francisco. A comprehensive approach to connecting the city's non-profit cultural and scientific organizations to high-speed broadband would position San Francisco as a world leader in this sector as well.

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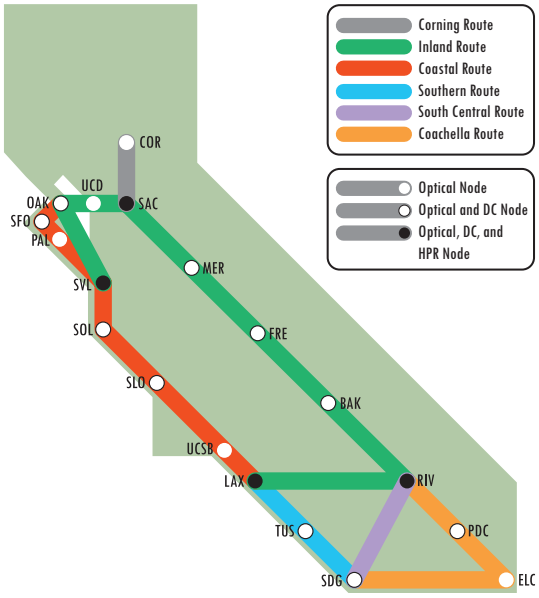
California has a resource that is already making these innovations possible for a wide range of research and education organizations.

CENIC, the Corporation for Education Network Initiatives in California, is a non-profit corporation created by the California research and education communities in order to obtain cost-effective, high-bandwidth networking to support their missions and respond to the needs of their faculty, staff, and students. CENIC began in 1995 as a joint effort by networking experts from UC, CSU, Stanford, Caltech, and USC. The design and architectural roots come from the joint brain trust of these institutions, and each segment added since then has brought its own set of strengths.

CENIC has grown to serve – and is governed by – the 23 California State Universities, the 112 California Community Colleges, the 10 University of California campuses, private universities, and nearly all California K-12 schools. These CENIC Associates continue to be actively involved in guiding the effort. Becoming involved in CENIC means being involved with a broad, well-established community with significant expertise and commitment.

The California Research & Education Network



CENIC designs, implements, and operates CalREN, the **California Research & Education Network**, a 3,800-mile fiber-optic based, high-performance Internet network designed to meet the unique requirements of these communities. Over 10 million Californians use CalREN every day. In order to provide highly robust and high-performance connectivity to a variety of external networks, CENIC actively pursues peering relationships with other network providers around the world, providing global connectivity to its members. The CENIC website provides a full list of global partners: http://www.cenic.org/page_id=991/

CENIC has a long history of innovation in the Bay area. The San Francisco County Office of Education (SFCOE), City College of San Francisco (CCSF), California State University, San Francisco (SFSU), University of California, San Francisco (UCSF), University of San Francisco (USF), and Exploratorium have all been on the CalREN network for over a decade as have every K12 county office of education, community college, CSU campus, and UC campus in the greater Bay Area. The non-profit Internet Archive in San Francisco, accessed by users the world over, gets its connectivity via CalREN as does the UC Hastings College of the Law and the University of Pennsylvania's Wharton School which recently relocated to the historical Hills Brothers Building.

Recently, the San Francisco Public Libraries connected to CalREN and will soon have 10 Gigabits of connectivity. Over the next year, connectivity speeds for each of the twenty-seven branch libraries will dramatically increase. CENIC's long history of work in the Bay Area supports the mayor's vision of a "smart city" where network infrastructure between a wide range of sites is a given and can be leveraged for the public good.

By connecting to CalREN, non-profit scientific and cultural institutions in San Francisco would expand their capacity to serve patrons, collaborate globally, and preserve their work.

As noted above, research and education are central to the mission of non-profit scientific and cultural institutions, and it is well within CENIC's mission to connect these institutions to the CalREN backbone. Doing so would enrich all education institutions currently connected to CalREN and would make a wide range of artistic and educational innovations possible.

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Possibilities include:

1. Develop and expand archives of performances and events.

2. Stream live events to sites in the community and around the world and bring performances from around the globe to local audiences.

3. Attract new audiences to their venues by using tools such as online videos, podcasts, live streaming, touch-screen kiosks, and iPad apps in their marketing.

4. Create platforms and events in which artists at different locations can collaborate in real time. This technology can be used to foster exchange between student and professional artists and to support collaborations between artists such as composers and visual artists.

5. Provide audiences with extensive contextual information to enrich the performance or museum experience.

6. Engage the audience in the process of creation, research or even in the performance of a work of art.

7. Host a wide array of education engagements with participants from remote sites including master classes, individual and group lessons and online courses.

Two San Francisco organizations are leading the way.

SFJAZZ and the **Exploratorium** are currently connected to CalREN and receive 1 Gigabit of connectivity. A typical cultural institution might have 50 Megabits of connectivity, so these connections to CalREN are 20 times faster than the connectivity a typical institution might be able to access. Because it is a private network only for research and education organizations, it is closely monitored in a 24/7/365 network operations center and highly reliable.

Thanks to this connection, visitors to the Exploratorium access data collected through remote sensors and sensors at the museum. The Exploratorium operates and maintains oceanic and atmospheric instruments on the pier and serves as a location on San Francisco Bay for instruments installed and maintained by partners. They serve as a node in numerous scientific observation networks, including NOAA's Ocean Acidification Network, and UC Berkeley's BEACON greenhouse gas regional network. Visitors can also see things like solar eclipses, evidence of climate change, and undersea images through virtual field trips to places such as NASA's Jet Propulsion Laboratory, Antarctica, the Nautilus research vessel, and CERN, the European Organization for Nuclear Research. Originally, videos were made and then broadcast but now a significant amount of this kind of content is live-streamed.

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SFJAZZ was recently connected to CalREN in February 2014. Their first use of high speed broadband was to create a cyber-symposium focused on the work of pianist and jazz legend Mary Lou Williams (1910-1981). This cyber symposium was a collaboration between eight educational and cultural institutions: University of Michigan, Harvard University, Emory University, Columbia University, University of Pittsburgh, SFJAZZ, the Kennedy Center, and the Guggenheim. High-speed broadband allowed participants to use music collaboration software and videoconferencing to explore and celebrate the life of this great American artist. The national symposium, streamed live and archived at music.pitt.edu, featured improvised piano duets by pianists in studios hundreds of miles apart, a portion of a work-in-progress film on Williams, and panel discussions with university scholars.

Great examples can be found around the country.

These two San Francisco organizations join a handful of other scientific and cultural institutions in the United States that are using high-speed broadband to engage audiences.

The **MIT Computer Science and Artificial Intelligence Lab** and internationally acclaimed dance company **Pilobolus** worked together to create a large-scale, live performance piece using umbrellas enhanced with LED lights. Guided by the Pilobolus creative team, participants swarmed an outdoor playing field and manipulated the hue of their umbrellas, creating a colorful and ever-changing display that was both live art and experiment.

The **New World Symphony WALLCAST™** concerts allow audiences to experience select events throughout the season at Miami Beach SoundScape through the use of visual and audio technology on a 7,000-square-foot projection wall.

The **Manhattan School of Music** delivers distance-learning programs across the US and to more than a dozen foreign countries over NYSERNet and Internet2. Via its Global Conservatory Videoconference Program Series, students receive instruction, coaching, audition preparation, professional development, and music history courses from the school's renowned faculty. Its K12 distance-learning program delivers live music performance and experiences directly to K12 classrooms.

The **American Museum of Natural History** shoots HD nature videos on various subjects, shipping them via the network to the National Center for Supercomputing Applications in Chicago for distribution to subscribers.

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San Francisco can lead the nation in using high-speed broadband as an engine for the artistic, scientific, and educational innovation it is already renowned for.

By bringing together artistic excellence, new approaches to education, and technology expertise, San Francisco science and cultural institutions are poised to make a difference in the lives of millions.

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